SCIENCE TECHNOLOGY PLAN FOR DISASTER RISK REDUCTION

Asian Perspectives

IRDR
Integrated Research on Disaster Risk

INTERNATIONAL COUNCIL FOR SCIENCE

Science Technology Plan For Disaster Risk Reduction

Asian Perspectives

ICSU Regional Office for Asia and the Pacific (ICSU ROAP)

Integrated Research on Disaster Risk (IRDR)

About This Publication

This publication is developed by Integrated Research on Disaster Risk (IRDR) and representatives with support from researchers, scientists and policy-makers in 12 countries in Asia and the Pacific region. A call for submission was made for developing science and technology plan for disaster risk reduction. This publication is supported by IRDR International Programme Office (IPO), International Council for Science (ICSU) Regional Office for Asia and the Pacific (ROAP), IRDR International Centre of Excellence (ICoE)-Taipei and National Research Council of Thailand(NRCT). This publication is not the official voice of any country and the analysis presented in this publication is of the author (s) mentioned for each country.

Team Members:

Pacific: Helene Jacot Des Combes
Bangladesh: Md. Anwarul Abedin
India: Kamal Kishore: Vinod Kumar Sharma
Indonesia: Sugeng Triutomo, Lilik Kurniawan
Iran: Ali Ardalan,Behnam Saeedi, Mehdi Zare, Ali Darvishi, Daoud Khorasani, Kambod Amini, Hamidreza Khankeh, Abbas Ostadtaghizadeh, Ahmad Soltani, STPDRR Advisory Group, Hasan Azadeh, Rasoul Hajahmadi, Mona Khaleghi, Meshkat Torkamanian, Homa Yusefi, STPDRR Research Team
Malaysia: Ir. Bibi Zarina Che Omar, Joy Jacqueline Pereira, Mohd Khairul Zain Ismail
Myanmar: Aung Myint
Nepal: Amod Mani Dixit, Nepal Reconstructive Authority
Pakistan: Atta-Ur Rahman, NDMA, Pakistan
Philippines: Antonia Yulo Loyzaga, Jessica Dator Bercilla, JoeMar S. Perez, Carlos Primo David
Sri Lanka: Deepthi Wickramasinghe, GLS Senadeera
Thailand: Monthip Sriratana

Integrated Research on Disaster Risk (IRDR) International Programme Office: Rajib Shaw, Lucy Lu, Fang Lian

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PREFACE

Role of Science and Technology for Disaster Risk Reduction (DRR) has constantly evolved globally in accordance with different international declarations from the IDNDR (International Decade of Natural Disaster Reduction) to the Hyogo Framework for Action (HFA: 2005-2015) and the Sendai Framework for Disaster Risk Reduction (SFDRR: 2015-2030). SFDRR highlighted the important role of science and technology for disaster risk reduction in each of its priority areas, as well as emphasised the essential presence of science and technology community to a wide range of stakeholder engagements.

As a result of the regional initiatives in Asia, the 1st Asian Science and Technology Conference for Disaster Risk Reduction was held in Bangkok in August 2016 to understand the key issues and challenges as well as prioritize needs and opportunities in the application of science and technology in DRR. Following the regional conference, IRDR along with ICSU ROAP, ICoE Taipei, and NRCT organized two workshops aiming to strengthen scientific advisory capacities in 12 Asian countries and region and contributing to the development of science and technology plans in line with the Sendai Framework.

The purpose of this publication is to illustrate the science and technology plan for disaster risk reduction from the 12 countries in Asia. The publication consists of two parts: Science Technology Plan for DRR and Country Report. The first part contains the background information of the workshop, context and the outcome document of 1st Asian Science and Technology Conference for Disaster Risk Reduction. The second part includes the summary of science technology plan of 11 countries (Bangladesh, India, Indonesia, Iran, Malaysia, Myanmar, Nepal, Pakistan, Philippines, Sri Lanka and Thailand) and one region (Pacific).

This is just the beginning of a long process of engaging the science technology community and the disaster risk reduction decision makers in a planned and meaningful way to co-implement SFDRR in different Asia Pacific countries. We hope that this document will serve as a good reference for the development and implementation of science and technology plan for disaster risk reduction from Asian perspectives, and can be a reference document to share it with other disaster prone regions of the world.

Rajib Shaw

Executive Director, IRDR

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ABOUT ICSU ROAP

INTERNATIONAL COUNCIL FOR SCIENCE

www.icsu.org

The ICSU Regional Office for Asia and the Pacific (ROAP) promotes the development of science throughout Asia and the Pacific and help to strengthen the voice of developing countries scientists in international research programmes. ICSU ROAP supports the implementation of the ICSU Strategic Plan II, 2012 – 2017 in the Asia – Pacific region with its:

Vision

The long-term ICSU vision is for a world where science is used for the benefit of all, excellence in science is valued and scientific knowledge is effectively linked to policy-making. In such a world, universal and equitable access to high quality scientific data and information is a reality and all countries have the scientific capacity to use these and to contribute to generating the new knowledge that is necessary to establish their own development pathways in a sustainable manner.

Mission

ICSU mobilizes knowledge and resources of the international science community for the benefit of society, to:

- Identify and address major issues of importance to science and society
- Facilitate interaction amongst scientists across all disciplines and from all countries
- Promote the participation of all scientists in the international scientific endeavour, regardless of race, citizenship, language, political stance or gender
- Provide independent, authoritative advice to stimulate constructive dialogue between the scientific community and governments, civil society, and the private sector

ABOUT IRDR

www.irdrinternational.org

Integrated Research on Disaster Risk (IRDR) is a decade-long research programme co-sponsored by the International Council for Science (ICSU), the International Social Science Council (ISSC), and the United Nations International Strategy for Disaster Reduction (UNISDR). It is a global, multi-disciplinary approach to dealing with the challenges brought by natural disasters, mitigating their impacts, and improving related policy-making mechanisms. Core funding for IRDR is provided by the China Association for Science and Technology (CAST). IRDR International Programme Office is hosted by Institute of Remote Sensing and Digital Earth (RADI) Chinese Academy of Sciences.

Although the approaches in the sciences vary, the IRDR programme approaches the issues of natural and human-induced hazards and disasters from several perspectives: from the hazards to the disasters, and from the human exposures and vulnerabilities back to the hazards. This coordinated and multi-dimensional approach takes the IRDR programme beyond approaches that have traditionally been undertaken.

There are three research objectives:

1. Characterization of hazard, vulnerability and risk,
2. Understanding decision making in complex and changing risk contexts,
3. Reducing risk and curbing losses through knowledge based actions.

To meet its research objectives the IRDR established four core projects, comprising working groups of experts from diverse disciplines, to formulate new methods in addressing the shortcomings of current disaster risk research. The projects are as follow:

- Assessment of Integrated Research on Disaster Risk (AIRDR)
- Disaster Loss Data (DATA)
- Forensic Investigations of Disasters (FORIN)
- Risk Interpretation and Action (RIA)

The key part of IRDR is its global network, which consists of:

- Scientific Committee (15 members): Eminent scientists from different parts of the globe
- National Committees (10): Australia, Canada, China, Colombia, France, Germany, Iran, Japan, New Zealand and USA
- Regional Committee (1): Latin America and Caribbean Region
- ICoEs (12): Twelve International Center of Excellency located globally

The activities are coordinated by the IPO (International Programme Office) based in Beijing, China. The legacy of the IRDR programme "would be an enhanced capacity around the world to address hazards and make informed decisions on actions to reduce their impacts".

Context of
Science Technology Plan for Disaster Risk Reduction

1. Background

- On March 18, 2015, the Sendai Framework for Disaster Risk Reduction 2015-2030 (SFDRR) was agreed at the Third UN World Conference on Disaster Risk Reduction (DRR) in Japan, which is one of the landmark agreements together with the Sustainable Development Goals and the Paris Agreement.

- In Geneva in January 2016, a **Science and Technology Conference** was organised by the United Nation Offices for Disaster Risk Reduction (UNISDR) together with a wide range of partners, including Integrated Research on Disaster Risk (IRDR) to further discuss a roadmap defining the contribution of science and technology to the implementation of the Sendai Framework. The Science and Technology Roadmap (draft) was produced by the science and technology community as well as other stakeholders shortly thereafter.

- Subsequently, the **1st Asian Science and Technology Conference for Disaster Risk Reduction (ASTCDRR)** on 23-24 of August 2016 was organised by UNISDR with support from IRDR and other partners, which aims to discuss the key issues, challenges, needs and opportunities in the application of science in policy-making and explore the way forward for promotion of science-policy interface for evidence-based policy-making in DRR. Most importantly, the 1st Asia regional science and technology conference generated an outcome document, which consists of twelve recommended actions aligning with and contributing to the "Science and Technology Roadmap". See the attachment of the draft outcome document.

- Following the global and regional conference, IRDR together with International Council of Science (ICSU), the ICSU Regional Office for Asia and the Pacific (ICSU ROAP), the Academy of Sciences located in Taipei and IRDR International Centre of Excellence (ICoE) Taipei organised *the* ***1st Workshop to Strengthen Scientific Advisory Capacities for Disaster Risk Reduction*** in Bangkok, Thailand, from 25-26 August 2016, hosted by National Research Council of Thailand (NRCT). The 1st workshop aims at strengthening scientific advisory capacities on disaster risk management as well as enhances the interface between IRDR and policy platforms in charge of DRR among 12 countries, including Bangladesh, Fiji, India, Indonesia, Iran, Malaysia, Myanmar, Nepal, Pakistan, Philippines, Sri Lanka and Thailand.

- The 2nd workshop was held in January 2017, Taipei to present and further discuss the Science Technology Plan for DRR in the respective countries, with specific targets to implement the Sendai Framework.

2. The 1st and 2nd Workshop Outcome

- Analysed the gaps and challenges in implementing science based decision-making in DRR among the 12 countries

- Shared the best practices of science based decision-making from China, Japan, Taipei, Thailand and UN-SPIDER

- Discussed the essentials of the science technology plan for DRR in accordance with the outcome document and briefly developed the framework of the science technology plan for DRR
- Encouraged the 12 country representatives to focus on development of a framework for their respective science technology plan and then present their plans in the 2nd workshop in Taipei

- After the workshops, the country representatives co-authored a publication, Science Technology Plan for Disaster Risk Reduction.

3. Science Technology Plan for Implementation of SFDRR

Following are a few issues to be kept in mind while developing Science Technology Plan for SFDRR implementation:

- **Multi stakeholder partnership:** Please be reminded that Science Technology Plan is NOT a Scientist's plan. It needs multi stakeholder collaboration, including science community, government, civil society, private sector, media etc.

- **Focused approach:** The plan does not need to include the hazard, vulnerability of the country, which is already part of the national DRR plan. More emphasis is required to focus on the four priority areas of SFDRR, and looking through a science lens.

- **Inclusive approach:** The plan development should have a balanced mix of different professions, stakeholders, age and gender. Link to different professional societies and science academy is important.

- **Cultural calibration:** Science and its influences on society and governance are different in different country. Thus, there is not a single one-fit-all model for all countries. Science technology plan needs to keep in mind the local cultural issues of the countries, and customize accordingly.

- **Dynamic evolution:** DRR is an evolving subject. The science landscape is changing rapidly over time. The plan needs to cope with the dynamic evolution of the subject as well as science landscape.

- **Youth voices:** The whole subject of DRR is very much related to its future disciplinary evolution. Higher education plays an important role here. It is very important to involve young scientists, professionals and practitioners in the process to make it futuristic oriented.

1st Asian Science and Technology Conference for Disaster Risk Reduction:

Science-Policy dialogue for Implementation of the Sendai Framework

Conference Outcome

Introduction

The Sendai Framework for Disaster Risk Reduction 2015-2030 shifts the focus from managing disasters to managing risks. Such a shift requires a better understanding of risk in all its dimensions of hazards, exposure and vulnerability; a disaster risk governance that ensures disaster risk is factored into planning and development at all levels across all sectors as well as in disaster preparedness, rehabilitation, recovery and reconstruction; and cost-benefit analysis to support prioritization of investments in disaster risk reduction (DRR) for long-term resilience.

The Sendai Framework emphasizes the role of science and technology. It calls to prioritize the development and dissemination of science-based risk knowledge, methodologies and tools, science and technology work on DRR through existing networks and research institutions and strengthened interface between science and policy to support all four priority areas: understanding disaster risk; disaster risk governance; investing in DRR for resilience; and enhancing disaster preparedness for response and to build back better.

A '*Science and Technology Roadmap to Support the Implementation of the Sendai Framework for Disaster Risk Reduction 2015-2030*'[1] has been agreed as the result of the United Nations Office for Disaster Risk Reduction (UNISDR) Science and Technology Conference in January 2016. The Roadmap includes expected outcomes, actions, and deliverables under each of the four priorities of the Sendai Framework.

Asia has been the world's hotspot of economic development and innovation in terms of science and technology over recent decades. At the same time, the region continues to be highly exposed and vulnerable to disasters. Science and technology-based DRR was a priority in the implementation of the Hyogo Framework for Action in Asia. At the 6th Asia Ministerial Conference on DRR (AMCDRR) in 2014, the Science Technology Academia Stakeholder Group made a series of commitments to: promote a holistic, science-based approach towards community resilience; support the use of science and technology advancements through increased earth observation; develop course curriculum and promote higher education in DRR; and promote community- and problem-based implementation research.

The 1st Asian Science and Technology Conference for Disaster Risk Reduction was organized by the Hydro and Agro Informatics Institute (HAII) of the Royal Thai Government Ministry of Science and Technology and UNISDR, in collaboration with UNISDR's Asian Science Technology and Academia Advisory Group (ASTAAG), Integrated Research on Disaster Risk (IRDR), Future Earth and other scientific organizations and networks.

The Conference brought together more than 300 senior policy-makers, practitioners, researchers and academics, civil society and the private sector in the realm of disaster risk reduction from across Asia, and more widely, to discuss how to strengthen science based DRR policy development in support of the implementation of the Sendai Framework in Asia.

[1] https://www.unisdr.org/files/45270_unisdrscienceandtechnologyroadmap.pdf

Actions for Science and Technology-based DRR in Asia

The following recommended actions align with and contribute to the global 'Science and Technology Roadmap". They take due consideration of the forthcoming Asian Ministerial Conference on Disaster Risk Reduction in November 2016 and one of its expected main outcomes, the Asia Regional Plan for Implementation of the Sendai Framework.

Priority 1 – Understanding Disaster Risk

1. Enhance disaster loss and damage accounting, national and local disaster risk assessment and communication of disaster risk, with a specific focus on urban risks.

   This should be done through: data standardization; appropriate and robust methodologies and tools; building the capacities of both the scientific community for dynamic research and innovation to cope with fast changing context of hazards and vulnerabilities, and DRR practitioners to apply such methods; and promoting the role of mass media, civil society and people working with communities to translate scientific information into understandable and accessible risk information. A Multi-hazard, multi-scale, multi-stakeholder, and multi-facet approach and participatory process should be a standard.

2. Use space and disaster risk mapping technologies and strengthen the capacity for using these technologies for improved understanding of disaster risks at global, national and local level.

3. Strengthen regional exchange on disaster risk information and science in order to better understand complex disaster risks including risks of transboundary, cascading and compound disasters.

Priority 2 – Disaster Risk Governance

4. Strengthen science-policy-practice nexus at all levels (national, local, transboundary and regional) through: increased dialogue and networking among scientists, policy makers and practitioners; better evidence to inform decision making and proactive involvement of the science and technology community in regional, national and local platforms for DRR. Support these platforms to be multi-stakeholder partnerships, particularly including the private sector, civil society, media and communities at-risk to deliver science-based solutions and technological user-friendly tools and methods to reduce disaster risk and strengthen resilience.

5. Develop inter-disciplinary national science and technology plans to support implementation of the Sendai Framework. This includes actions by academia/universities to develop their own disaster risk management plans.

6. Enhance collaboration between local governments, academia and other partners to promote local communities" knowledge and traditions and to sustain and replicate many good practices that exist locally for science-based decision making.

Priority 3 – Invest in DRR for Resilience

1. Make DRR an area of focus within education including networking between universities. Jointly develop research and higher education programmes that contribute to the building of resilient communities and societies. Promote knowledge broker education and training programmes to help close the gap between disaster risk science and people including through community networks such as faith-based organizations

2. Ensure risk-sensitive investments. Enhance the role of the science and technology community in building public private partnerships for the purpose of reducing vulnerabilities of communities and ecosystems-at-risk, preventing risks and building resilience of critical infrastructure, essential services as well as emerging industries.

3. Develop young professionals in the field of multi-disciplinary disaster risk reduction. In particular, more women and girls should be engaged in DRR research and a gender marker should be a key element of many aspects of such enquiry.

Priority 4 – Enhance disaster preparedness for effective response and to Build Back Better

4. Promote the role of inter-disciplinary science and technology in effective pre-disaster planning, preparedness, response, rehabilitation, recovery and reconstruction to build back better. Promote the combination of traditional knowledge and modern science. Enhance regional cooperation, particularly for preparedness, response and build back better in transboundary disasters.

5. Develop an efficient and effective cooperation among the science community and business sector by utilizing the advancements of the fast developing information and communication technology (ICT) including big data.

6. Research into innovative solutions to promote the whole-of-society engagement; innovative financial mechanisms to maximize social capital for DRR (such as a disaster resilience fund to provide urgently needed resources to disaster affected communities for quick recovery), and to help the business sector shift towards sustainable and resilient development pathway.

The Way Forward

This Outcome Document will be shared at the 2016 AMCDRR. Participants of the conference will also share the document with relevant governments, organizations, communities and other stakeholders to promote the implementation of the recommended actions.

Asia's science, technology and academia community agreed to hold an Asian Science and Technology Conference for Disaster Risk Reduction every two years in advance of the AMCDRR so that science and technology influences the implementation and monitoring of the Asia Regional Plan for Implementation of the Sendai Framework. The 2nd Asian Science and Technology Conference for DRR will be hosted by the National Commission for DRR of China in 2018.

To prepare for the Asian Science and Technology Conference on DRR, progress of science and technology in DRR will be mapped periodically in different countries in terms of: i) science and

technology as part of decision making; ii) investment in science and technology including strengthening the capacity of academic and research institutions; and iii) how science and technology links to people. This should be done through multi-stakeholder consultations and in close cooperation with national platforms for DRR. Review of progress in implementing recommended actions from previous conferences will also be an important part of each biennial conference.

The UNISDR Asia Science Technology Academia Advisory Group (ASTAAG) could be utilized as a key resource to strengthen regional networking and to provide advice and insight to boost national science and technology capacities. As part of this role, ASTAAG should disseminate the successful applications of science and technology in mitigating risks from different types of hazards including flood, earthquake, drought, health and other climate related hazards showcased at this conference.

Tentative Framework of Science Technology Plan for Implementation of SFDRR

Following is a tentative structure of the Science Technology Plan. The summary version of the country/region level Science Technology Plan is presented from Page 13 onward.

1. Background (2 pages)
   - Science technology for public policy
   - Evidence based decision-making
   - Review of application of science and technology in DRR
   - Linking science technology plan to the SFDRR, the Sustainable Development Goals and the Paris agreement

2. Context of the Plan (4 pages)
   - Summary of National Science Technology Plan (if available)
     - Background, rational, goal and strategies
     - Strategic actions
     - Implementation framework
     - Performance Monitoring and Evaluation

   - Summary of National DRR Plan (if SFDRR implementation plan is available, please focus on that)
     - HFA (if the plan is before SFDRR) or SFDRR priority of actions
     - Role of science and technology mentioned in the DRR Plan
     - Financial mechanism

   - Science technology status
     - Countries who have conducted science technology mapping with the status report, can refer to the key findings there

3. Purpose and key objectives (0.5 page)
   - This section needs to focus on specific purposes and key objectives of the Science and Technology Plan. The actions identified in the section 4 (under SFDRR) needs to be linked to the objectives mentioned here.

4. Specific actions under SFDRR priorities (4 pages)
   - Refer to the Global Road Map of Science Technology in DRR. There are 39 specific actions and 7 outcomes of the road map.
   - Refer to the Outcome document of the 1st Asia Science Technology conference. There are 12 specific actions under the four priority areas of SFDRR.
   - Identify through a consultative process which actions are more crucial for your country perspective, keeping in mind the national science technology plan and DRR plan.
   - Refer to The Asia Science Technology Status for Disaster Risk Reduction White Paper, and consider the indicators under three key issues:
     - Science in decision-making
     - Investment in science and technology
     - Science link to people

5. Implementation framework (2 pages)
   - Institutions, networks and partnerships: This section needs to describe the key roles and responsibilities of the institutions responsible for the implementation of the plan. The key resource institution(s) need to be identified along with partner organisations. A network of institutions and organisations are required to facilitate the implementation of the science technology plan.

6. Key challenges to overcome (1 page)

Annex
Please add any other relevant information / website/ resources in this section

Workshop Photos

1st Workshop in Bangkok, August 25-26, 2016

2nd Workshop in Taipei, January 16-17, 2017

SCIENCE & TECHNOLOGY PLAN

For Disaster Risk Reduction

11 Countries and 1 Region (Pacific)

PACIFIC

1. BACKGROUND[1]

The Sendai Framework for Disaster Risk Reduction 2015-2030 mentions the need to use science and technology in several paragraphs. The need to more routinely use science and technology in DRR in the region was also highlighted in the outcome statement of the 2016 Pacific Regional Platform for Disaster Risk Management. However, Pacific Island Countries do not currently have national Science and technology Plans, although some of them are in the process of developing one. Moreover, some of the Pacific Island Countries may be too small for a National Science and technology plan to be relevant to them. As a result, a regional plan may be necessary to support the Science and Technology priorities identified by these countries.

It is important to note that this document is a draft of the final plan that will be reviewed, amended and finalised by the Pacific STAG when it will be established. As a result, some of the actions presented in section 4 may be changed or removed in the final version.

2. CONTEXT OF THE PLAN

Each Pacific Island Country has a National DRM plan, and some countries have a Joint National Action Plan integrating climate change and DRM. In addition to these plans, there is also a regional framework in the Pacific. The Framework for Resilient Development in the Pacific 2017-2030, an Integrated Approach to Address Climate Change and Disaster Risk Management (FRDP) does not focus only on DRR but is an integrated framework for both climate change and disaster risk management, two major issues for the development of Pacific Island Countries. The FRDP proposes voluntary guidelines for the Pacific islands region over three goals: Strengthened Integrated Adaptation and Risk Reduction to Enhance Resilience to Climate Change and Disasters, Low Carbon Development, and Strengthened Disaster Preparedness, Response and Recovery (SPC et al., 2016, p. 3). The FRDP is expected to support the implementation of commitments PICs have made under the different international agreements, including the Sendai Framework for Disaster Risk Reduction 2015–2030. There is thus a significant alignment between both regional and global frameworks.

Individually, Pacific Island Countries have limited resources to develop, access and implement science and technology-based solutions for DRR. As a result, science and technology projects are often conducted either at regional level by regional organisations (The Pacific Community (SPC), The Secretariat of the Pacific Regional Environment Programme (SPREP), The University of the South Pacific (USP)) or under bilateral projects with partners from outside the region, mostly from Australia and New Zealand.

There is a significant potential for research and development of science and technology-based solutions for DRR in the Pacific Island Countries. Beside the examples provided above, research and academic institutions from Australia and New Zealand are also working with Pacific Island Countries on DRR. However, most of the research is project-based and the findings are not always widely shared and applied. Similarly, although Damage and Losses assessments are conducted after emergencies

[1] Author: Helene Jacot Des Combes, The University of the South Pacific, Suva, Fiji

and disasters in the region, the information collected is not always analysed in a DRR context to try and limit losses caused by future disasters.

3. PURPOSE AND KEY OBJECTIVES

The purpose of this plan is to support the implementation of both the Sendai Framework for Disaster Risk Reduction and the FRDP in the Pacific Island Countries to reduce their risks and make them more resilient to disasters and climate change. In order to achieve this purpose, the following key objectives have been identified:

- Improve and standardise the collection of data and analysis of risk factors such as gender, age, land rights, human mobility and socio-economic status to help better understand the risks faced by Pacific Island Countries.
- Develop and implement user-friendly multi hazard early warning systems and mechanisms for disseminating warnings at national and local levels in a reliable and timely manner.
- Routinely use relevant Science and Technology to reduce risks from both natural and anthropogenic origins, in particular climate change impacts. The use of traditional knowledge, ecosystem services and innovative solutions which were rigorously assessed will be selected to provide the most cost-effective protection.
- Improve the dissemination of information and knowledge both within the region to support awareness of the population and decision making and outside the region to the global DRR and scientific communities.

4. SPECIFIC ACTIONS UNDER SFDRR PRIORITIES

This section presents some examples of specific actions that could be conducted under each of the SFDRR priorities.

Priority 1: Understanding Disaster Risk

1. Develop standardized post-disaster data collection tools and procedures for the different PICTs and for different hazards.
2. Standardized collection of baseline data for vulnerability assessment. In many cases, the information is collected but not stored in accessible databases, thus limiting the sharing of this information.
3. Use disaster risk mapping technologies and strengthen the capacity for using these technologies for improved understanding of disaster risks at regional, national and local level.
4. Validate traditional knowledge skills and practices and integrate it, when relevant, in disaster risk reduction plans.

Priority 2 – Disaster Risk Governance

1. Strengthen science-policy-practice nexus at all levels (regional, national and local) through: increased dialogue and networking among scientists, policy makers and practitioners; better evidence to inform decision making and proactive involvement of the science and technology community in regional, national and local platforms for DRR.
2. Support the integration of climate change projection into risk plans. Many risks in the PICs are altered by climate change impacts, either directly through the impacts of climate change on natural hazards or through an increase in the vulnerability of Pacific communities.

Priority 3 – Invest in DRR for Resilience

a). Develop accredited qualifications in tertiary education (TVET certificates and university degrees) to professionalise the Resilience field.

b). Develop partnerships between the scientific community and the private sector to develop innovative and/or specific solutions for the Pacific.

Priority 4 – Enhance disaster preparedness for effective response and to Build Back Better

1. Promote multi-hazard early warning systems with improved climate information, aerial and spatial data, emergency response services and communication to end users.
2. Include science into decision-making for resettlement process. Although some scientific disciplines are currently included in the resettlement process, the inclusion of other disciplines, especially social sciences and humanities should be improved.
3. Support capacity building to ensure the inclusion of all community groups, including the most vulnerable ones into all phases of decision-making for effective pre-disaster planning, preparedness, response, rehabilitation, recovery and reconstruction to build back better.

5. IMPLEMENTATION FRAMEWORK

The implementation of the framework will be decided and finalised by the Pacific Science and Technology Advisory Group (PSTAG) that is currently being established. According to the PSTAG TOR, yet to be finalised, the principal goal of the PSTAG is to provide the scientific and technical expertise to the Pacific Island Countries and Territories for the implementation of the Sendai Framework and the FRDP. The PSTAG is a voluntary group whose membership is not limited and will include representatives from institutions of the region, including academia, regional organisations such as SPC and SPREP, and UN agencies, and individual experts from outside the region but with documented interest in the region.

The PSTAG will have strong links with the Pacific Resilience Partnership (PRP), which will coordinate and facilitate the partnerships required to implement the FRDP. The PRP will bring together the climate change and disaster risk management communities of practice, along with other partners (for example, government representatives from ministries of finance and planning, relevant sectors and private sector and civil society stakeholders). The PRP will, therefore, include a broad range of all stakeholders with common interests but also some distinct concerns.

6. KEY CHALLENGES TO OVERCOME

One key challenge to overcome is funding. The issue is not only the amount of funds necessary to achieve the objectives of the plan but it is also the current structure of the funding. At present, funding is available through direct budget support or is project-based and does not always support science and technology. The result is a series of uncoordinated outcomes, using different approaches, methodologies and standards, making it difficult to compare the outcomes and replicate the good practices.

Another key challenge is human resources. Although there are projects currently running to develop the capacity of not only disaster managers but also stakeholders from different sectors to professionalise the DRR field, and more generally the resilience sector, it will take time for these projects to achieve their goals. Technical expertise is also limited and technology transfer is required. However, combined with the limited human resources presented above, the use of technology may be limited in the region due to maintenance issues.

Finally, the integration of DRM and climate change that took place in some PICs and is now supported at the regional level by the FRDP is currently generating a reorganisation of the resilience sector in the region. New partnerships are being developed and new organisations, such as the PSTAG, established. It may take time for the benefits of this new structure to be significant.

BANGLADESH

1. BACKGROUND[1]

The role of science and technology in providing evidence for policy is gaining prominence, with demand growing for multidisciplinary enquiry to address the complex and inter-related problems of climate change, disasters and sustainable development. The growing demand for a more prominent and effective role for science and technology in providing evidence for policy, with the international community recognizing that successful disaster risk reduction (DRR) depends on it. The application of science and technology can substantially reduce losses of lives and property, as is illustrated by several studies. For examples, in Bangladesh, a national flood warning system provides warnings up to 10 days ahead to millions of villagers, helping them defend against the regular flooding and preserve household assets. Studies indicate savings of about US$40 for every dollar invested.

However, there is recognition that the current international DRR framework is not meeting set targets in all regions or countries and lack of scientific evidence and uptake of evidence may be causes. So, the decisions regarding DRR must be taken based on the evidences to make risk reduction strategies more effective in national and international level. Several science-policy negotiations and multilateral dialogues contributed to the post-2015 framework for DRR, which identified the need to bring science and technology into the policy and planning mainstream in order to achieve more effective risk reduction (Chatterjee et al. 2015). The more recent Sendai Framework for DRR 2015–2030 recognizes the importance of science and technology in all of its priority action areas, and subsequent global and regional forums and conferences have reconfirmed science and technology's importance.

The greater use of science and technology including the natural and social sciences and the applied fields such as environment, health, agriculture, water and engineering helps to reduce the disaster risks and losses. In line with this, the linkage between science and technology plan and SFDRR is essential as science and technology are accelerants of progress. They create new insights and methods, solve old problems, and establish higher standards and better evidence based policies. Investment in disaster risk reduction requires evidence based risk management methods and its proper way of application during emergency.

2. CONTEXT OF THE PLAN

Science and technology has become not only a way of life, but has now been identified as an instrument of change. The bloom of science and technology in the last century have radically changed the face of the earth and impacted on transportation and communication, trade and commerce, education and learning, and agriculture and industry, health and medicine, environment and ecosystem etc. In fact, these developments brought in a new world order. In order to use science and technology as a vehicle for development, the government needs to adopt a science and technology policy reflecting the commitments of the politicians and legislators for effective use of science and technology in improving the living conditions of people and their environment. Beside the political commitment, the bureaucrats, administrators, financial managers, scientists, technologists, planners, people involved in the communication media and all concerned sectors of the population including people at

[1] Author: Md. Anwarul Abedin, Bangladesh Agricultural University

the grass-root level have not only to appreciate the role of science and technology, but also to have a clear understanding about effective application and management of science and technology for development. It is now generally realized that the inherent strength of a nation lies in the skills of its people which can be acquired and enhanced through the practice of science and technology in every field. The promotion of scientific knowledge and development of technology, through their increasing application, create the necessary conditions for socio-economic development of a country.

Currently, Bangladesh has several laws, policies and regulations on disaster risk reduction. However, the appropriate role and responsibilities of science and technology in DRR related decision- making, policy formulation and implementation processes is still not clearly defined and/or negligible. In order to use science and technology as a vehicle for development, the government needs to adopt a science and technology plan and policy practice reflecting the commitments of the politicians and legislators for effective use of science and technology in improving the living conditions of people and their environment.

3. PURPOSE AND KEY OBJECTIVES

In Bangladesh, the National Science and Technology Plan (NSTP) is designed to contribute to the achievement of the country's development objectives through the effective application of science and technology for development. Therefore, the Government of Bangladesh considers it appropriate to formulate a revised national science and technology policy. Therefore, the prime objective of the reviewed NSTP is to ensure application(s) of science, technology and innovation (ST&I) for achieving sustainable economic growth with due attention to employment generation, poverty alleviation, gender equity and environmental sustainability.

4. SPECIFIC ACTIONS UNDER SFDRR PRIORITIES

In Bangladesh, although, a number of actions have been taken through various plans, policies, and acts, however, contrasting with SFDRR, the following activities have been pointed out that need to be considered for successful risk reduction and to achieve sustainable development global to local level.

Priority 1: Understanding Disaster Risk

- Develop methods, models and tools including spatial for national risk assessments and monitor changes in disaster risk and risk profiling.
- Promote real time and near real time access to reliable data and use of information and communications technology.
- Integrate traditional, indigenous and local knowledge and practices in disaster risk reduction.
- Promote intergenerational partnership between scientists, policy makers, private sectors and community leaders.
- Develop partnerships between science and technology community and the disaster risk management institutes and agencies.

- Adopt a multi-hazard approach that integrates lessons learned, including from trans-boundary and biological and technological hazards.
- Develop inter-disciplinary national science and technology plans to support implementation of the Sendai Framework by targeting disaster risk management plans of academia/universities
- Enhance collaboration between local governments, academia and other partners to promote local communities" knowledge and traditions and to sustain and replicate many good practices that exist locally for science-based decision making.
- Establish and strengthen link between science technology and academia (STA) institutions and network to the related governmental, regional and international organizations.

Priority 3: Investing in DRR for Resilience

- Science based DRR needs to be promoted through investment in public and private R&D institutions/universities.
- Investment for data generation and management, preparing hazard, risk and vulnerability maps, developing GIS databases, incorporating disaster risk knowledge in formal and non-formal education needs to be increased both at local and national level.
- Investment is necessary to strengthen science–society–governance interfaces so that scientific innovation can be adapted by local people and implemented efficiently.
- Non-formal education and training for local people should also be promoted
- Investment in academic institutions to promote disaster preparedness, response, recovery and risk reduction related formal and non-formal education, training, research and development
- Investment on scientific validation of the indigenous knowledge is crucial

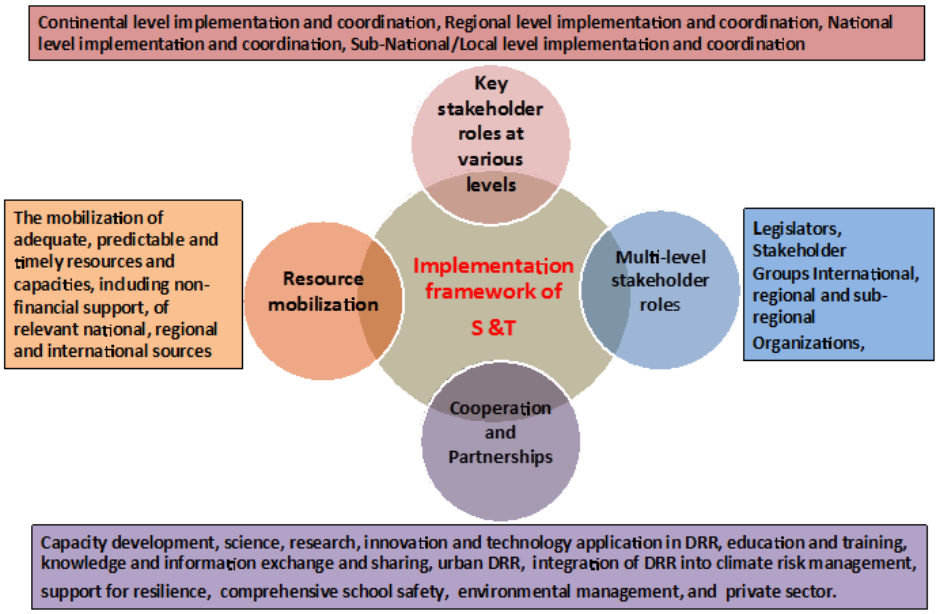
Priority 4: Enhancing Disaster Preparedness for Effective Response, and to "Build Back Better" in Recovery, Rehabilitation and Reconstruction

- Develop an efficient and effective cooperation among the science community and business sector by utilizing the advancements of the fast developing information and communication technology (ICT) including big data.
- Incorporate build back better in insurance policies.
- Institutionalize effective recovery and reconstruction as strategies to reduce risks and promote resilient development.
- Promote science based decision-making for resettlement processes.

5. IMPLEMENTATION FRAMEWORK

There is a need of national science and technology plan (NSTP) for integrating all science and technology issues with the objective of enhancing sustainable development by disaster risk reduction. Now, it needs to be stressed that S&T inputs are necessary for enhancing the development activities of all the economic sectors. Important items necessary for the success of S&T based sectoral development are: sectoral & sub-sectoral policies, policy instruments, infrastructures, production facilities, research facilities, S&T manpower and related institutions. It is envisaged that sectoral plan and

policies would consider intra-sectoral issues related to integration of S&T issues (infrastructure, production and research facilities) to enhance development of respective sectors. Multistakeholder's collaboration, partnership and mutual ownership of the problem and solution are also important to implement the science and technology both at the national and local levels. Moreover, it should be done in close cooperation with UNISDR partners, both individual experts and institutions in the science and technological communities to foster the science and technology plan. The diagram illustrates the implementation framework of STP in Bangladesh context.



6. KEY CHALLENGES TO OVERCOME

There are some challenges to implement the science and technology plan in disaster risk reduction in Bangladesh. These are as follows:

i) The status of science and technology for disaster risk reduction has contributed to the paradigm shift from disaster response to risk reduction, and to resilience building. However, it is crucial to examine the current level of application and acceptance in the disaster risk reduction community, although, the scientific knowledge and technological tools available, especially policy makers in the governments.

ii) It is further challenging to assess the strengths and weaknesses of existing knowledge and approaches generated in the social sciences for making the political and economic case of investment in disaster risk reduction.

iii) Identifying the opportunities and solutions for bridging existing gaps in research and overcoming is a challenge for further increasing political commitment, economic investment and social demand for disaster risk reduction.

iv) To overcome the challenges, a set of practical recommendations should be included to bridge the existing gaps identified in knowledge and research on disaster risk reduction, its application is vital by disaster risk reduction community, especially policy and decision makers.

INDIA

Context[1]

As we pursue the implementation of Sendai Framework for Disaster Risk Reduction with a renewed vigour, it is important to optimize the application of scientific and technological capacities to the maximum extent possible. This not only entails development of new scientific and technological research programmes but also optimizing the application of existing capabilities. Science, technology and research have brought a deeper understanding of disaster risks and 'how to' reduce them. However, there are gaps in translating this scientific information into evidence and science-based policy making. There is also the need for the research community to formulate applicable methodologies and tools that respond to real-world challenges and facilitate the shift from disaster management to disaster risk management.

There is often a time lag between the availability of scientific and technological capability and its on-the-ground application. For example, mobile computing has been around for more than a decade, yet few post-disaster damage assessments make full use of the technology to come up with quick, rigorous and geo-referenced disaster risk assessments. While application lags, new scientific work also often lacks focus and a problem-solving orientation. If we were to optimize the application of science and technology during the period of implementation of Sendai Framework, fresh thinking will be required in terms of science-application interface.

In this regard, five key guiding principles are proposed for promoting application of science and technology for and disaster risk reduction.

GUIDING PRINCIPLE ONE: Sharper problem definition (from disaster reduction perspective) helps galvanize scientific efforts and leads to tangible progress

- Many parts of the world have made progress in reducing mortality from disasters. This is particularly true of weather and climate related disasters.
- A major contributing factor for the above progress is application of science and technology in weather and climate prediction: cyclone warning has improved immensely; seasonal climate prediction has also improved significantly. Improved lead time and accuracy of cyclone warning has not only saved lives but also reduced economic losses by supporting better targeting of evacuation measures.
- One of the reasons we have made progress in the above-mentioned areas is that there has been a clear articulation of demand from the disaster risk management community. This has galvanized the efforts of multiple institutions to focus on certain well-defined problems. For example, in just over a decade we have seen tangible results in India in terms of reduction in mortality from disasters.

[1] Authors: Vinod Sharma, Professor, Disaster Management, Indian Institute of Public Administration; Kamal Kishore, Member, National Disaster Management Authority

- Progress has also been made in application of space-based technologies, particularly with regards to mapping of landslides, glacial lakes, as well as GPS studies for seismic research.

GUIDING PRINCIPLE TWO: Need for multi-disciplinary work for comprehensive disaster risk reduction

- A lot of the applications, however, are biased towards studying hazards. There are relatively few examples of studying the interaction between hazards and current and future exposure (population, property and economic activity), and vulnerability. This will require multi-disciplinary effort.
- In order to support such multi-disciplinary work, there needs to be much greater cooperation between universities and technical institutions across the country as well as transnationally. Capacities of some of the universities and technical institutions can be utilized regionally and globally.

GUIDING PRINCIPLE THREE: Develop Global Public Good, Optimise the Use of Global Capacities

- Many institutions in different parts of the region have excess capacities that can benefit other countries with marginal increase in costs. For example, the ASEAN Specialized Meteorological Centre based in Singapore produces seasonal climate forecast products that are useful to the national meteorological services in the entire region to use as an input to producing their own regional forecasts.
- Similarly, in the western hemisphere, the International Research Institute (IRI) for Climate and Society at the Earth Institute at Columbia University Research has focused on seasonal Climate Prediction (particularly El Nino Southern Oscillation) for the last twenty years. This has yielded specific societal benefits globally. The IRI produces seasonal forecasts for many different regions of the world. These are picked up by national meteorological services for developing nationally specific applications. The IRI also provides free access to a data library – a global public good – that compiles raw climate, geophysical, health and agriculture data from numerous providers and formats into a common framework that makes powerful cross-disciplinary research and analysis possible.

GUIDING PRINCIPLE FOUR: Technical and Scientific Institutions/ Universities should engage with local disaster issues

- The scientific and technical institutions need to focus on specific disaster related problems in their immediate environments. For example: universities in coastal towns may focus on solutions for cyclone and tsunami risk reduction; institutions in mountain areas may study Glacial Lake Outburst Floods. The tertiary education system should proactively encourage universities to work on issues of local relevance.

GUIDING PRINCIPLE FIVE: Create Space for Dialogue Between Users and Producers of Scientific and Technical Knowledge

- There is also need for a more structured dialogue between scientists and disaster risk managers to maximize the utilization of existing scientific and technological

capabilities. For example, it is only in recent years that meteorologists and seasonal climate forecasters have begun to sit in the same room when seasonal climate forecasts are released. The producers and users of scientific information need to come together both at the policy and operational levels.

A broad-based consultative process at the country level that embodies the guiding principles outlined above can lead to science and technology for SFDRR in each country. Such a plan will be ambitious in its scope and yet will be fully cognizant of practical realities in each country.

Discussion on Application of Science and Technology for DRR at the AMCDRR

India has always pursued the application of science and technology for disaster risk reduction with a sense of purpose and urgency. This has led to specific risk reduction outcomes in the form of reduction in mortality, particularly from hydro-meteorological disasters. At the Asian Ministerial Conference on Disaster Risk Reduction held in New Delhi from 3-5 November 2016, India hosted a Featured Event on this theme. The session brought together experts from across the region to deliberate on the urgent need for a stronger science-policy interface towards science-based policy development in DRR.

The event recognized various capacity constraints across levels that affect the utilization of science and technology. Regional cooperation is limited similarly through capacity differentiations between countries. Definitions of hazards and risks are not always regionally aligned, making reporting and assessment difficult. At the local level as well, science and technology is not yet sufficiently mainstreamed. Information is often difficult to understand and interpret and thus not accessible to groups outside of the science and technology field. Institutions are failing to overcome this gap through facilitating conversations between local communities and science and technology experts and linking them to systems.

The way forward

Disaster risk reduction related problems need sharper definition to galvanize scientific efforts that lead to progress. Initiatives to reduce disaster must be evidence-based and globally scalable, with appropriate resources mobilized. Coherence should be fostered. DRR must be collaborative between governments, stakeholders and IGOs. Science and technology can then be utilized in a way that are not politically aligned or geographically contained.

There needs to be a deeper understanding of how science and technology can effectively address disaster risk at the local level. Stakeholders should establish channels through which information can move with ease strengthening collaboration. It was agreed that information must be mainstreamed. There needs to be shift in the language used by science and technology experts so that information can become accessible to all stakeholders and on all levels. A more coherent approach to science

and technology that addresses disaster risk will in turn make policy making easier and more effective in its implementation.

The featured event recognized the strong need to continue innovative science and technology research. Communication channels need to be further developed. Information needs to be more readily accessible and easy to understand to benefit at-risk communities. The impact of a stronger science-policy nexus needs to extend positively into communities. This nexus must pay greater attention to a people-centred focus if it is to prevent and reduce disaster risk.

Science and technology needs to be more incorporated into regional and national-based DRR networks. This will lead to a better understanding of disasters in the region. Such actions should include development of technology that is shared, accessible, and analysed under a shared umbrella of understanding.

The event identified the need for a stronger context analysis and more explicit definition of the challenges that science and technology can help address. A 'global public good' of science-informed DRR should be encouraged as a norm to optimize the use of global capacities. This will involve technical and scientific institutions and universities engaging on local disaster issues. This will facilitate dialogue between users and producers of scientific knowledge for DRR.

The key conclusions of the featured event and other insights drawn from past experience will form a basis for India's efforts towards maximizing the utilization of S&T capacities for disaster risk reduction.

INDONESIA

1. BACKGROUND[1]

Indonesia's Law No. 24/2007 on Disaster Management has been the basis of disaster management in Indonesia. The issuance of Law has triggered a paradigm shift-oriented disaster management into risk reduction.

The development of science and technology is a major prerequisite in the development of DRR plans in Indonesia. DRR action plans in Indonesia used evidence-based to set priorities and targets. Disaster Risk Assessment has been carried out based on data and methods that can be justified scientifically. Reducing disaster risk and increasing the resilience of the government, local government and communities in facing disaster are the mandate of the National Development Plan 2015-2019 in the field of disaster management. Indonesia has prepared road map of National DRR Plan until 2030, to incorporated SFDRR framework into National DRR programs.

2. CONTEXT OF THE PLAN

1. Summary National Science and Technology Plan

Technology plays an important role in strengthening DRR system in Indonesia. Improvement of science and technology will directly increase the capacity a country to cope with disasters and climate change. Therefore the development of technology in the field of disaster and climate change becomes an important issue for Indonesia. There are two main focuses in accordance with disaster context, which are Land and Forest Fire and Hydro-meteorological hazards.

2. Summary of National Disaster Reduction Plan

In the National mid-term Development Plan 2015-2019, disaster management and disaster risk reduction are driven as part of its issue. Regarding national and global, as well as local needs for disaster risk reduction, science and technology utilization has been considered to respond the national development strategic objectives. Which are:

a. Internalization of disaster risk reduction within the framework of sustainable development at the Central and in other regions;
b. The reduction of disaster vulnerability; and
c. Increase disaster management capability.

3. Science and technology for DRR Status

The use of science and technology for comprehensive and integrated disaster management requires human resources and financial support. Budget for the development of science and technology is not explicitly mentioned instead of the budget is dependent with each program supporting disaster management. Based on disaster management law, management of disaster has to be taken into account by multi sectors.

The development of science and technology are provided through ministries and institutions, such as Meteorology and Geophysics Agency, Geological Agency, Ministry of Public Works and others.

[1] Authors: Lilik Kurniawan, BNPB; Sugeng Triutomo, DRRI

3. PURPOSE AND KEY OBJECTIVES

SFDRR emphasizes the role of science and technology in DRR. It calls to prioritize the development and dissemination of science based risk knowledge, methodologies and tools, science and technology work on DRR through existing networks and research institutions and strengthening interface between science and policy to support all four priority areas.

The purpose and key objectives is implement national DRR movement that is people-centred, comprehensive, fair, sustainable and exercise good risk governance supported by science and technology and local wisdom. Also clarify and assign roles and responsibilities in DRR for government and other stakeholders at all levels with utilize DRR as part of the national development strategy and international diplomacy of the country.

4. SPECIFIC ACTIONS UNDER SFDRR PRIORITIES

These are National Action Plan paired with expected outcomes of SFDRR. The National plan is categorized into short-term (2016-2018), medium term (by 2020) and long term.

Priority I (2016-2018)

a. the availability of general risk assessment for multi hazards
b. the availability of hazard, vulnerability, exposure and capacity assessment based on science and technology
c. local knowledge for understanding risk are collected and disseminated
d. damage and losses record and report as basis for risk prediction
e. the use of risk assessment as a policy consideration and DRR investment
f. information access insurance for people in disaster prone area
g. government and local government has fully understood the risk and proactively involve on risk management and climate change adaptation.

Priority II (2016-2018)

a. sectoral planning assessment has adopted DRR perspective
b. DRR sensitive sectoral development process and observation
c. Local Development Plan are started to integrate DRR view
d. the forming of coordination and cooperation among stakeholders
e. all local government have DRR and DM policies
f. implementation of minimum service standard on disaster management
g. establishment of more derivative and legal policies on DRR
h. disaster risk assessment and mapping on 50% areas
i. availability of incentive and disincentive system on DRR sensitive allegiance, evaluation and development planning report.
j. establishment of coherence and synergy among agency on DRR, CCA and SDG's program
k. enforce joint monitoring and risk assessment on multi hazard in ASEAN and Asia Pacific Region.

Priority III (2016-2018)

a. availability of policies to enhance budget on DRR and resilience program
b. increase of actual DRR budget in key sectors
c. structural resilience improvement of critical public facility, especially school and hospital
d. increase of social protection, education and health coverage for people lived on disaster prone area
e. increase DRR and preparedness training program for people
f. integrating DRR to monetary and fiscal instrument and also elaborate risk sharing and transfer
g. increase of business resilience on climate related disaster and other extreme condition
h. promote DRR coherence implementation on system, sector and organization.

Priority IV (2016-2018)

a. availability of regulation, plan and program on disaster preparedness improvement for all local government
b. availability on instrument, tools, mechanism, protocol, procedures, standards on local preparedness program.
c. formed cooperation among government, private sectors and community on disaster preparedness
d. availability of multi hazard EWS focused on community
e. development of community and local government preparedness program
f. availability of physical preparedness facility such as shelter
g. availability of guideline on disaster recovery preparedness
h. increase of recovery coordination (procedure and financing)

5. IMPLEMENTATION FRAMEWORK

The implementation of science technology plan in DRR is using multi-disciplinary approaches. Thus, it is not only BNPB responsibility to implement the action plan. Depends on the priority, each line ministry has responsibility to provide the service to the people. The DM policy and strategy has acknowledged the importance of multidisciplinary and multi stakeholder approaches in implementing DRR in grass root level.

Here are the examples of science technology action points that involving other ministries.

a. Construction of infiltration wells and or bio-pores in domestic and commercial districts (by Ministry of Public Works)
b. Construction of earthquake safe building (by Ministry of Public Works)
c. Availability of plants or building for protect tsunami (Min. of Marine)
d. Revitalization of dikes, ponds and reservoirs (Min. Public Works)
e. Restoration of peat-lands (Peat Restoration Agency)
f. Vegetative conservation of watersheds prone to landslides (Ministry of Forestry and Environment)

Other Institutions

BNPB has conducted some research cooperation with universities in Indonesia for identification of major hazards, such as:

- Earthquake with Bandung Institute of Technology
- Tsunami with Syiah Kuala University
- Flood with Diponegoro University
- Drought with Udayana University
- Volcano Eruption with UPN Yogyakarta
- Land and Forest Fire with Bogor Agricultural University
- Abration and Extreme Wave with Andalas University
- Climate Extreme with Indonesia University
- Industrial Accident with ITS Surabaya
- Epidemic and Disease with Airlangga University
- Flash Flood with Hasanuddin University
- Landslides with Gadjah Mada University

There is forum called "Higher Education Forum for Disaster Risk Reduction (FPT-PRB) which was established on 2008 and Indonesia Disaster Expert Association (IABI) established on 2014, both were conducted Annual Scientific Meeting on Disaster Risk Reduction.

The result of the meeting will be dedicated to the Government in order to strengthen national capability in disaster risk reduction.

6. KEY CHALLENGES TO OVERCOME

There are some challenges in DRR to overcome in Indonesia, which as follows:

a. Implementation disaster management in the local level

b. Resilience city and resilience village

c. Relation between other programs on National Action Plan of DRR

d. The HFA2 and SDG will serve as reference in formulating Indonesia's Resilience City Indicators

e. Synchronization between DRR, CCA and Spatial Planning

f. Strengthening research and knowledge management, including public awareness

g. Encourage community participation and public-private partnership in DRR and CCA

h. Enhancing institutional capacity building of local government to support community resilience for disaster risk management, in formulating and implementing local and community plans for DRR and CCA.

i. Conducted Law Enforcement.

IRAN

1. BACKGROUND[1]

Disasters destroy our lives, societies, and livelihood. In Iran, during only in one-quarter of a century ended to 2015, natural disasters have caused over 73 thousand deaths, 42 million people affected, and 20 billion USD economic damage. There are hazardous events that are becoming more frequent or sever as a result of changing climate. Global community pays increasing attention to the disaster risk reduction (DRR) and its intermediate outcome, i.e., resilience. Science is essential in DRR efforts. According to the former head of UNISDR, "a resilient planet needs robust science for disaster risk reduction". This statement is supported by many strong evidence and best practices around the world. As a result of scientific research, we are able to assess and map earthquake risks, forecast floods, detect tsunami waves, prevent infectious disease outbreaks with vaccination, evaluate impacts of DRR measures, effectively communicate disaster risk to communities, etc. Similarly, there is strong evidence of science contribution in reducing risk of disasters in Iranian community. In line with global initiatives and the Asia regional plan, I.R.Iran has taken an initiative to develop the national Science and Technology Plan for DRR (STPDRR) to support implementation of SFDRR under the auspices of I.R.Iran National Disaster Management Organization (NDMO) and in collaboration with stakeholders from academia, public and private organizations, and civil societies.

2. CONTEXT OF THE PLAN

According to Iranian 1404 Perspective Document, the I.R.Iran will be the first in the region including in terms of science and technology. This approach has resulted in a national movement coordinated by the Commission of Science and Technology Information System (CSTIS) and Vice President Office for Science and Technology in line with the 5th Development Plan (2010–15), the Comprehensive Scientific Plan, and under guidance of Science and Technology General Policies decreed by Supreme Leader. Science and technology have been well addressed by the highest level of policy making in Iran. The Science and Technology General Policies was decreed by the Supreme Leader in line with the implementation of Clause 1 of Article 110 of Iran's Constitution, and after consultation with the country's Expediency Discernment Council of the System. The Comprehensive Scientific Plan has been developed and endorsed by the Higher Council of Cultural Revolution in 2010, in collaboration with Vice President Office for Science and Technology, MSRT, MoHME, Ministry of Education, and Islamic Parliament. Prediction and forecasting of earthquake and flood, and strengthening of civil defense are explicitly mentioned in the plan but as level 2 priority. Science and technology have been well addressed in National Disaster Management Act in articles 4, 5, 8.

[1] Authors: Ali Ardalan, National STPDRR Technical Focal Point; Behnam Saeedi, NDMO Focal Point for STPDRR; Mehdi Zare, Ali Darvishi, Daoud Khorasani, Kambod Amini, Hamidreza Khankeh, Abbas Ostadtaghizadeh, Ahmad Soltani, STPDRR Advisory Group; Eng. Hasan Azadeh, Eng. Rasoul Hajahmadi, Dr Mona Khaleghi, Dr Meshkat Torkamanian, Dr Homa Yusefi, STPDRR Research Team

3. PURPOSE AND KEY OBJECTIVES

The I.R.Iran Science and Technology Plan for DRR (STPDRR) in line with the SFDRR 2015-30, aims to strengthen science-based policy making and practice of disaster risk reduction in the country. Specifically, the STPDRR:

- Determines the DRR priority areas and needs that require science and technology support
- Develops strategies and actions that strengthen science and technology sector to be useful and usable in DRR policy making and practice
- Develop strategies and actions that enhance capacities of all stakeholders (governmental, public, and private) to effectively use the science and technology)

4. SPECIFIC ACTIONS UNDER SFDRR PRIORITIES

Priority 1: Understanding Disaster Risk

Expected outcome 1. Disaster risk knowledge is developed.
Priority actions

a) **Strengthen spatial data infrastructure along with related national database and processes** to record and monitor information on hazards' exposure and impacts, vulnerability and capacity status
b) **Develop methods, models and tools for multi-hazards risk assessment** using spatial and space technologies from one hand and community-based approaches from other hand
c) **Conduct regular multi-hazards risk assessment and mapping** to understand and monitor changes in disaster risk at national and local levels
d) **Strengthen solution-driven disaster research capacities** including human, technical, financial and institutional to produce and synthesize prioritized scientific evidence related to DRR
e) **Promote integrated and multi-disciplinary research** that bridges social and natural sciences and uses both quantitative and qualitative data. Promotion of following research areas are suggested: ethics; psychosocial determinants of risk perception and understanding; traditional, indigenous and local knowledge and practices; insurance, social protection and safety nets.

Expected outcome 2. Disaster risk knowledge is disseminated, accessed and understood.
Priority actions

a) **Develop breakthrough technologies to disseminate disaster risk information and knowledge to public**. Development of innovative public education methods, and promotion of information and communication technology and social media are needed.
b) **Enhance public-policy-science interface and partnership** including private sector and community leaders, and through establishment of networks, institutionalization of science advisory groups, and involvement of end users of science in the earliest stages of research and technology development.
c) **Integrate risk assessments into disaster risk management** across all sectors and all levels.

Expected outcome 3. Disaster risk knowledge is used for informed decision-making and translated to action.

Priority actions

a) **Develop and endorse standards and accreditation systems for disaster risk management based on scientific evidence** to ensure that scientific data and information are used in policy making and practice of disaster risk reduction and resilience building.

b) **Develop and endorse research utilization protocols** including appropriate incentives to ensure that design and implementation of disaster risk reduction research are solution-driven and the results are led to proven use.

c) **Capacity building on knowledge translation and use for both the science community and the policy and decision makers** to ensure they collaborate on effective and efficient design and conduct of applied research to facilitate use of results

Priority 2 – Strengthening Disaster Risk Governance to Manage Disaster Risk

Expected outcomes 1. Disaster risk science is used in inform policy and decision-making within and across all sectors at all levels.

Priority actions

a) **Strengthen engagement of science in coordination platforms for disaster risk reduction** at national and provincial levels

b) **Promote research for providing better evidence on good risk governance solutions** while involving all sectors, considering their needs, concerns and capacities.

c) **Ensure disaster risk management authorities are capable of using scientific evidences** and applications of appropriate technologies

d) **Promote science-policy-practice dialogue through** increased dialogue, networking, and sharing best practices of science-based solutions and user-friendly technologies. Collaboration between local governments and local academia, institutes and other partners should be promoted.

Priority 3 – Invest in DRR for Resilience

Expected outcomes 1. Scientific evidence supports investment on DRR for resilience and provides policy and decision-making options.

Priority actions

a). **Provide funding and resources to research community** to produce better scientific evidence and technologies for disaster risk reduction toward resilience. Incentives and cooperation with commercial sector is recommended. Following priority research areas are suggested: risk transfer, information and communication technologies, space technologies, seismic network, multi-hazards early warning systems, monitoring, forecast and prediction systems, building codes, climate adjusted structures, people-cantered initiatives, public education, and simulation educational methods.

b) **Promote disaster economy research** to provide robust evidence on risk-sensitive investments including cost-benefit analysis of disaster risk reduction measures. The results need to be widely disseminated among policy and decision-maker.

c) **Integrate disaster risk reduction in higher education studies.** Joint and interdisciplinary research and educational programs should be given high priority. Knowledge broker education and training programs are needed to help close the gap between disaster risk science and end-users.

d) **Establish research and development units** in national and provincial disaster management organizations to facilitate bridging science and policy and close the distance between research and practice.

e) **Promote inter-disciplinary science and technology cooperation** including all stakeholders (governmental organizations, public institutes, business sector, research and academia).

Priority 4 – Enhance disaster preparedness for effective response and to Build Back Better in Recovery, Rehabilitation and Reconstruction

Expected outcomes 1. Research supports policy and decision-making in preparedness, response, rehabilitation, recovery and reconstruction phases.

Priority actions

a) **Research into innovative solutions for priority areas** such as multi-hazards early warning systems, decision support systems, and response financial mechanisms, vulnerable groups, etc.

b) **Conduct and use research to develop and evaluate policies, protocols, guidelines and plans** on preparedness, national disaster scenarios, response operations, rehabilitation, recovery, and rehabilitation

c) **Support rapid research during and after disasters** through establishment of rapid grants.

5. IMPLEMENTATION FRAMEWORK

The current draft of STPDRR that is being developed under auspices of National Disaster Management Organizations, is planned to be submitted to "Coordination Council of Disaster Management" and "Higher Council of Disaster Management" for endorsement and decree to all national stakeholders. The plan has an all-hazard, risk-based, problem-solving approach. It is a strategic document and has a fifteen-year duration with a planned review to be carried out in the fifth year of implementation. The review will determine progress on implementation and facilitate course correction as needed to ensure relevance and flexibility in changing circumstances. Progress will be monitored on an annual basis and report back to "National Platform for Disaster Risk Reduction".

6. KEY CHALLENGES TO OVERCOME

Key challenges include coordination among stakeholders from different sectors and background. However, "National Platform for Disaster Risk Reduction" would facilitate this coordination.

MALAYSIA

1. BACKGROUND[1]

On 26 August 2015, the Malaysian Cabinet agreed to establish the National Disaster Management Agency (NADMA Malaysia) to be the new focal point for disaster management, as a successor to the Disaster Management Division, under the aegis of the National Security Council (MKN), Prime Minister's Department, to meet national needs and to overlook current disaster scenario and address future challenges (Malaysia, 2016a). Further to this, the Government through NADMA Malaysia is currently in the midst of strengthening the policy, regulatory, and institutional framework of DRM. Initially, the discussion tended towards the establishment of an act for disaster management. However, NADMA Malaysia is more inclined to focus on disaster risk reduction (DRR) instead of disaster management as it will complement all related acts in the country being implemented by the respective Ministries. In early 2016, a comprehensive Disaster Risk Reduction bill was drafted covering DRR from five aspects; prevention, mitigation, preparedness, response and recovery. Once gazetted, the bill is expected to address gaps in DRM, enhance resilience and ensure effective and faster response to affected areas. On 4 August 2016, the proposal for the establishment of a Scientific Expert Panel (SEP) for Disaster Risk Reduction was presented by NADMA Malaysia to the National Science Council, which was chaired by the Honourable Prime Minister of Malaysia. The proposal was approved and the Scientific Expert Panel, which will be co-chaired by the Science Advisor to the Prime Minister of Malaysia and the Director General of NADMA, has since been institutionalized to support NADMA Malaysia. The Panel will serve to harness science and technology for preventing disasters and complement the National Platform on Disaster Risk Reduction and Action Plan (MyDRR), which is now under the aegis of NADMA Malaysia.

The integration of DRR into the overall national development plan, particularly in the Eleventh Malaysian Plan (RMK-11), which is covering the period from 2016 to 2020, has earmarked a transition for the country, from disaster management towards disaster risk management. The emphasis is now on disaster risk management (DRM) by strengthening the preparedness, response as well as recovery from disasters in the country. With support from the technical agencies such as the Malaysian Meteorological Department, Drainage and Irrigation Department, Minerals and Geoscience Department, Public Works Department, and Town and Country Planning Department, Malaysia has geared to improve the quality of science and technology solutions especially for local level development projects in the future, as outlined by SFDRR (Malaysia, 2016b). A website is operational as the main platform to channel information to the public. The integrated one-stop centre for early warning and dissemination of information is channelled through e-Bencana Portal (http://portalbencana.ndcc.gov.my/portal), a website which is maintained and managed by the National Disaster Management Centre (NDCC), a department under the aegis of NADMA Malaysia. In 2010, Malaysia launched the National Policy on Climate Change (NPCC) to mainstream and provide a framework for the country's various activities in this area. The establishment of a National Green Technology and Climate

[1] Authors: Ir. Bibi Zarina Che Omar, National Disaster Management Agency, Prime Minister's Department, Malaysia; Mohd Khairul Zain Ismail, Universiti Kebangsaan Malaysia's Southeast Asia Disaster Prevention Research Initiative; Prof. Joy Jacqueline Pereira, Universiti Kebangsaan Malaysia's Southeast Asia Disaster Prevention Research Initiative.

Change Council (NGTCCC) in January 2010 has earmarked a history for the country towards integrating DRR and CCA into developmental programmes especially at local and national levels. The Council chaired by the Prime Minister of Malaysia, aims to provide support for the NPCC and National Adaptation Roadmap. Through these initiatives, there are potential instruments for converging DRR and CCA within the National Adaptation Roadmap and MyDRR, especially through institutional arrangements for both initiatives (Pereira, 2015).

2. CONTEXT OF THE PLAN

Previously, the Disaster Management Division based at the National Security Council of the Prime Minister's Department (MKN) was entrusted with the responsibility of ensuring the effectiveness of the disaster management mechanisms that have been put in place, as mandated by MKN Directive 20. In order to strengthen the collection of actions that are being undertaken in the country, the National Security Council formalised the National Platform and Action Plan on Disaster Risk Reduction (MyDRR) in 2013. This process involved expanding the array of stakeholders to include policy-makers and practitioners from government, universities, non-governmental organisations as well as representatives from the private sector, to take ownership of disaster risk reduction and maintain the continuum between prevention, mitigation, preparedness, response and recovery to support the country's aspiration for sustainable development. Since its establishment, NADMA Malaysia spearheads the National Platform to address disaster related issues.

3. PURPOSE AND KEY OBJECTIVES

Purpose

The main purpose of the Science Technology Plan is to expand the array of science and technology organisations and promote public-private partnership to take ownership in marshalling science and technology for SFDRR implementation.

Among the key objectives are as follow:

a. To identify and deliver science and technology in a holistic manner and explicitly across the disaster management cycle;

b. To coordinate mechanisms for national science and technology for effective scientific knowledge transfer;

c. To strengthen networking of all multi-stakeholder at sub-national level in implementing local level solutions.

4. SPECIFIC ACTIONS UNDER SFDRR PRIORITIES

Priority 1: Understanding Disaster Risk

1. Enhanced capacity of science at the local level particularly in detection, projection and provision of innovative solutions for slow onset and emerging hazards due to climate change

2. Organised a National Conference on Science and Technology for DRR in every year. The Conference will be organised by NADMA Malaysia and co-organised with Office of the Science Advisor of the Prime Minister and SEADPRI-UKM, as a stock-taking for the advancement of S&T in the country
3. Continuation of Series of National Workshop on SFDRR in every year, so that the sustainability of knowledge and update on SFDRR at the global level could be transmitted to all agencies and stakeholders

Priority 2: Strengthening Disaster Risk Governance to Manage Disaster Risk

4. Institutionalisation of the National Scientific Expert Panel for Disaster Risk Reduction to harness science and technology for preventing climate induced disasters and supporting NADMA Malaysia
5. Development of protocols for multi-hazard assessments, information sharing, risk communication, disaster databases development, stakeholder involvement and community engagement at the local level
6. Publication of National Risk Register as a tool for government in preparing for disaster response

Priority 3: Investing in DRR for Resilience

7. Establishment of a foundation to mobilise financial resources and technical assistance for targeted transmission of science and technology in disaster risk reduction via public-private participation

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

8. Sub-national satellite networks of science and technology organisations comprising several local authorities as well as other key stakeholders including the community that share context and area specific multi-disciplinary information, which are linked to the national level
9. Community disaster resilience plans anchored by the local authority with the support of key stakeholders that is contextualised, area specific, routinely updated based on projected climate impacts with hazard-specific preparedness and emergency response measures

5. IMPLEMENTATION FRAMEWORK

The proposed stakeholders to implement those actions as per listed below:

- *National Disaster Management Agency (NADMA Malaysia)*

The agency has taken a full responsibility of ensuring the effectiveness of the disaster management mechanisms in the country. The newly established Agency is now a national focal point for DRR in the country.

- *Office of the Science Advisor to the Prime Minister of Malaysia (OSA)*

Malaysia is one of the few countries that have an Office of the Science Advisor to the Prime Minister. The functions of the Office include advising the Prime Minister directly on prioritising the role of S&T for national development; Strengthening the

Investment for R&D; Reinforcing the human capital for S&T; Encouraging S&T based innovation in business; and Promoting Science Diplomacy.

- *Malaysian Industry-Government Group for High Technology (MIGHT)*

The Malaysian Industry-Government Group for High Technology (MIGHT) is an agency under the Prime Minister's Department of Malaysia, to support the Science Advisor to the Prime Minister and leverage on the multi-disciplinary and inter-ministerial synergies from both the industry and Government.

- *Central Bank of Malaysia (Bank Negara Malaysia)*

Central Bank of Malaysia or known as Bank Negara Malaysia (BNM) can play a greater role in ensuring the implementation of those actions is well in place. The BNM can play a greater role by providing a platform and bridging the linkages between government and insurances and re-insurance companies and association in Malaysia, especially in relation to DRR.

- *Southeast Asia Disaster Prevention Research Initiative (SEADPRI-UKM)*

Universiti Kebangsaan Malaysia's Southeast Asia Disaster Prevention Research Initiative (SEADPRI-UKM) has been in operation since June 2008. The Centre addresses crucial challenges on disaster risk reduction in Malaysia and the region.

- *MERCY Malaysia*

A world well-known NGO that is based in Malaysia aimed to provide a platform for Malaysians to unite and take their role in the international humanitarian arena, especially during post-disaster recovery processes.

6. KEY CHALLENGES TO OVERCOME

The following issues have been highlighted to advance science and technology for disaster risk reduction in Malaysia:

a. Identification and delivery of science and technology in a holistic manner and explicitly across the disaster management cycle targeting prevention, mitigation, preparedness, response and recovery, involving multiple technical departments and other stakeholders;

b. Institutionalisation of strong coordination mechanisms for national science and technology organisations with means to effectively transfer scientific knowledge to local authorities and collate local data that is relevant to all aspects of disaster management;

c. Expansion of the array of science and technology organisations to include policy-makers and practitioners from governments, universities, non-governmental organizations, as well as representatives from the private sector to take ownership in marshalling science and technology for disaster risk reduction;

d. Nurturing of networking among researchers, academics, government agencies and the private sector at the sub-national level in order to strengthen implementation of multi-stakeholder local level solutions;

e. Establishment of an entity that is dedicated to foster private participation to mobilise resources and transmit science and technology for disaster risk reduction on a sustainable basis;

f. Revision of various regulations, policies, guidelines, standards, procedures and early warning in view of climate extreme events;

g. Fostering a multi-hazards approach as well as context and area specific disaster risk reduction as the first step to climate change adaptation.

MYANMAR

1. BACKGROUND[1]

Myanmar is exposed to multiple natural hazards which include Cyclone, Storm surge, Floods, Landslide, Earthquake, Tsunami, Drought, Fire and Forest Fire. Its coastal regions are exposed to cyclones, storm surges and tsunamis while major parts of the country are at risk from earthquakes and fires. The rainfall-induced flooding is a recurring Phenomenon across the country while some parts of the country are exposed to landslide and drought risks. Myanmar is one of the most vulnerable countries in Asia due to the topographic and geographic situation. The country is exposed to a wide range of natural hazards, triggering different types of small scale to large-scale disasters across the country's territory. Myanmar is committed to various global and regional Frameworks and Declarations on Disaster Management and Disaster Risk Reduction along with 168 other countries, Myanmar has endorsed the Hyogo Framework for Action (HFA-2005 -2015), SFDRR (2015-2030), an active participant in the Asian Ministerial Conferences on DRR (AMCDRR), the ASEAN Committee on Disaster Management (ACDM). Myanmar have already signed in AADMER, Regulatory Framework for DRR-NAS (National Awareness Strategy), Standing Order (2009), DM Law (2013), DM Rules and regulations (2015). Myanmar Action Plan for Disaster Risk Reduction MAPDRR (2012) has already existed and currently the New Government of Myanmar has embarked upon formulation of the New MAPDRR with the overall objective of risk reduction and enhancing resilience. It is formulated through a 34-member government led Task Force named 'New MAPDRR Task Force'. The Task Force, headed by the Relief and Resettlement Department, will steer the overall process and report to the National Disaster Management Committee (NDMC) through the Ministry of Social Welfare, Relief and Resettlement as the Secretariat of NDMC.

2. CONTEXT OF THE PLAN

The key landmark in recent years was the Cyclone Nargis of 2008, which changed the disaster risk reduction landscape of the country. Myanmar Engineering Society, a key professional and technical body has been advising the government in different capacities to develop technical guidelines formation and human resource development. In recent days, the universities and research institutions have been increasingly taking interests in contributing to the disaster risk reduction field. The newly established Disaster Management Training Centre (DMTC) provides a unique opportunity of collaboration with science technology academia sector. Currently, the New Myanmar Action Plan on Disaster Risk Reduction with the overall objective is to seek technical inputs as well as engage wider range of stakeholders in drafting of the New MAPDRR, the Task Force has decided to constitute Technical Working Groups (TWGs) including lead and co-lead Government departments, Academic, Institution, INGO,NGO and other technical organizations composing four TWGs such as (1) Assessing disaster and extreme events risk in Myanmar, (2) Strengthening disaster risk governance to reduce and manage disaster risk, (3) Mainstreaming disaster risk reduction for resilience development in Myanmar and (4) Creating public awareness and Enhancing disaster preparedness for effective response and resilience rehabilitation and reconstruction in Myanmar. Besides, there is a newly formed National Spatial Data Infrastructure (NSDI) under the Ministry of Science and

[1] Author: Aung Myint, Myanmar Engineering Society

Technology, which develops science, based national level spatial planning. (e.g., drones to assess the conditions of landslides). MES is implementing science and technology activities cooperated with different stakeholders such as developing Seismic Zone Map of Myanmar and hazard maps with Myanmar Earthquake Committee and updating of the Myanmar National Building codes in cooperation with Ministry of Construction and UNHABITAT.

3. PURPOSE AND KEY OBJECTIVES

The objectives of the Science and Technology Plan in Myanmar are–

- To carry out research and development works for national economic and social development
- To utilize natural resources so as to develop the national economy, and raise the living standard of the people
- To distribute the results of research and development works in industrial and agricultural sectors to enhance the production
- To plan and carry out human resources development so as to get specialists and professionals in science and technology
- To analyse and test raw materials and finished products, to implement quality control and standardization of industrial products
- To coordinate research, development and use of atomic energy

4. SPECIFIC ACTIONS UNDER SFDRR PRIORITIES

The importance of science and technology is emerged in Myanmar where is exposed to a wide range of natural hazards, triggering different types of small scale to large-scale disasters across the country's territory. Under such circumstances, the collective consensus among academician in the Republic of Union of Myanmar (herein after "the country") are made during the High level meeting on integration of science and technology into research of disaster risk reduction (DRR) in Myanmar which was organized by SEEDS Asia in cooperation with MES under Myanmar Consortium for Capacity Development for Disaster Management (MCCDDM) Project on 7th October, 2016 at the Conference Room, Myanmar Engineering Society.

Priority 1: Understanding Disaster Risk

1. Enhance disaster loss and damage accounting, national and local disaster risk assessment and communication of disaster risk (through mobile application, ICT, hub portal and platform), with a specific focus on urban risks.
2. Use space and disaster risk mapping technologies and strengthen the capacity for using these technologies for improved understanding of disaster risks at global, national and local level.
3. Strengthen regional exchange on disaster risk information and science in order to better understand complex disaster risks including risks of trans boundary, cascading and compound disasters.

Priority 2: Disaster Risk Governance

4. Strengthen science-policy-practice nexus at all levels (national, local, trans boundary and regional) through: increased dialogue and networking among scientists, policy makers and practitioners through formulation of comprehensive human resources (HR) plan for science and technology application and training capacity building, better evidence to inform decision making and proactive involvement of the science and technology community in regional, national and local platforms for DRR. Support these platforms to be multi-stakeholder partnerships, particularly including the private sector, civil society, media and communities at-risk to deliver science-based solutions and technological user-friendly tools and methods to reduce disaster risk and strengthen resilience. Disaster Management Training Centre in Myanmar can take an important role to be a hub to collect good practices existed at local level to national level on science-based decision making for DRR in the country.
5. Develop inter-disciplinary national science and technology plans to support implementation of the Sendai actions by academia/universities to develop their own disaster risk management plans.
6. Enhance collaboration between local governments, academia and other partners to promote local communities knowledge and traditions and to sustain and replicate many good practices that exist locally for science-based decision making.

Priority 3: Invest in DRR for Resilience

7. Make DRR an area of focus within education including networking between universities. Jointly develop research and higher education programmes (including government officials and practitioners) that contribute to the building of resilient communities and societies. Promote knowledge broker education and training programmes to help close the gap between disaster risk science and people including through community networks such as faith-based organizations. Organized annual DRR conference on training-research-action, develop specific provision for research budget and conduct innovative sector-based research on important economic and social issues.
8. Ensure risk-sensitive investments. Enhance the role of the science and technology community in building public private partnerships for the purpose of reducing vulnerabilities of communities and ecosystems-at-risk, preventing risks and building resilience of critical infrastructure, essential services as well as emerging industries.
9. Develop young professionals in the field of multi-disciplinary disaster risk reduction. In particular, more women and girls should be engaged in DRR research and a gender marker should be a key element of many aspects of such enquiry.

Priority 4: Enhance disaster preparedness for effective response and to Build Back Better

10. Promote the role of inter-disciplinary science and technology in effective pre- disaster planning, preparedness, response, rehabilitation, recovery and reconstruction to build back better. Review effectiveness of existing guidelines and provide scientific and technical inputs and updating based on the past disaster experience. In post disaster recovery forum, engage science and technology community to provide expert inputs along with government, development practitioners, civil society and practitioners. Promote the combination of traditional knowledge and modern science. Enhance regional cooperation, particularly for preparedness, response and build back better in trans boundary disasters.
11. Develop an efficient and effective cooperation among the science community and business sector by utilizing the advancements of the fast developing information and communication technology (ICT) including big data.
12. Research into innovative solutions to promote the whole-of-society engagement; innovative financial mechanisms to maximize social capital for DRR (such as a disaster resilience fund to provide urgently needed resources to disaster affected communities for quick recovery), and to help the business sector shift towards sustainable and resilient development pathway.

5. IMPLEMENTATION FRAMEWORK

The following are the way forward of Science and Technology Plan in Myanmar which is based on the discussions and inputs of High Level Workshop participants (64 in total: 5 from government, 42 academics from 14 universities, 6 from technical institutes and 11 from civil society organizations) and Signatories by Director General of Alternative Education Department, Ministry of Education , Director General of Research and Innovation Department (Former Ministry of Science and Technology) and President of Myanmar Engineering Society. The participants agreed on the specific following actions:

1) It is recognized and emphasized the importance of both natural sciences and social sciences in reducing disaster risks in the country.

2) It is required to strengthen capacities of the science technology academia communities in terms of disaster risk reduction both at the national and local levels in the country.

3) It is required to enhance the networking both at regional, national and local level for better utilization of scientific innovations and higher education in the country.

4) It is required at the national level, science-policy-practice nexus is important. To enhance that, science and technology community needs to take part in the national platform proactively. National level science and technology plan needs to be developed, which should support the implementation of SFDRR in the country.

5) It is recommended at local level; a stronger collaboration of local governments and local resource institutes is envisaged. To enhance the process, Disaster Management Training Centre can take an important role to be a hub to collect good practices existing at the local level to National level on science-based decision making for DRR in the country.

6) It is recommended that the science technology community should develop multi-stakeholder partnership along with private sectors, civil society and media to deliver science based solutions and provide implementation based technological user friendly tools and methods.

7) It is required to nature the young professionals in the multi-disciplinary field of disaster risk reduction. Therefore, higher education is highly recommended and for that disaster risk reduction academic field needs a disciplinary evolution through networking of universities, Disaster Management Training Centre and strengthening as well as upgrading university curriculum.

8) It is recommended that the Republic of Union of Myanmar to consider disaster risk reduction as one of the prioritized area of research. Establishing Society for Promoting Science and Technology can be established which supports research initiatives, strengthening the network among academicians and linkage with communities.

9) It is recommended to hold annual meetings on science and technology in DRR between academicians and multi-stakeholders including government officials, other decision makers and DRR practitioners at DMTC.

10) It is recommended to establish an innovation fund for disaster risk reduction research, which will be managed through a multi-stakeholder partnership along with the concerned ministries.

11) Periodic collection of good practice repository on application of science and technology in DRR in Myanmar

6. KEY CHALLENGES TO OVERCOME

One of the key challenges of science and technology is to link people with open data. In several cases, different ministries have their own data set, and there are strong barriers of inter-ministerial or inter-departmental collaboration, which prohibits common data/ information to be shared with the people and communities. There needs to be a single central level research institution, which will conduct technical as well as policy research to support the government decision making. It needs a proper investment mechanism from the national government, both from the science and technology ministry as well as ministry related to disaster risk reduction. There needs to be greater focus on research-based higher education in the universities. Some universities can do research on national issues as well as local issues, especially focusing on local hazards. The universities in Myanmar are undergoing restriction for becoming semi-autonomous bodies. Although a full transition would take more time, it would provide better opportunities for the universities to undertake partnership with private sectors, external donor agencies for seeking research investments.

NEPAL

1. BACKGROUND[1]

Nepal is a least developed landlocked country with a population of over 28 million; GDP per capita is 762 US$ which is contributed about equally by agriculture, tourism and remittances. Nepal faces a multitude Natural hazards such as floods, debris flow, landslides, wild and settlement fire, hail storms, cold and heat waves, epidemics, etc. due to the extremes of topography, relief, rainfall and river flows along six large river basin some of which originate in Tibet and cross over the Himalayas cutting some of the deepest gorges in the world. The country has a long history of destructive earthquakes, the latest one being the Gorkha earthquake that took a toll of over 9,000 lives, cause injury to over 20 thousand people, destroyed more than 800,000 houses causing a total monitory loss equivalent to over 8 billion US Dollar.

Nepal started developing scientific understanding of natural hazards and risk only after the 1988 Udaypur earthquake and the 1993 floods in south-central Nepal. This effort received a big boost after the advent of the UN-declared and universally implemented IDNDR, HFA 2005-2015, and SFDRR. The country developed and enacted the National Strategy for Disaster Risk Management (NSDRM) in line with the stipulations of HFA 2005-2015, which is being updated to tune it in line with the SFDRR.

Nepal has been an active participant in the global initiatives on DRR, Climate Change Adaptation processes, Sustainable Development Goals (SDGs), the Paris Agreement since the inception of these global movements and campaigns. The Nepal Science and Technology Plan for Implementation of SFDRR (NSTPDRR) should be looked at in close link with these global efforts concept and Nepal's commitments.

2. CONTEXT OF THE PLAN

The proposed National Science and Technology Policy on DRR will have relevance, as well as conceptual and operational coherence with more than ten relevant legal Acts, including the following:

1. Natural Calamities (Relief) Act, 1982;
2. Local Self Governance Act, 1999;
3. Nepal Building Act, 2055 (1998):
4. Nepal Town Development Act, 2045 (1998)
5. Nepal Academy of Science and Technology Act, 1991

One of the key policies to provide oversight and guidance to the Science and Technology Plan will be the existing National Science policy 2005. With a vision of development and use of science and technology for enhancing living standards of Nepalese and with an overarching objective to enhance Science and Technology capacities for national development, the Policy has the following stated specific objectives:

- Planned development of science and technology and its mainstreaming into different development sectors including poverty reduction, environmental protection and preservation, etc.
- Promote national and international collaboration for bringing in and contextualization of S/T knowledge available globally

[1] Author: Amod Mani Dixit, NSET/ IRDR IoCE, Kathmandu, Nepal, with inputs from Nepal Reconstructive Authority (NRA)

- Human resources development
- Promote high quality S/T education from primary to tertiary education

Another instrument to influence the proposed Science and Technology Plan would be the National Building Code, 1994 and the Building Act in 1998. Although made mandatory for urban areas, enforcement of the building code has been slow over the years. After the Gorkha earthquake of 2015, Government of Nepal has made the national building code mandatory for all urban and rural areas of Nepal. The proposed science plan should help such bold and far-reaching decision of the government.

The proposed NSTPDRR has to be in relevance with the following main global and regional initiatives and conclusions:

1. SFDRR Recommendations
2. The Global Road Map of Science Technology in DRR, organized by ISDR in January 2016 stipulates 39 specific actions and 7 outcomes that every country should consider to incorporate into the national science and technology plan for the implementation of SFDRR.
3. The 1st Asia Science Technology conference held in Bangkok in 2016 advanced 12 specific actions under the four priority areas of SFDRR.

The national science and technology plan has to identify, through a consultative process, those actions that are crucial for Nepal, keeping naturally in mind the national science and technology policy and the NSDRM stipulations.

3. PURPOSE AND KEY OBJECTIVES

The purpose of Nepal DRR Science and Technology Plan (NSTPDRR) would be to develop a road map which would be compatible with the Nepal Governments' Policy on Science and Technology, for an effective implementation of the SFDRR in the best interest of Nepal by duly integrating the links among DRR, CCA, and SDGs and environmental protection ambitions of the country, by mobilizing all human, institutional and policy resources available in the country by articulating the roles and responsibilities of the different DRR stakeholders in the country.

Key objective of the Plan would be to provide overarching guidance and stimulus for the use of science and technology in achieving vulnerability and risk reduction against natural hazards and serve as a strong component of the overall science and technology Plan of Nepal to promoting overall national development.

The proposed plan should have the following as indicators for implementation:

- Extent of use of Science in decision-making
- Extent of budgetary Investment in science and technology
- Number of programs that evidences improved linkage of Science and Technologies in solving the problems felt by vulnerable people in Nepal.

4. SPECIFIC ACTIONS UNDER SFDRR PRIORITIES

Although the priority activities are yet to be defined by the planning process, the following six activities are apparent and proposed as priority actions:

SFDRR Priority 1. Understanding Disaster Risk:

a) Assess the current state of the knowledge on data and information on disaster risks, the needs and opportunity of DRR, and the corresponding expected outcomes of the SFDRR as applicable for Nepal, including the Strength, Weaknesses, Opportunities, and threats that define the present-day situation of the four major

stakeholders of DRR in Nepal – the national and local governments, the private sector businesses, the academia and the civil society organizations involved in DRR.

SFDRR Priority 2. Strengthening Disaster Risk Governance to Manage Disaster Risk:

a) Develop a comprehensive 15-years DRR road map for Nepal, both for disaster risk reduction and for disaster preparedness for likely residual risks. The Road Map should be compatible with Nepal's commitments to the international covenants on CCA, SDG, environmental preservation, use of natural resources, and also the economic development goals of Nepal. Hazard–specific programs for DRR and resilience enhancement for earthquake, landslide, cloud burst/floods and debris flow, and other forms of human-induced and natural hazards, covering both extensive risk hazards and intensive risk hazards, that are well coordinated with the economic development initiatives of the country and the people of Nepal,

b) Develop a system of organizational structure and implementation mechanism that would lead, motivate, distribute responsibilities, and coordinate the works of different stakeholders. The system should be able to monitor and evaluate the progress and update the plan, redefine the priorities and introduce any mid-course corrections, for achieving the DRR Road map, define the roles and responsibilities including a system of reward and punishments for all stakeholders engaged in aspects of DRR and DP.

c) Create modus operandi (standard operating procedures or SOP), legislations and policies, and integration mechanism with economic development priorities, policy and regulations, guidelines, ensuring that the knowledge, finances and governance collectively reached to the last miles,

SFDRR Priority 3. Investing in Disaster Risk Reduction for Resilience:

a) Develop capacities and knowledge management capabilities at central as well as local levels, especially at the last mile level so as to ensure that the policy decisions are based on scientific evidence and that the policy implementation is strongly assisted by the science and technology based standards, qualities, procedures.

SFDRR Priority 4. Enhancing Disaster Preparedness for Effective Response, and to Build Back Better in Recovery, Rehabilitation and Reconstruction

a)Ensure that people and the government are best prepared for the residual risk for identified hazards, and there is enough capacity at all levels in understanding, planning, implementing DRR and for BBB post disaster events, to contain the disaster impact to an acceptable level of risks.

5. IMPLEMENTATION FRAMEWORK

Planning

IRDR has asked NSET (ICoE/IRDR) to initiate, coordinate and facilitate the development of a draft of the Science and Technology Plan for Nepal. At the request of NSET, The Nepal Reconstruction Authority designated a senior representative to attend the 2nd Workshop to Strengthen Scientific Advisory Capacities for DRR, 16-17 January 2017, Taipei.

NSET proposes to develop a draft of the plan by the combined effort and wisdom of four group of experienced persons: 1) Central Level Government Agencies (such as the Ministry of Urban Development, Ministry of Local development, Department of

Architecture, Department of Mines and Geology, Department of Urban Development and Building Construction etc., 2) Local level government agencies such as the municipalities and the Village, 3) Representatives of the academic institutions ,engineering faculties of Nepal' s universities including private engineering colleges, 4) Private sector businesses institutions, and 5) professional societies and civil society organizations that are working in aspects of disaster risk reduction and disaster preparedness.

Identification of the Plan Activities and Plan Development

The plan development is proposed to take in the following steps to collect the planned activities:

1. A Kick-Off workshop will culminate the informal person-to-person contact the Coordinator will undertake with the potential plan contributors from the central and local government institutions, academic institutions, NGOs and professional societies and the interested private sector organizations such as the real state dealers and building contractors. Representatives will be selected in consultation with by recommendation from the agencies as well on individual standings.
2. A series of Thematic Consultative workshops will be organized to first stock-taking (through SWOT analysis) and collective identification of the plan activities for SFDRR implementation at household (family), municipal, provincial and at central government levels.
3. Writing the Draft Plan: NSET will write the draft Plan based on the outcome of the workshop and other researches.
4. An End Line Workshop will be organized with participation of all plan contributing organizations and related individuals for discussing the draft Plan. NSET will incorporate all the suggestions and critiques received fro the workshop to write the final plan, which will be submitted to the concerned Government Agency and IRDR for further action.

Time Line

We propose the following Time line:

1. Preparatory works, Fund raising, Literature Review etc. – Feb 2017 to April 2017
2. Kick Off Workshop – End of May 2017
3. Thematic Workshops – June-August 2017
4. End-line Workshop – September 2017
5. Submission of Final Draft – End September 2017.

6. KEY CHALLENGES TO OVERCOME

Main challenge is the lack of resources to conduct the planning process and the series of thematic as well as the Kick-off and End-line workshops.

Another challenge is to overcome the possibility of involvement of the government agencies because of their engagement with the forthcoming elections. The third challenge may be the disturbances in regular flow of activities and businesses because of potential political unrest.

PAKISTAN

1. BACKGROUND[1]

Pakistan has a long history of wide range of natural and human-induced disasters. The climate change has exacerbated the extreme weather events. Almost every year the impacts of disastrous events put extra pressure on the country meagre budget. In Pakistan, the science and technology is also contributing to disaster risk reduction (DRR). Nevertheless, the devastating 2005 earthquake was a turning point to restructure the disaster risk management system. In this regard, national disaster management authority (NDMA), a focal body was assigned a task to implement DRR policies, strategies and programs. The implementation on National Disaster Management Plan is in full swing. Globally, several countries have developed S&T policy and plan, which reflect the country vision in addressing S&T as key pillars in development planning, research, strategies formulations and DRR planning. Pakistan is one of the countries, who has developed Science, Technology and Innovation Policy (STIP) in 2012 with a vision of well-defined road-map and put the country on course for achieving excellence in all sectors of modern Science and Technology.

In follow-up of post HFA, in March 2015 the Sendai Framework for Disaster Risk Reduction (SFDRR; 2015-2030) was developed. The member countries agreed in the 3rd UN World conference on DRR to shift from managing disasters to managing risks. In Geneva, during January 2016, the UNISDR together with partner organizations including IRDR has organized Science and Technology Conference to prepare roadmap and discussed how to mainstream Science and Technology (S&T) in implementation of Sendai Framework, the S&T Roadmap was developed. The SFDRR has specifically highlighted the role of S&T in managing risks and insisted on mainstreaming science-based evidences and application of S&T in risk knowledge, techniques and models and obtaining science-based information from research institutions and expanding linkages between science and policy. It calls for support in all four priority areas: understanding disaster risk; disaster risk governance; investing in DRR for resilience; and enhancing disaster preparedness for response and to build back better.

2. CONTEXT OF THE PLAN

In Pakistan, the Ministry of Science and Technology (MoST) is planning for national science, technology and innovation plan. The aim is to coordinate and implement national science and technology policy; promote and coordinate research activities and utilize research findings. Administratively, the division is also responsible to look-after the National Science Council (NSC), Pakistan Council of Scientific and Industrial Research (PCSIR), the Pakistan Atomic Energy Commission (PAEC) and the Space and Upper Atmospheric Research Commission (SUPARCO). The STIP insisted to encourage the use of ozone friendly technologies, phase out the use of ozone depleting substances and use of renewable energy sources is in-line with the Paris agreement.

SFDRR also calls the scientific community for looking into the risk through science lens and to bridge the effective linkages between Science, Technology, decision-makers and practice. The application and mainstreaming of latest state-of-the-art S&T in managing risk and collective wisdom for various dimensions of multi-hazards, spatial extent of exposure and risk governance. The use of remotely sensed data, real-time digital data, evidence-based digital cum social data and the application of Geo-Information technology are some of glimpses of latest tools and techniques that need to be infused while managing risk. However, to make it cost-effective and more action oriented, centre of excellences need to be built at regional level to train and built capacities of young scientists.

[1] Author: Atta-ur Rahman, University of Peshawar, Pakistan, with inputs from NDMA, Pakistan

3. PURPOSE AND KEY OBJECTIVES

3.1 Purpose of Science Technology DRR Plan

The purpose is to formulate Science Technology Disaster Risk Reduction Plan for implementation of Sendai Framework as a central pillar of national planning, research and developmental strategy in reducing disaster risk.

3.2 Key Objectives of Science Technology DRR Plan

i. To enhance the use and application of science and technology in DRR.
ii. To bridge the Science-Technology, scientists, practitioners, civil society and community in reducing disaster risk.
iii. To encourage young professionals to undertake research on multi-hazards and integrated risk reduction strategies.
iv. To take into account all the global protocols, standards and in line with the country legal framework while formulating ST DRR Plan.
v. To enhance disaster resilience using science and technology and reduce disaster risks, vulnerabilities.
vi. To enhance ST based DRR capacities of institutions, human and material sources for mitigation, prevention, preparedness, response and recovery.

4. SPECIFIC ACTIONS UNDER SFDRR PRIORITIES

This section discusses the specific action under each SFDRR priority area and its reflections in the National Disaster Management Plan (NDMP; 2012-2022) and National Science, Technology and Innovations Policy (STIP).

Priority 1: Understanding Disaster Risk

1. In NDMA, a full-fledged section is responsible for maintaining and keeping record of all type of digital spatial databases, attribute data, satellite images and event-wise extent of damages to various sectors.
2. The application of space born data for multi-hazard risk assessment is gaining importance. In this regard, NDMA in consultation with SUPARCO and UNSPIDER is providing space born data to organizations and institutions working on DRR.
3. The NDMA has recently developed guidelines for conducting MHVRA studies. For each hazard, a detailed scientific models/methodologies have been suggested.
4. To avoid repetition in research study of same area, it is binding on organization/institutions to submit both soft and hard copy of the project to NDMA for record and sharing the same with other research organizations for reducing the cost and time of activity.

5. In the Higher Educational Institutions, plagiarism software is widely used by the scientific community for assessing the ethical issues and copyright. However, the uses of such plagiarism software is lacking in line agencies.
6. The STIP highlighted bridging partnerships between science and technology community and the disaster risk management institutions and agencies.
7. The application of S&T in DRR and strengthen real-time extreme weather events, rainfall, snowfall and establishment of real-time sensor-based gauging stations for enhancing the forecasting and early warning system in the country.
8. The NDMA is in process of preparing hazard based expert group to provide policy guidelines and help in decision making process.
9. The setting of indicators and standard to measure the progress in S&T is identified as one of the key policy action in STIP. The Pakistan Environmental Protection Act 1997 provides legal framework for standards /protocols to monitor the air, water and land pollution. NDMA has also developed standard guidelines for MHVRA.

Priority 2: Strengthening Disaster Risk Governance to Manage Disaster Risk

1. The use of space borne data, real-time digital data, evidence-based digital cum social data and the application of Geo-Information technology are some of glimpses of latest tools / techniques to be infused while managing risk. However, to make it cost-effective and more action oriented, centre of excellences need to be opened at regional level to train and built capacities of young scientists.
2. STIP Action 32a, establish close linkages between industries and R&D institutions/ universities and incentives for scientists working on industry-related projects.
3. NDMP Intervention-5, promote training, education and awareness in relation to disaster management. NDMP Intervention-6, Strengthen awareness program on disaster risk reduction at local level
4. STIP Action 17, Access to scientific, engineering and technical higher education to be increased by enhancing the existing facilities and establish new research centres

Priority 3: Investing in DRR for Resilience

1. The STIP stresses to effectively use remote sensing data in environment, agriculture, DRR, hydrology, meteorology and satellite-aided search and rescue operations. Similarly, monitoring climate change with space born data can help prevent losses due to natural disasters.
2. The crucial role of space technology in forecasting, dissemination of early warning, emergency response planning, evacuation route, identification of emergency shelter and disaster relief have also been elaborated in STIP.
3. The NDMP has also focused on strengthening and establishment of specialized high/Medium Range Forecasting Centres with Appurtenant Facilities has given high priority. Similarly, the establishment of New weather Doppler Radar Stations at critical location will be installed for forecasting extreme weather events and enhancing effectiveness of early warning system.

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

1. There is need to invest and develop systemic mechanisms for trained human resource for implementing the national policies and strategies. The major challenge being faced by Pakistan is the lack of science-based DRR experts and application of advanced S&T to devise a comprehensive system of preparedness, forecasting/prediction of extreme events, effective multi-hazard early warning system, state-of-the-art emergency response mechanism, monitoring, archiving data and dissemination of information.
2. In Pakistan, Flood Forecasting Division (FFD), undertake Weather & Flood Forecasts (WFF) through a Network of weather RADAR, Real-Time Telemetric system for Rainfall and Discharge, Weather Satellite coverage and WMO network. Doppler weather RADARs are required to effective cater the entire country and to furnish the most accurate and quantified weather and flood forecasting at the regional level.
3. Pakistan has yet to go a long way to develop its own tools and research methods for multi-risk assessments, state-of-the-art core competencies in DRR and cost benefit analysis. At the university level, so far very few universities have started graduation and research in DRR.

5. IMPLEMENTATION FRAMEWORK

The ministry of Science & Technology and the Climate Change Division are the key government line agencies to implement the Science Technology DRR Plan in implementing the Sendai Framework for Disaster Risk Reduction. In the climate Change division, the role and set-up of National Disaster Management Authority is of vital nature. This is the organization which are more dedicated to implement the Science Technology DRR plan at national, provincial and district level.

6. KEY CHALLENGES TO OVERCOME

The expected major challenges in implementing ST DRR plan includes:

i. Lack of financial capabilities in implementing science technology DRR plan
ii. Expansion and installation of additional met stations, Automatic Weather Observation System and automated gauging stations
iii. Installation of RADAR system to cope with Coastal Extreme Hydro-Meteorological Event and control centre for networking and early warning
iv. Little attention has been given to apply Science and Technology in DRR
v. Limited DRR experts and research scientists to apply S&T in DRR
vi. Establishment of a Seismic Intensity Reporting System for data compilation and dissemination
vii. Installation of Advanced Multi-hazard forecasting and early warning system
viii. Devise and enforce land use regulations and Building Codes and byelaws

PHILIPPINES

1. BACKGROUND[1]

The National Disaster Risk Reduction and Management Plan (NDRRMP) of the Philippines is a fulfilment of the requirements of Republic Act No. 10121, otherwise known as the Philippine DRRM Act of 2010. The NDRRMP covers four distinct thematic areas, namely, (1) Disaster Prevention and Mitigation, (2) Disaster Preparedness; (3) Disaster Response; and (4) Disaster Rehabilitation and Recovery. The NDRRMP is the implementation guide for the National Disaster Risk Reduction and Management Framework (NDRRMF) which aims for a "safer, adaptive and disaster resilient Filipino communities toward sustainable development" (NDRRMP, 2011). To achieve this goal, the four DRRM thematic areas must be addressed with particular focus on disaster prevention and mitigation and preparedness. The plan puts a premium on, "Competency and science-based capacity building activities alongside the nurturing of continuous learning through knowledge development and management of good DRRM practices on the ground" (NDRRMP,2011).

2. CONTEXT OF THE PLAN

The NDRMMP mandates the preparation of national plans for each thematic area. The Department of Science and Technology (DOST) has assumed this operational mandate as the institution coordinating disaster prevention and mitigation amongst national line agencies. As of the moment, there is no National Disaster Prevention and Mitigation Plan yet. However, the science and technology agenda for DRR is reflected in the recently released DOST documents: the DOST Plan 2017-2022 and the Harmonized National Research and Development Agenda (HNDRA) of 2017-2022.

3. PURPOSE AND KEY OBJECTIVES

The overall goal or purpose of Disaster Prevention and Mitigation under the NDRRMP is to avoid hazards and mitigate their impacts by reducing vulnerabilities and exposure and enhancing capacities of communities to reduce their own risks and cope with the impacts of all hazards. DOST, as the coordinating agency for the thematic area, aimed for science-based information on weather, climate change and geological hazards to ensure the country's survival and future in an era of extreme and rapidly changing climate.

4. SPECIFIC ACTIONS UNDER SFDRR PRIORITIES

Based on the internal documents of the DOST and related agencies, its contribution to the SFDRR goals and targets have been incorporated into the DOST Plan for 2017-2022 (DOST,2016) and into Sections I, II and V of the Harmonized National Research and Development Agenda prepared in 2016 (HNDRA, 2016). Using DOST's plans of action, the researchers used the SFDRR Science and Technology Roadmap to classify the elements of the plan. It is important to note that the DOST initiated a similar planning process in 2016. These do not have specific budget alignments for SFDRR compliance.

[1] Authors: Antonia Yulo Loyzaga and Jessica Dator Bercilla, Manila Observatory; JoeMar S. Perez, NDRRMC-OCD; Carlos Primo David, DOST-PCIEERD; Philippines.

Priority 1: Understanding Disaster Risk

1.1. Assess and update the current state of data, scientific and local and indigenous knowledge and technical expertise availability on disaster risks reduction and fill the gaps with new knowledge.

- Flood models of major river basins in the country and the mapping of storm-surge vulnerable areas have been pursued.

1.2. Synthesize, produce and disseminate scientific evidence in a timely and accessible manner that responds to the knowledge needs of policy-makers and practitioners.

- (1) Automated weather stations and automated rain gauges and establish a Monitoring and Troubleshooting Team (MaTT) (2) Scientific Earth Observation Micro-Satellite (DIWATA program),

1.3. Ensure that scientific data and information support are used in monitoring and reviewing progress towards disaster risk reduction and resilience building.

- (1) Project HYDROMET (Emergency Distribution of hydrometeorological devices in hart-hit areas in the Philippines) in 18 major river basins; (2) Enhancing Philippine Landslide Hazard Maps with LiDAR and High Resolution Imageries for 36 priority provinces; (3) Disaster Management using Web GIS initiative; (4) Weather Information-integration for System Enhancement (NOAH-WISE)

1.4. Build capacity to ensure that all sectors and countries have access to, understand and can use scientific information for better informed decision-making

- (1) Monitoring of susceptible areas and data on landslide hazard are made available online; (2) A Flood Information Network (FloodNet); (3) Development and Deployment of EWS for Deep-Seated Catastrophic Landslides; (4) A strategic communication intervention for the NOAH Program; (5) ROGER (Robust and Rapidly Deployable GSM based stations and backhaul for Emergency response); (6) Technical Advisory Services for Geologic and Geophysical Phenomena; (7) Development of Real-time Physico-chemical Monitoring Network; (8) Ground Deformation Monitoring

Priority 2: Strengthening Disaster Risk Governance to Manage Disaster Risk

2.1 Support a stronger involvement and use of science to inform policy and decision-making within and across all sectors at all levels

- (1) Technical Advisory Services for Geologic and Geophysical Phenomena; (2) Fault Finder App; (3) Deployment of Early Warning Systems in Disaster-Prone Areas; (4) Promotion of Culture of Science (5) Science and Technology Education for Ordinary Citizens (6) S&T Regional Alliance of Universities for Inclusive National Development (STRAND); (7) Providing municipal level risk assessment and incident reporting and visualization; (8) (Psychosocial) adaptation capacity of communities

Priority 3: Investing in DRR for Resilience

3.1. Provide scientific evidence to enable decision-making of policy options for investment and development planning

- (1)Development of Spatial Models for Comprehensive Land Use Planning; (2) Turnover of Flood/Hazard/Resource Vulnerability Maps to LGUs (3) use of advanced and emerging technologies; (4) Intervention models to reduce prevalence of infectious diseases; (5) Research on Climate change related disease, impact of climate change on health, emerging diseases related to climate change; (6) Industries enabled by state-of the-art R&D facilities, technologies and science-based policies, moving up the value chain and attracting foreign direct investments

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

4.1. Identify and respond to the needs of policy- and decision-makers at all level for scientific data and information to strengthen preparedness and to "Build Back Better in Recovery, Rehabilitation and Reconstruction to reduce losses and impact on the most vulnerable communities

- (1) Establishing and upgrading disaster risk reduction facilities; (2) Improvement of Weather Prediction and Information for Disaster Prevention (3) Volcano, Earthquake and Tsunami Disaster Preparedness and Risk Reduction; (4) Providing hazards analyses through the National Disaster Risk Reduction and Management Council (NDRRMC) partner-agencies of the Department of Science and Technology (DOST); (5) Establishing and maintaining exposure datasets from the Philippine Statistics Authority and the DSWD Listahanan; (6) Develop and enhance predictive analytics and maps for situational awareness and visualization. (7) Enhancing Cytogenetic Biological Dosimetry Capabilities of the Philippines for Nuclear Incident Preparedness Establishment of Real-time Environmental Radiation Monitoring System; (8) ReliefOps. Ph – a multi-stage and multi-user decision support system for disaster preparedness and response; (9) Virtual OpCen where users can view and download information; (10) Develop post-disaster solutions to access health care services, e.g., maternal, new-born and child health, sexual and reproductive health, food security, nutrition, housing, education; (11) Emergency food development.

5. IMPLEMENTATION FRAMEWORK

In the absence of a National Disaster Prevention and Mitigation Plan, these plans are now incorporated in the DOST Plan for 2017-2022 and the Harmonized National Research and Development Agenda. Implementation is primarily led by the institutions under the DOST and also participated in by line agencies with specific science and technology objectives that contribute to the DRR goals of the country.

6. KEY CHALLENGES TO OVERCOME

The possible challenges facing the development of a science and technology plan for the implementation of SFDRR are as follows:

1) Political - The Science and Technology Plan for the implementation of SFDRR will need a champion. There is a need for an influential leadership to embrace a science-based development lens for DRR and balance the needs of different communities.

2) Organizational - Bureaucratic and administrative challenges to the implementation of SFDRR are constrained by rigid bureaucratic and administrative regulations. A review of existing government policies and protocols to enable more inclusive, feasible and facilitative programs and activities and new laws and protocols to support inter-departmental/agency consultation and collaboration are needed. In some cases, budgets may have to be re-aligned.

3) Science and Technology-related - The availability and access to quality data and analytical tools in the appropriate resolution and scale is critical to the mainstreaming of both the physical and social science of risk in different contexts, levels of decision-making, and, across sectors.

4) Financial – Funding sources for trans-disciplinary research would need to be identified.

5) Institutional - Platforms for knowledge generation and mobilization from academia to policy and practice communities need to be designed to meet local conditions.

6) Transactional - Different models for strategic and operational partnerships between academia, government, the private sector, CSOs and communities will need to be explored for different regions in the country

7) Conceptual - Identifying, preparing for and preventing Non Economic loss and damage and risk generated from linkage between identities- cultures-ecosystems, including psycho-social impacts.

8) Risk communication - Popular media reporting on preparedness and prevention in terms of hazard, exposure, vulnerability and risk in terms of sustainable development needs to be enhanced.

The DOST's formulation of the National Prevention and Mitigation Plan in collaboration with the thematic area leaders, the private sector, CSOs and communities themselves provides timely opportunity to initiate the development of the science and technology plan for the implementation of SFDRR. It could, essentially build on the DOST Plan for 2017-2022 as presented by the Secretary of Science and Technology, himself in October 2016. In this plan, the DOST outlines its contributions to the national socio-economic agenda and links its targets on disaster risk reduction to specific outcomes, such as: promoting science and technology, increasing competitiveness and promoting value chain development (De La Peña, 2016).:

i. Lack of financial capabilities in implementing science technology DRR plan

ii. Expansion and installation of additional met stations, Automatic Weather Observation System and automated gauging stations

iii. Installation of RADAR system to cope with Coastal Extreme Hydro-Meteorological Event and control centre for networking and early warning

iv. Little attention has been given to apply Science and Technology in DRR

v. Limited DRR experts and research scientists to apply S&T in DRR

vi. Establishment of a Seismic Intensity Reporting System for data compilation and dissemination

vii. Installation of Advanced Multi-hazard forecasting and early warning system

viii. Devise and enforce land use regulations and Building Codes and byelaws

SRI LANKA

1. BACKGROUND[1]

Since the largest disaster event in the recent history, Tsunami hit in 2004, Sri Lanka's emphasis on Disaster Risk Reeducation has undergone a tremendous transformation. Since then, different aspects to strengthen DRR activities have been introduced and implemented.

Ministry of Disaster Management and the Disaster Management Centre (DMC) were established. This was followed by the formation of the institutional framework to address integrated Disaster Management. Other initiatives towards a disaster resilient country were taken that included Towards a Safer Sri Lanka, A Road Map for DRM.

Build upon on local experience, learning from global scenarios as well as recommendations of UNDAC Assessment 2014, the "Sri Lanka Comprehensive Disaster Management Programme (SLCDMP), 2014 – 2018" was introduced. The main goal of this is to enhance safety of Sri Lanka by reducing the direct and associated potential risk of the country and minimising the impacts on different economic, environmental political aspects. It also emphasizes on facilitating an enabling environment for multi hazard, participatory and partnership oriented DM programmes. These process are planned to use risk knowledge as the base, in line with international conventions and frameworks.

Implementation of interventions outlined in the "Road Map Towards a Safer Sri Lanka" during the period of 2005-2013 has improved in the disaster management capacity in relation to preparedness, response and awareness in the island and development of the legal and institutional structures, together with the fostering of an enabling environment for risk reduction. Although all of these initiatives are composed of science and technological elements, its real involvement in this mission needs much further development. This paper provides some basic ideas on how to incorporate Science and Technology (S&T) into better DRR practices.

2. CONTEXT OF THE PLAN

A new S&T plan will guide national policy for the next few years to come. This plan for DM emphasizes the need for the country to apply new and effective methods in science and technology to cope with various impacts of increasingly evident natural disasters. Some key issues that has to be addressed include socioeconomic, political as well as environmental problems. The current plan calls for greater cooperation among the government, the corporate sector, community and the academia in the field of enhanced flavour of science.

3. PURPOSE AND KEY OBJECTIVES

Among the key objectives the following could be noted:

a. To enhance and facilitate the use of innovations and effective tools in science and technology in DRR activities in an integrated manner

b. To identify area and event specific disaster sectors where a greater emphasis should be placed with science and technology

[1] Authors: Deepthi Wickramasinghe, Professor, Department of Zoology and Environment Sciences, University of Colombo; GLS Senadeera, Director General, Disaster Management Centre, Sri Lanka

c. To develop a mechanism to get the involvement of both local and international experts to obtain necessary assistance and advise

d. To initiate and further develop the research needs to address DRR related issues

e. To establish an efficient network of information sharing in decision making

4. SPECIFIC ACTIONS UNDER SFDRR PRIORITIES

The DMC operates under several different sections. Mitigation, Research and Development, Preparedness and planning, Emergency operation and Education and public awareness. Under these sections, different ongoing activities which need further expansion and new proposed actions are summarized here.

Priority 1: Understanding Disaster Risk

Potential exists to promote universities and research institutions to conduct research and development and targeted studies to strengthen DRR and CCA. In the past DMC has supported universities to conduct studies on wind effect on buildings and development of seismic zonation maps and guidelines, as well as to develop hazard profiles in Sri Lanka. Research institutions have been supported to develop crop varieties and management practices to meet challenges of drought and floods. Only a limited number of policy related research has been carried out so far.
Identification of priority research needs in DRR and CCA at sectoral and spatial levels to deliver better results.

Actions suggested:

- Supporting a platform for technical experts to develop research concepts, methods and proposals in line with identified priorities.
- Establish a data and information exchange mechanism to support research.
- Develop a mechanism to financially support proposed research and, a monitoring and knowledge management system to promote findings.
- Adopt UN solution exchange concept to improve dialog between researchers, users of research findings and technology developers.

Priority 2: Strengthening Disaster Risk Governance to Manage Disaster Risk

When National Physical Plan and the Policy – 2030 (NPP&P) was developed it was not possible to incorporate disaster risk management concerns primarily due to the non-availability of necessary data. Yet, the government on principle agrees to pay special attention to better governance of DRR and policy.

Actions suggested:

- Appoint a technical group to review the National Physical Plan taking into consideration the Sri Lanka Hazard Profiles, Strategic Environment Assessment recommendations, Census – 2011 information, Intergovernmental Panel on Climate Change (IPCC) led climate change related knowledge.

- Inter-agency consultations on the study findings and recommendation of technical group for revision of NPP&P.
- Revise the NPP&P based on the study recommendation and consultations.
- Development of environmentally friendly, low cost technology resilient to natural hazards and provide assistance to encourage research related to this field
- Hazard prone areas should not be selected for housing projects. Make it compulsory to obtain a certificate from National Building Research

Priority 3: Investing in DRR for Resilience

It is well accepted that investments in DRR activities with strong support of science and technology should be initiated, strengthened and promoted.

Actions suggested:

- Incorporate disaster risk reduction components in to guidelines and training modules in construction industry and curricula of universities as well as technical college.
- In order to encourage the use of affordable, hazard resistant technology and environmentally friendly construction methods, technical officers at national level should be trained.
- Tax concessions and financial incentives should be introduced to encourage the use of such technology.
- Capacity building in downscaling of global climate model outputs, identification of reliable downscale procedures (statistical, dynamical) with the establishment of an advanced computer laboratory
- Develop a system to cover gaps in disseminating EW messages for floods (riverine, dam related, urban and coastal), landslides, tsunami and cyclones
- Procure and install infrastructure required to fill the gap in EW dissemination system

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

The DMC and related agencies will work on a number of key technical areas linking the development efforts to potential disasters preparedness and response plans.

Actions suggested:

- Promote science based decision making in response and recovery.
- Strengthening preparedness activities with advanced early warning systems and effective ways of disseminating warning messages.
- Carrying out needs assessments to guide post disaster recovery and cost benefit analysis of DRR investment at national and district levels.
- Enhanced recovery capacities with proper and adequate touch of science and technology needs assessments to guide post disaster recovery and cost benefit analysis of DRR.

5. IMPLEMENTATION FRAMEWORK

Several actions were identified under each strategic component to address the key issues.

This integrated programme uses a partnership strategy where a number of Ministries, Departments, Non-Government Organizations and Private Sector will be responsible for the implementation of the activities as articulated in the next chapters of this plan under the four outcome areas presented therein. In addition, to support the programme's formal coordination system led by the Ministry of Disaster Management, a set of capacity development initiatives to strengthen the agencies in implementing the activities and a rigorous monitoring and evaluation system for the programme is proposed to be established.

6. KEY CHALLENGES TO OVERCOME

With the overall goal of inculcating science and technology in different aspects in disaster risk reduction, the Ministry as the sole authority, will have to secure more fund allocations for activities. One recurring challenge when multi stakeholders are involved is the decline in enthusiasm of parties over the time as well as barriers in proper coordination and sharing of information. The difficulty of driving significant change in an organization rooted in autonomy and individual behaviour is another hindrance to overcome. In some cases, the communities resist to change which again is a major issue in implementing DRR initiatives.

THAILAND

1. BACKGROUND[1]

Following a significant increase in per capita income over the past few decades. Thailand is now experiencing a decline in growth as well as productivity. The country is at risk of falling into the "middle – income trap" as it faces increasing difficulty in competing against Rower cost locations in less skill intensive economic activities while still lacking of technological know-how and human capabilities of moving into more sophisticated, higher value-added activities. Other major concerns for Thailand relate to social inclusiveness and environmental sustainability.

2. CONTEXT OF THE PLAN

The critically of science and technology in pursuit of implementing Hyogo Framework for Action has been recognized in the note "support the development and sustainability of the infrastructure and scientific, technological, technical and institutional capacities needed to research, observe, analyse, map and where possible forecast natural and related hazards vulnerabilities and disaster impacts. The science and technology applications are very important in all stages of disaster risk reduction from mapping the hazards and assessing vulnerability, through monitoring and forecasting, through dissemination of a warning in an understandable way to relevant decision makers and the public including the appropriate action plans and early warning system. Integration of science and technology in disaster risk reduction has received high priority at all levels.

The agenda of science and technology in Thailand has been initiated and implemented by the government agencies. The application of science and technology in the context of disaster risk reduction (DRR) have been set up for the systematically monitor and provide observational networks to ensure the available real time/near real time data/information on various aspects of natural disasters.

Further innovation in monitoring such as automatic weather stations, broadband seismic networking and multi – parameter satellites and computer – based prediction modelling. In most of the countries, there is gap between the development of effective local capacities to receive and use real time / near real time data / information and early warning system to prevent and protect the disaster. At national level, it is necessary to set up the appropriate mechanisms and at the regional level it requires the willingness and ability to cooperate.

The key challenge emerge are as follows

- Effective integration, of S/T for Disaster Risk Reduction (DRR) and Management with the marginal institutional base and investment.

- Establishment of mechanisms for regional cooperation to integrate S/T for DRR in different area of cooperation such as sharing of information regional network through research network.

- Strengthening capacity building and exchange information and experiences by networking national regional and international S/T networks.

[1] Author: Monthip Sriratana, Climate Change Research Strategy Center, National Research Council of Thailand (NRCT)

- Conducting research and development program to understand the precursors of disasters for more effective application on early warning systems such as remote sensing, disaster mitigation technologies.

- Multi – disciplinary S/T knowledge to develop multi – hazard approaches.

- Promoting science disaster risk reduction for community action

- Education curriculum towards awareness raising.

3. PURPOSE AND KEY OBJECTIVES

This report aimed to discuss the critical role of science and technology in disaster risk reduction and the commitment of the scientific and technical community to support the implementation of the Sendai Framework for Disaster Risk Reduction 2015 – 2030 in Thailand.

The objectives are to:

- Highlight particular science and technology for public policy to implement science and technology in disaster risk reduction.

- Context of the disaster risk reduction plan.

- Implementation framework and key role of institution to implement the plan.

- Identify the scope of international collaboration.

- Key challenges to overcome.

4. SPECIFIC ACTIONS UNDER SFDRR PRIORITIES

Strategic goals on the implementation of the Hyogo Framework for Action (2009 – 2011) of Thailand

Strategic 1: The more effective integration of disaster risk considerations into sustainable development policies, planning and programming at all levels, with a special emphasis on disaster prevention, mitigation, preparedness and vulnerability reduction.

Goal: Disaster risk reduction is being adopted and integrated into national development plans. The DRR is being incorporated in the strategy of managing natural resources and environment towards sustainability under the National Economic and Social Development Plan. The plan provides guideline for natural disaster preparedness, including hazard mapping at national, regional and provincial level and prioritization of identified hazards, in order to develop proper preventive and mitigation structural and non-structural measures with emphasis on social and economic aspects.

Strategic 2: Development and strengthening of institutions, mechanisms and capacities at all levels, in particular at the community level, that can systematically contribute to building resilience to hazards.

Goal: Existing mechanisms stated in the national disaster prevention and mitigation plan are adopted and executed in a more integrated and holistic fashion in order to create and strengthen disaster warning and assessment networks as well as to encourage people's participation in disaster reduction activities at all levels.

Strategic 3: The systematic incorporation of risk reduction approaches into the design and implementation of emergency preparedness, response and recovery programmes in the reconstruction of affected communities.

Goal: National risk reduction and risk management frameworks are translated into action at provincial level and local level through a series of planning training and a periodical plan monitoring and evaluations.

5. IMPLEMENTATION FRAMEWORK

Institutions, networks and partnerships

The Thai Government has provided information technology knowledge to support risk reduction for instance Ministry of Science and Technology has signed MOU with Ministry of Interior to reduce thee impacts of disaster such as early warning systems to the public.

Key role of institution to implement the plan and network of key institution.

1) Human Security and social equity approaches integrated into disaster risk reduction and recovery activities.

The application is implemented by all key stakeholders. The minority groups have been included into this plan. Provincial Disaster Management Plan is also taken vulnerable group into account and mentioned in the community level plan.

2) Engagement and partnerships with non-governmental organizations, civil society, private sector.

Partnership with NGOS such as private companies, civil society, volunteers and private sectors to promote disaster risk reduction approach.

Presently, Hyogo Framework for Action, Thailand is adopted the campaign "One Million safe school and Hospital" with collaboration among UNISDR, Ministry of Interior, Ministry of Health and Ministry of Education has provided curriculum for disaster management such as flash flood, Flood and Tsunami.

Some companies such as Honda have signed MOU with the Provincial Administrative Association to disseminate "Drive safety training course" throughout the country.

6. KEY CHALLENGES TO OVERCOME

1. Strengthen cross – sectoral coordination in Science Technology Plan

The importance of multi – sectoral and multi – stakeholder DRR platforms, supported by legal framework, written guidelines and appropriate institutional arrangements. Identification of hazards and risks is critical. It is essential to identify clear roles and responsibilities as well as research organizations to work together during and after disasters. Regular capacity building of human resources in the field of research related to disaster risk reduction through training is important for developing and maintaining competencies for effective integration of research work. Therefore, assessment of the needs of disaster risk reduction is important to develop share goals. National planning and mechanisms for achieving the goals of Sendai Framework are instrumental in this regards.

2. Lesson learned and areas for strengthening research under Science Technology Plan

Experiences from partnerships show that these are more partnership at national than regional level. More partnerships among research institutions are needed which require all sectors to work more closely with the disaster risk management field. Improving evidence through research and enhancing cooperation across similar hazards are important are as require greater attention and investment.

3. Strengthening transboundary collaboration and information sharing for all hazards.

Successful collaboration mechanisms at different levels as well as among research institutions as well as international organizations led to effective exchange of information and the integration of work under Science and Technology Plan.

1) Emphasize the role of multi – sectoral and multi – stakeholder DRR platforms on science and technology among all sectors and disaster risk managements as well as climate change community (Paris Agreement) and Sustainable Development Goals (SDGs)

2) The Sendai Framework makes it clear that progress cannot be made if the work is keeping in the own systems and siloes. Human resources need to be strengthened and capacities built to work across scientific sectors at the national and sub – national levels.

3) Strengthen partnership with the private sector, including on research and development on prevention, recovery and reconstruction, especially at sub – national levels, as well as cross – sectoral and cross – border collaboration.

Contact Us:

Intergrated Research on Disaster Risk (IRDR)
Email: connect@irdrinternational.org
Website: http://www.irdrinternational.org