ASIA
Science Technology Status For Disaster Risk Reduction

2016

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Integrated Research on Disaster Risk

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Integrated Research on Disaster Risk (IRDR)
Future Earth Integrated Risk Governance (IRG)
Asia Science Technology Academia Advisory Group (ASTAAG)

About this Publication

This publication is developed by a group of individuals from the Asia Science Technology Academia Advisory Group (ASTAAG) with support from researchers, scientists from different countries. A call for submission was made for case studies on application of science and technology for disaster risk reduction. A total of 28 case studies on13 countries and 4 cross cutting cases were submitted. The publication is supported by Integrated Research on Disaster Risk (IRDR) International Programme Office (IPO) and Future Earth Research project on Integrated Risk Governance. This publication is not the official voice of any country or any United Nations organization. The analysis presented in this publication is of the author (s) mentioned for each country.

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PREFACE

Disasters are increasing, and Asia bears the maximum impacts of the disasters, in terms of number of people affected, as well as human and economic losses. Science and Technology for disaster risk reduction has always been there in some form in different countries. Through the advancement of scientific research, disaster risk reduction has been benefitted, especially in terms of early warning system, to identify risk in both spatial and temporal scale, strengthening of buildings and infrastructures for different types of hazards etc. There have also been significant achievements in recognizing higher education in disaster risk reduction, either as a specialized subject and/or integration of the disaster studies into other higher education curriculum. In recent years, apart from hard science, which is more on innovations and engineering, soft science or social sciences have also got prominence and importance. Through different major disasters, it has been realized that there needs to be a good balance between the hard and soft technology, and engineering solutions and social solutions.

This publication has two parts: Country Status Report and Case studies. To understand the science and technology advancement in disaster risk reduction, the Asia Science Technology Academia Advisory Group (ASTAAG) has undertaken a survey in 11 countries in Asia. The survey was conducted by the ASTAAG members as well as fellow scientists and researchers. A qualitative judgment of the current status of the country was made under 21 different indicators, which are characterized into 3 broader categories: 1) science technology into decision making, 2) investment in science and technology, and 3) science link to people. A scale of 1 to 5 was used, 1 being lowest, and 5 being the highest. This is purely a qualitative judgment, which was discussed among different groups of scientists, researchers, practitioners and government officials. This is followed by the description of role of science and technology in the respective category. Then, relative importance and emphasis of science and technology in Sendai Framework for Disaster Risk Reduction (SFDRR) is mentioned, followed by short and long term actions required to enhance the advancement of the related field. Finally, the status report ends with the note on higher education system in respective country.

The second part of the report includes 28 case studies and good practices on applying science and technology in different field of disaster risk reduction as follow:

Country cases (24): Bhutan (1), China (1), India (4), Indonesia (2), Iran (3), Japan (4), Mongolia (2), Myanmar (1), Malaysia (2), Nepal (1), Pakistan (1), Philippines (1) and Thailand (1)

Cross cutting issues (4): Cross boundary flood, Digital radio, Resilient housing and schools and River basin ecosystem

The hazards covered under the case studies are:

GLOF (Glacier Lake Outburst Flood), earthquake, drought, flood, landslide, salinity, tsunami, dzud and typhoon

Following sectors were covered in the case studies:

Disaster risk reduction, early warning system, building, climate change, health, education, agriculture, water, communication

The case studies were submitted by:

Government, UN and wider range of stakeholders (Regional organization, Civil Society, Academics, Private Sector, Media)

The status report and case studies illustrate that there exists a good partnership of science technology group and different other stakeholders. However, it is required to strengthen this partnership with a clearer direction and strategy for implementation as a mechanism to 'foster collaboration across global and regional mechanisms and institutions for the implementation and coherence of instruments and tools relevant to disaster risk reduction" around common goals and actions identified in the Sendai Framework for Disaster Risk Reduction (SFDRR) and the road map.

Advancement in science and technology is a non-ending process. And, this cannot be achieved by scientists only. This publication is a modest attempt to document the contribution of science and technology in disaster risk reduction in Asia. This is the collective effort of many different professionals and practitioners from different parts of Asia. We are thankful to all ASTAAG members for their active roles in the publication. We also thankfully acknowledge to all, who submitted case studies. We are thankful to UN ISDR Asia Pacific Regional office in Bangkok for their constant encouragements. A special thank goes to ASTAAG Secretariat, IRDR IPO and Future Earth IRG project for their support to the publication.

We hope that this document would be a good reference material to understand the achievements, gaps and challenges of role of science and technology in disaster risk reduction in Asia.

Rajib Shaw, Takako Izumi and Peijung Shi

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About ASTAAG

The increasing importance and role of science-based decision-making was strongly emphasized in the Sendai Framework for Disaster Risk Reduction (SFDRR). In response to that, the UNISDR Asia Pacific Office has formed the Asia Science Technology and Academia Advisory Group (ASTAAG) in May 2015. Academia, science, and technological communities have a responsibility to be an active partner for providing solutions to problems based on their research findings, to introduce new technology and innovations as well as to improve the dialogue and cooperation with other relevant stakeholders and policy makers.

Key Focuses

1. Strengthen capacities of the Science, Technology and Academic community in disaster science
2. Support governments in science based decision making to implement SFDRR
3. Enhance networking among academic community and other stakeholders

Major activities

Periodic assessment of status and science and technology for DRR in the region
Provide specific advices to national and local governments on science based decision making
Assisting governments in reviewing the progress of the SFDRR implementation
Recognition of networks of universities/center of excellences and engage them in sharing knowledge and experience

Members

ASTAAG comprises selected disaster experts from Asian countries: Bangladesh, China, India, Indonesia, Iran, Japan, Malaysia and Philippines. The Group provides policy advisory services to governments and other stakeholders on appropriate technology and its application in decision-making. Advisory services include: Risk governance, Community-based Disaster Risk Management, Urban risk management, Earthquake risk mitigation, Private sector involvement, Climate change adaptation, Disaster and environmental education and Disaster resistant building design. The group also provides advices on higher education curriculum development in disaster risk reduction. The ASTAAG secretariat is hosted in Beijing Normal University (BNU), China, and is headed by Saini Yang. Current ASTAAG members are as follow:

- Bangladesh: Jamiur Reza Chaudhury
- China: Peijung Shi (Chair) and Emily Ying Yang Chan
- India: Vinod Sharma
- Indonesia: Sugeng Triutomo
- Iran: Ali Ardalan
- Japan: Rajib Shaw (Co-chair) and Takako Izumi
- Malaysia: Joy Jacqueline Pereira
- Philippines: Antonia Yulo Loyzaga

About IRDR

http://www.irdrinternational.org

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"

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 (8): Eight International Center of Excellency located globally

The activities are coordinated by the IPO (International Programme Office) based in Beijing, China.

About Future Earth IRG Project

http://futureearth.org

Future Earth is a major international research platform providing the knowledge and support to accelerate transformations to a sustainable world.Launched in 2015, Future Earth is a 10-year initiative to advance Global Sustainability Science, build capacity in this rapidly expanding area of research and provide an international research agenda to guide natural and social scientists working around the world. But it is also a platform for international engagement to ensure that knowledge is generated in partnership with society and users of science. We are closely engaged in international processes such as the United Nations' Sustainable Development Goals and climate and biodiversity agreements (United Nations Framework Convention on Climate Change and the Convention on Biological Diversity).

Future Earth is built on many decades of international research on global environmental change carried out by projects sponsored by DIVERSITAS, the International Geosphere-Biosphere Programme (IGBP) and the International Human Dimensions Programme (IHDP). Over 20 projects, ranging from the Global Carbon Project to the Earth System Governance project, have joined Future Earth. From this intellectual base Future Earth is launching Knowledge-Action Networks to catalyze new research and partnerships around eight key challenges to global sustainability.

Future Earth's five Global Hubs are based in Colorado, Montreal, Paris, Stockholm and Tokyo and coordinate and catalyse new research for global sustainability. Regional Centres are operational in Asia, Europe, the Middle-East and North Africa and Latin America and the Caribbean, while Regional Offices are emerging in Africa and South Asia. National Structures are also forming in countries across the planet.

We are an open network for scientists of all disciplines, natural and social, as well as engineering, the humanities and law. We endorse world-class projects, networks and institutes who can contribute to our research agenda and are committed to transformation.

The vision of Future Earth (2025 Vision) is for people to thrive in a sustainable and equitable world. This requires the evolution of a new type of science – Global Sustainability Science – that links disciplines, knowledge systems and societal partners to support a more agile global innovation system.

Future Earth carries out research around three broad themes. They are: Dynamic planet, Global sustainable development, and Transformations towards sustainability.

STATUS REPORT

Science and Technology for Disaster Risk Reduction

1. PROFILE / CONTEXT*

Bangladesh

Bangladesh is a deltaic country formed by the Ganges, Brahmaputra and Meghna rivers systems. Bangladesh is vulnerable to various natural and human induced disasters including floods, droughts, earthquakes, cyclones and storm surges, tornadoes, arsenic contamination, salinity intrusion, landslide, river bank erosion, tsunami, infrastructure collapse etc. Bangladesh has several laws and regulations on disaster risk reduction. However, the role of science and technology in DRR related decision-making, policy formulation and implementation processes is still not clearly defined and/or negligible.

2. STATUS

	Attributes of Science and Technology to Disaster Risk Reduction (DRR)	1	2	3	4	5
1	**Science and Technology in decision making**					
1.1	Presence of Science and Technology advisory group to DRR nodal ministry and or/related ministries		■			
1.2	Presence of Science and Technology group in DRR national platform		■			
1.3	Existence of inter-ministerial discussion/dialogue on science related issues	■				
1.4	Implementation of risk, needs and damage assessment with involvement of Science and Technology group		■			
1.5	Existence of early warning system and mechanism with Science and Technology knowledge and tools			■		
1.6	Availability of disaster data/statistics on damage and impacts and its data collection mechanism			■		
1.7	Involvement of Science and Technology group in infrastructure design			■		
1.8	Scientific revision/updating of regulations, policies and guidelines for DRR including building codes, disaster response and preparedness plan etc.		■			
2	**Investment in Science and Technology**					
2.1	Existence of grant support by the national government to researchers in disaster related topics that focus on Science and Technology	■				
2.2	Establishment of disaster related courses in higher-education			■		
2.3	Presence of national research institutes and organizations for disasters			■		
2.4	Investment/support by the national government in national/international conferences and events on disasters for knowledge sharing	■				
2.5	Support to collaboration with academia and the private sector for developing innovative technical solutions	■				
2.6	Support to collaboration with academia and civil society for developing innovative social solutions	■				
3	**Link of Science and Technology to people**					
3.1	Availability of a hazard map to people, developed based on scientific knowledge	■				
3.2	Scientific validation of indigenous knowledge	■				
3.3	Involvement of Science and Technology group in developing program for evacuation drills		■			
3.4	Availability and participation of Science and Technology group in community discussion as facilitator or advisor/commentator		■			
3.5	Dissemination of science based early warning and forecast to people			■		
3.6	Involvement of Science and Technology group in developing disaster related education curriculum		■			
3.7	Existence of facilities such as museum and events such as expo to disseminate disaster knowledge and deepen understanding on disasters among citizens	■				

*This report is prepared by Professor Jamiur Reza Choudhury and his colleagues in Bangladesh.

3. SCIENCE AND TECHNOLOGY IN DECISION MAKING

Ministry of Disaster Management and Reliefis responsible for DRR activities in Bangladesh. The Disaster Management Act, 2012 (hereinafter DMA), Disaster Management Rules, 2015 (hereinafter DMR) and Disaster Management Policy 2015, are the key legal and policy documents related to disaster management. Department of Disaster Management has been formed to implement the DMA (Articles 7-11 of DMA).

National Disaster Management Council (NDMC) is the highest policy support body of the government (Article 4 of DMA). Science, Technology and Academia (hereinafter STA) is excluded from this council. Article 17.1 of DMR stipulates formation of seven national disaster management committees to support NDMC, namely Inter-Ministerial Disaster Management Council (IMDMC), National Disaster Management Advisory Committee (NDMAC), Cyclone Preparedness Programme Policy Committee (CPPPC), Cyclone Response Programme Implementation Board (CPIB), Earthquake Preparedness and Awareness Committee (EPAC), National Platform for Disaster Risk Reduction (NPDRR), Disaster Warnings Publicity, Planning and Implementation Committee (DWPPIC).

STA has representation in NDMAC, EPAC and NPDRR (Articles 9, 18 and 21 of 2015 DMR). However, STA has no representation in IMDMC, CPPPC, CPIB and DWPPIC (Articles 3, 12, 15 and 24 of 2015 DMR). As per Article 14 of DMA, National Disaster Response Coordination Committee (NDRC) has been formed; however, STA has no representation in NDRC.

Overall, the representation of Science and Technology in DRR related decision making is extremely weak in Bangladesh. At this stage, Bangladesh is mostly dependent on bureaucrats for disaster related decision making. STA should be involved more explicitly in DRR decision making, policy formulation and implementation mechanisms.

4. INVESTMENT IN SCIENCE AND TECHNOLOGY

Bangladesh Government provides very limited financial support to research and development. University Grants Commission of Bangladesh (UGC) and Ministry of Science and Technology provide limited funding for research. Climate Change Trust Fund of Bangladesh Government provides funding for projects aiming to address climate change risks that fall under the six thematic areas specified in Bangladesh Climate Change Strategy and Action Plan (2009).

University Grants Commission (UGC) is currently implementing the Bangladesh Research and Education Network (BdREN) under Higher Education Quality Enhancement Project (HEQEP) with assistance from World Bank. BdREN aims to connect all universities, research institutions, laboratories and libraries with reliable access to high-end computing, simulation tools and datasets. Article 12 of DMA provides provision for the establishment of national disaster management research and training institute. In recent years, several universities introduced disaster related postgraduate programs and research.

Science based DRR needs to be promoted through investment in public and private R&D institutions/universities. Disaster risk resilience through structural and non-structural measures and development and revision of new or existing standards, codes, and rehabilitation and reconstruction practices should be encouraged. Due to lack of research funding, retaining quality scientists in the country is a major challenge.

Investment is necessary to strengthen science–society–governance interfaces so that scientific innovation can be adapted by local people and implemented efficiently. 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.

5. LINK OF SCIENCE AND TECHNOLOGY TO PEOPLE

Department of Disaster Management in coordination with Bangladesh Water Development Board and Bangladesh Meteorological Department currently provides real time disaster related information by using IVR (Interactive Voice Response) technology and short message service. People can dial the number 10941 from any mobile phone to know the latest weather, cyclone and flood related forecast; however, the IVR service needs to be free for disaster prone areas. Flood Forecasting and Warning Center (FFWC) provides real time water level data for all major rivers; however, the grass root level people have limited knowledge to access this database.

Due to long history of disasters in Bangladesh, people often rely on indigenous knowledge to deal with natural hazards. Scientific validation of the indigenous knowledge is essential. It is necessary to prepare user-friendly hazard, risk and vulnerability maps and disaster warning and forecasting systems in order to implement DRR policies and plans at local level.

Structural measures for DRR are quite satisfactory in Bangladesh. Government is also promoting non-structural measures for DRR. There should be a balance between these two approaches. In this regard, traditional "product focused education and research" should be reformed towards "process oriented education and research" or "product-process linked education and research".

The curricula of primary and secondary level education need to be reviewed, and modified through high level STA committees to ensure disaster risk knowledge among future generations. Non-formal education and training for local people should also be promoted.

6. LESSONS / ISSUES FROM PAST MAJOR DISASTERS

Bangladesh has been successful in reducing the numbers of deaths from natural disasters in recent years through improved preparedness, warning dissemination, disaster response and recovery mechanisms. For example, in flood of 1988, 61% of the country was inundated that caused around 4,000 deaths. In the flood of 1998, 69% of the country was inundated but the death toll was 1,100. In the 1970, 1991, 2007 and 2009 cyclones and storm surges, the numbers of deaths were 500,000, 138,882, 3,363 and 190 respectively. At the same time, the economic losses from natural disasters have been rising. In the 1984, 1987, 1988, 1998 and 2004 floods, the estimated damages were around USD 378 million, USD 1 billion, USD 1.2 billion, USD 2.8 billion and USD 6.6 billion respectively. This is due mainly to the increase in non-farm activities and structural and industrial development in flood prone areas.

Bangladesh is doing well in disaster response and recovery to save human lives largely due to its excellent trained volunteers' networks in the disaster prone areas, but at the same time, disaster risk to economy is rising sharply. The socio-environmental damages from disasters are yet to be assessed. In recent years, Bangladesh is experiencing major human induced disasters like collapse of an eight-storey Rana Plaza Building where over 1,130 workers working in ready-made garment factories were killed. Management of human induced disasters is a new challenge for Bangladesh.

To reduce natural and human induced disaster risks, plan and policy formulation and their subsequent implementation with explicit involvement of STA need to be ensured.

7. SFDRR PRIORITY AREAS

SFDRR Priorities		Relative level of involvement of Science and Technology				
		1	2	3	4	5
1	Understanding disaster risk					
2	Strengthening disaster risk governance					
3	Investing in disaster risk reduction					
4	Enhancing disaster preparedness					

8. SHORT AND LONG-TERM GOALS (3 SPECIFIC ACTIONS FOR BOTH SHORT AND LONG-TERM GOALS)

1. Inclusion of science, technology and academia (STA) in various disaster management and disaster response coordination committees under Disaster Management Act (2012).
2. Increase investment in academic institutions to promote disaster preparedness, response, recovery and risk reduction related formal and non-formal education, training, research and development.
3. Reforming present "product focused education and research" towards "process oriented education and research" or "product-process linked education and research".

1. Link STA institutions and network to the related governmental, regional and international organizations.
2. Establish a funding agency governed by Government of Bangladesh, named Bangladesh Disaster Research Council, to support excellent research. A STA advocacy group should be formed to encourage government and private sectors to ensure that, in the long run, minimum 2% of GDP is invested for research and development.
3. Ensure that science and technology in DRR is based on four basic principles, i.e., Innovation, Customization, Implementation and Transparency.

9. HIGHER EDUCAITON STATUS

Some of the Universities in Bangladesh, e.g., Dhaka University, Independent University of Bangladesh, BRAC University, currently offer postgraduate degree, diploma and certificate courses in disaster management. Patuakhali Science and Technology University has four departments under the faculty of Disaster Management. BUET offers Post-graduate Diploma Course in Water Resources Development and Flood Management under Institute of Water and Flood Management. In 2011, BUET- Japan Institute of Disaster Prevention and Urban Safety (BUET – JIDPUS) was established in Bangladesh University of Engineering and Technology. It now offers training courses on earthquake resistant building design, remote sensing and GIS for natural hazard assessment. BUET-JIDPUS is now developing new postgraduate research and degree program in DRR under HEQEP. DRR related topics are included in the undergraduate degrees curriculum of the Civil, Environmental and Water Resources Engineering. Currently, there is a lack of quality teaching faculties in the field of DRR.

1. PROFILE / CONTEXT*

CHINA

China has experienced some of the most destructive natural disasters in the world's history. China's natural disasters have the features of diverse range, wide geographic distribution, high frequency, significant damage and high disaster risk. As an inter-ministerial coordinating mechanism under the State Council, the National Commission for Disaster Reduction (NCDR) is responsible for drafting key disaster reduction policy and plans, coordinating major disaster reduction across the country, and to guide local government in this regard. The Expert Committee under the NCDR has been actively providing S&T support and mobilizing S&T forces at all levels in the all phases of national and local disaster risk reduction, particularly emphasizing the concept of comprehensive disaster reduction which looks at the overall picture of disaster prevention and reduction from research to decision-making, from policy to practice, and from national to local.

2. STATUS

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3.6	Involvement of Science and Technology group in developing disaster related education curriculum					
3.7	Existence of facilities such as museum and events such as expo to disseminate disaster knowledge and deepen understanding on disasters among citizens					

*This report is prepared by Professor Peijung Shi and his colleagues in China.

3. SCIENCE AND TECHNOLOGY IN DECISION MAKING

The Expert Committee under the China NCDR consists of over 100 board members and experts from all fields related to DRR. This committee is the key policy support body to national government including policy consultation, scientific guidance, technical support and S&T research.

The Expert Committee has direct channel to provide policy and implementation suggestion to the national major decision making and planning processes, emergency response and relief to major disasters, and post-disaster recovery and reconstruction. The committee also takes actions of reviewing and evaluation on major DRR engineering and research projects, investigating and assessment of major disasters, suggesting on strategy planning of national DRR, and participating in national and international S&T DRR cooperation. All these activities make significant influence in national and local decision making on DRR. This committee has direct route to reach Prime Minister and state council members for urgent and important issues.

National Disaster Reduction Center of China (NDRCC) under Ministry of Civil Affairs is the main body linking DRR S&T with government administration and decision-making at all levels. The provincial and city governments have also established their disaster reduction centers, which strengthened S&T utilization and implementation at local levels.

In case of large-scale disaster, Chinese government has the mechanism of establishing expert panel to ensure proper and timely decision-making.

4. INVESTMENT IN SCIENCE AND TECHNOLOGY

To ensure the sufficient investment in scientific and technological innovations in disaster prevention and reduction, the Chinese government compiled the Twelfth Five-year Special Planning for the National Science and Technology Development for Disaster Prevention and Reduction in 2012. This national S&T plan has not only identified the priorities of actions in DRR but also ensured sufficient investment to meet the national target. All provincial and local government uses this national plan to set up their 5-year targets and action plans.

Research and innovation programs in the field of DRR have been set-up to ensure S&T advance and implementation. These programs include natural science foundation program, S&T pillar program, high technology program, and fundamental research program. The national and provincial financial input, along with industrial matching funds, has become the main S&T research investment.

A series of critical technologies in DRR has been developed and implemented during the S&T research. The improvement of disaster information collection, database development and construction of national emergency platform has been achieved. A series of science and technology demonstration bases for disaster prevention and reduction and a number of state key laboratories and engineering and technology research centers for disaster prevention and reduction have been established.

5. LINK OF SCIENCE AND TECHNOLOGY TO PEOPLE

Thirteen disaster information officer evaluation centers have been set up at central and provincial levels. By the end of 2013, more than 650,000 disaster information officers had been established across the country. These disaster information officers became the linking points between government and the people.

The Chinese government has strengthened its community-based disaster risk reduction management and has encouraged communities to set up disaster reduction mechanisms. Community disaster risk maps have been created and the government has improved residents' survival skills for disaster prevention and reduction. Communities have also been familiarized with various disaster risks, emergency shelters, evacuation routes, and the use of facilities. By the end of 2013, a total of 5408 "national disaster reduction-prepared communities" had been established, which has significantly increased the disaster prevention and reduction capacities at the local community level in urban and rural areas.

The Chinese government has established a complete early warning disclosure system, and uses over 650,000 disaster information officers, cell phones, TV, radio stations to disclose and update information during a disaster in a prompt and timely manner. A national disaster information management system has been established and provided coverage to all county-level administrative units to ensure information full coverage to all people.

6. LESSONS / ISSUES FROM PAST MAJOR DISASTERS

It is crucial to adopt and insist the concept of comprehensive disaster prevention and reduction in strategies and reform governance structure accordingly. S&T should pay more attention to the integrated risk governance.

It is necessary for national and local government to set up goals for comprehensive disaster prevention and reduction in national and local DRR plans. However, the compilation of plans need substantial S&T support.

Disaster assessment and information release requires further coordination, particularly a scheme to ensure rapid reporting and release of disaster information.

Research focusing on multi-hazards and disaster chains and their risk management is needed.

Climate change uncertainties lead to greater environmental risks, and S&T should be advanced to build better understanding the relationship between climate change and disaster risks.

Sustainable development is facing challenges from emerging risk and DRR S&T should expand the scope to link resource safety, ecological safety and food safety.

The challenges from globally networked disasters is identified, and S&T should seek better solutions for integrated risk governance of large-scale disasters that have global impacts.

7. SFDRR PRIORITY AREAS

SFDRR Priorities		Relative level of involvement of Science and Technology				
		1	2	3	4	5
1	**Understanding disaster risk** (Assessment, data, baseline, capacity)					
2	**Strengthening disaster risk governance** (standards, certification, capacity building)					
3	**Investing in disaster risk reduction** (innovative products with private sector)					
4	**Enhancing disaster preparedness** (guidance, instruments)					

8. SHORT AND LONG-TERM GOALS (3 SPECIFIC ACTIONS FOR BOTH SHORT AND LONG-TERM GOALS)

1. Promote the integration of coping with climate change and disaster prevention and reduction through national research programs and international forums.
2. Improvement on the precision and timeliness of disaster and risk assessment for large-scale disasters.
3. National Forum on Comprehensive Disaster Reduction and Sustainable Development is to be held in May, which includes four sub-forums: Institutional System, Integrated Risk Governance, S&T Innovation and Implementation, and Social Participation.

1. Promote financial innovation on disaster risk transferring mechanism and establish a diversified protection system to strengthen national and local disaster resilience.
2. S&T advance to encourage and motivate public to participate actively in DRR actions and to contribute more in disaster preparedness and emergency response.
3. Enhance national integrated risk governance capacity for large-scale disasters and develop a national system to monitor DRR progress to achieve Sendai Framework targets.

9. HIGHER EDUCAITON STATUS

China’s higher education is administered by first-level disciplines. Each discipline has a few majors. The majors directly addressing DRR include Natural Disasters under Geography, Disaster Prevention and Mitigation Engineering under Civil Engineering, Public Safety under Safety Science and Engineering, Emergency Management under Public Management etc.

There is no specific major named DRR or Disaster Risk Management (DRM), but there are some Master level programs (under the majors listed above) which focuses on DRR and DRM.

Some universities (such as Beijing Normal University) have been offering Master of Science programs to young professionals from Ministry of Civil Affairs, insurance industry etc.

Institutional cooperation (such as joint institutions) between universities and government is crucial to ensure the true linkage between S&T innovation and governance.

1. PROFILE / CONTEXT*

INDIA

India is prone to multiple hazards across its diverse geo-climatic regions. Earthquakes, landslides, avalanches, cloud bursts, glacial lake outburst flows, forest fires, floods, cyclones and tsunamis are prominent rapid onset hazards, while droughts, water stresses, epidemics, crop failures and distress migration are some of the stresses that are felt due to disasters and climate change, but are not very prominently studied or reported. The National Disaster Management Authority, Ministry of Home Affairs, National Institute of Disaster Management, Department of Science and Technology, State Relief Departments, District Collectorates, Meteorological Department and Water Commission are some key institutions that play a role, within the framework set out by the National Disaster Management Act.

2. STATUS

	Attributes of Science and Technology to Disaster Risk Reduction (DRR)	1	2	3	4	5
1	**Science and Technology in decision making**					
1.1	Presence of Science and Technology advisory group to DRR nodal ministry and or/related ministries				■	
1.2	Presence of Science and Technology group in DRR national platform			■		
1.3	Existence of inter-ministerial discussion/dialogue on science related issues		■			
1.4	Implementation of risk, needs and damage assessment with involvement of Science and Technology group				■	
1.5	Existence of early warning system and mechanism with Science and Technology knowledge and tools					■
1.6	Availability of disaster data/statistics on damage and impacts and its data collection mechanism			■		
1.7	Involvement of Science and Technology group in infrastructure design			■		
1.8	Scientific revision/updating of regulations, policies and guidelines for DRR including building codes, disaster response and preparedness plan etc.				■	
2	**Investment in Science and Technology**					
2.1	Existence of grant support by the national government to researchers in disaster related topics that focus on Science and Technology			■		
2.2	Establishment of disaster related courses in higher-education			■		
2.3	Presence of national research institutes and organizations for disasters					
2.4	Investment/support by the national government in national/international conferences and events on disasters for knowledge sharing			■		
2.5	Support to collaboration with academia and the private sector for developing innovative technical solutions		■			
2.6	Support to collaboration with academia and civil society for developing innovative social solutions		■			
3	**Link of Science and Technology to people**					
3.1	Availability of a hazard map to people, developed based on scientific knowledge			■		
3.2	Scientific validation of indigenous knowledge	■				
3.3	Involvement of Science and Technology group in developing program for evacuation drills		■			
3.4	Availability and participation of Science and Technology group in community discussion as facilitator or advisor/commentator			■		
3.5	Dissemination of science based early warning and forecast to people					■
3.6	Involvement of Science and Technology group in developing disaster related education curriculum				■	
3.7	Existence of facilities such as museum and events such as expo to disseminate disaster knowledge and deepen understanding on disasters among citizens		■			

*This report is prepared by Professor Vinod Shoram and his colleagues in India.

3. SCIENCE AND TECHNOLOGY IN DECISION MAKING

The Ministries of Science & Technology and Earth Sciences and the other concerned Departments of the GoI, in consultation with the NDMA, identify the specific needs and disciplines for research and also designate domain-specific institutions depending on their expertise and knowledge base.

There is a strong presence of these institutions, as well as scientific and technological expert groups drawn from the Indian Institutes of Technology, Schools of Planning and Architecture, specialised institutions such as Wadia Institute of Himalayan Geology, National Remote Sensing Agency, Indian Institute of Remote Sensing, National Institute of Oceanography etc. Specialised Non Government Organisations with technical expertise such as SEEDS, Taru, TERI etc. are also a resource that is drawn upon. The UNDP also runs programmes that support the government with technical and scientific knowhow. These operate at national, state, district and even local levels.

4. INVESTMENT IN SCIENCE AND TECHNOLOGY

India has been investing in science and technology for disaster management very concertedly. In acknowledgment of the need for a knowledge sharing platform on DM, and to facilitate interaction and dialogue with related areas of expertise, the India Disaster Knowledge Network (IDKN) Portal has been set up. The portal will serve as a tool to collect, collate and disseminate information related to DM. It will connect all Government Departments, statutory agencies, research organisations/institutions and humanitarian organisations to share collectively and individually their knowledge and technical expertise.

The existing framework of India Disaster Resource Network (IDRN) needs to be further expanded to include the resources of various agencies, domains and disciplines at the National level. The relevant information will be placed in the public domain for easy retrieval, usage and online updates.

Documentation of best practices and research is another area of investment. In the immediate aftermath of any disaster, field studies will be carried out, with the help of experts, as an institutional measure. These studies will concentrate on identifying gaps in the existing prevention and mitigation measures and also evaluate the status of preparedness and response. Similarly, the lessons of past disasters will also be compiled and documented. The recovery and reconstruction process will also be analysed for further refining the DM processes and training needs. With the help of experts, NIDM will develop a reference book for the development of case studies and documentation of best practices in a professional manner. This knowledge will be disseminated to all concerned within the country and also shared with International organisations.

5. LINK OF SCIENCE AND TECHNOLOGY TO PEOPLE

The link of science and technology to people still requires a lot of attention and investment. The most important aspects in this regard are as follows:

Making scientific information simple and understandable in its language and presentation.

Creating portals, apps or avenues for science to reach out to people in large numbers with less expenditure.

Involving schools and colleges in scientific activities through national and local programmes.

Encouraging publication of scientific outputs in popular media and through news.

Involvement of civil society organisations, particularly community based organisations in programmes for propagation of science and disaster management.

Linking local wisdom and vernacular media for outreach and also learning from the communities.

6. LESSONS / ISSUES FROM PAST MAJOR DISASTERS

India has seen many major disasters in the past three decades, from which many lessons can be learnt. Some prominent ones are:

The Uttarkashi Earthquake of 1991 demonstrated the need for access to affected communities in remote areas. Geographic knowledge and transportation alternatives are a key that requires research.

The Latur Earthquake of 1993 showed how ill constructed buildings can cause heavy loss of life. Research in safe construction practices using local materials is key to saving lives.

Orissa Supercyclone of 1999 demonstrated the vulnerability of coastal communities to disasters, and highlighted the need for research on coastal risk to disasters and climate change.

Gujarat Earthquake of 2001 showed high vulnerability of major cities, and also demonstrated how traditional wisdom such as construction of Bhunga houses can resist disasters. Research on urban risk, and traditional wisdom go hand in hand.

Many other events, including the Sikkim Earthquake of 2011 showed how modern technology needs to be studied for application in local context in conjunction with traditional wisdom.

7. SFDRR PRIORITY AREAS

SFDRR Priorities		Relative level of involvement of Science and Technology				
		1	2	3	4	5
1	**Understanding disaster risk** (Assessment, data, baseline, capacity)					
2	**Strengthening disaster risk governance** (standards, certification, capacity building)					
3	**Investing in disaster risk reduction** (innovative products with private sector)					
4	**Enhancing disaster preparedness** (guidance, instruments)					

8. SHORT AND LONG-TERM GOALS (3 SPECIFIC ACTIONS FOR BOTH SHORT AND LONG-TERM GOALS)

1. Establish indicators for localizing SFDRR, and conducting pilot programmes.
2. Initiating a national campaign on awareness raising on local actions for DRR.
3. Documenting good practices including traditional wisdom and local innovations.

1. Developing a national capacity building programme framework.
2. Developing and deploying TOT and training courses on DRR-CCA.
3. Strengthening institutions to deliver national capacity building through outreach across all sectors, all levels and all geographies of the country.

9. HIGHER EDUCAITON STATUS

Higher education programmes currently include over twenty masters degree courses in disaster management, but only one or two bachelors degree programmes and those too through distance learning. There is significant coverage, however, through mainstreaming of DRR through other thematic courses including geography, planning, engineering etc. Short-term training courses are carried out in large numbers through various training institutions, but these are not accredited and do not have a robust screening or certification system. Research is carried out, but needs to be organized further through a national networking approach and multi-sectoral learning programmes.

1. PROFILE / CONTEXT*

Indonesia is geologically located at the confluence of three tectonic plates, namely the Eurasian, Indo-Australian and the Pacific. The country is also located in the tropical zone, which has two extreme seasons; the rainy and dry seasons. Therefore, Indonesia is vulnerable to a variety of hazards, geological, hydro-meteorological, and environmental.

Research and development in disaster management continue to be done by research institutions and universities to understand disaster risk. This activity is starting to increase since the Indian Ocean tsunami occurred in 2004. The Government of Indonesia has given a serious attention in disaster research and development. It is seen through the policy of the government through Ministry of Research, Technology and Higher Education, and the National Disaster Management Agency.

2. STATUS

	Attributes of Science and Technology to Disaster Risk Reduction (DRR)	1	2	3	4	5
1	**Science and Technology in decision making**					
1.1	Presence of Science and Technology advisory group to DRR nodal ministry and or/related ministries			■		
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1.3	Existence of inter-ministerial discussion/dialogue on science related issues			■		
1.4	Implementation of risk, needs and damage assessment with involvement of Science and Technology group			■		
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1.7	Involvement of Science and Technology group in infrastructure design			■		
1.8	Scientific revision/updating of regulations, policies and guidelines for DRR including building codes, disaster response and preparedness plan etc.				■	
2	**Investment in Science and Technology**					
2.1	Existence of grant support by the national government to researchers in disaster related topics that focus on Science and Technology					■
2.2	Establishment of disaster related courses in higher-education				■	
2.3	Presence of national research institutes and organizations for disasters				■	
2.4	Investment/support by the national government in national/international conferences and events on disasters for knowledge sharing			■		
2.5	Support to collaboration with academia and the private sector for developing innovative technical solutions			■		
2.6	Support to collaboration with academia and civil society for developing innovative social solutions				■	
3	**Link of Science and Technology to people**					
3.1	Availability of a hazard map to people, developed based on scientific knowledge		■			
3.2	Scientific validation of indigenous knowledge		■			
3.3	Involvement of Science and Technology group in developing program for evacuation drills				■	
3.4	Availability and participation of Science and Technology group in community discussion as facilitator or advisor/commentator				■	
3.5	Dissemination of science based early warning and forecast to people					■
3.6	Involvement of Science and Technology group in developing disaster related education curriculum				■	
3.7	Existence of facilities such as museum and events such as expo to disseminate disaster knowledge and deepen understanding on disasters among citizens			■		

*This report is prepared by Dr. Sugeng Triutomo and his colleagues in Indonesia.

3. SCIENCE AND TECHNOLOGY IN DECISION MAKING

Act No. 24 of 2007 on Disaster Management mentioned that science and technology has been become a principle in disaster management. In Indonesia, the science and technology in disaster has gained special attention. This is evident from the involvement of academics, researchers and practitioners in disaster research and development. It is characterized also by close institutional relationship between the Ministry of Research, Technology and Higher Education (RISTEK DIKTI) with the National Disaster Management Agency (BNPB).

A harmonious relationship between the two national-level decision-making bodies in research and technology and disaster is a valuable capital for disaster risk reduction efforts in Indonesia. National Research Council (DRN), as higher institution in research activities has also determined disaster management as one of priorities in research topics in Indonesia.

Science and technology in disaster risk management developed by several research and development of related ministries such as Ministry of Public Works and Housing, the Ministry of Health, Ministry of Social Affairs, Ministry of Maritime Affairs and Fisheries, Ministry of Environment and Forestry, and also agencies such as the Meteorology, Climatology and Geophysics (BMKG), Indonesian Institute of Sciences (LIPI), Agency for the Assessment and Application of Technology (BPPT), and other research institutes.

In implementation, BNPB (nationally) and BPBDs (at local level) has appointed experts and professionals as a steering committee along with representatives from the relevant ministries / agencies and other stakeholders.

4. INVESTMENT IN SCIENCE AND TECHNOLOGY

The development of science and technology on disaster in Indonesia proceeded by the establishment of disaster study centers at the universities. Some experts from various disciplines formed disaster study center to do research, teaching and community service, in line to the university mission. The universities develop their disaster study center in accordance with their competencies.

In 2008, some disaster study center agreed to establish Higher Education Forum for Disaster Risk Reduction. Until now, the Forum has consisted of 45 study centers all along Indonesia. The management of this forum has been selected for 3 (three) years alternately. Disaster study centers has a function consulting, advocacy and technical assistance to local governments through BPBDs.

Some universities have developed a master degree program in disaster management. Currently there are 8 universities that open disaster management program.

In June 2014, disaster experts and professionals established a professional organization called Indonesian Disaster Experts Association (IABI), which is composed of researchers, academics and practitioners in disaster management. Every year, IABI organize annual scientific meeting as a forum for members to exchange knowledge and information.

In order to improve national capability in research on disaster risk, Min. of Research, Technology and Higher Education annually allocates budgets for research to support areas of national development priorities. Disaster management is one of the main areas covered in it.

Meanwhile, research institutions under the Min. of Research, such as LIPI, BPPT, LAPAN, BMKG also allocated a budget for research activities in disaster risk reduction.

BNPB in cooperation with the universities have conducted disaster risk assessment for 12 major hazards in Indonesia. The risk assessment is then used as basic data in preparing disaster risk profile and disaster management plans in Indonesia.

5. LINK OF SCIENCE AND TECHNOLOGY TO PEOPLE

The purpose of disaster management in Indonesia is to realize a resilient community. Creating resilient communities can be achieved by shifting the perspective of the disaster. To change that perspective it is necessary to develop science and knowledge in disaster management.

At the national level the utilization of science and technology is quite good progress, this is because it required speed and accuracy in reaching a very broad national territory. Science and technology developed related to measurement and risk mapping and early warning systems.

Meanwhile for local level, science and technology that is required is appropriate and easy to understand by people. For the use of technology at the local level, disaster research center to develop technology related to community-based disaster risk management in order to realize community resilience. Universities in collaboration with the local government provide technical assistance in the form of local disaster risk maps, contingency planning, emergency response plan to recovery plan.

Some universities and research institutes in collaboration with the private sectors have developed an appropriate technology such as: prediction and designing early warning system and also structural mitigation.

Ministry of Education and Culture has issued a circular to the Regional Office of Education in all over Indonesia to incorporate disaster risk reduction education in school curricula. This disaster education can be provided in the form specific lessons concerning disaster, fused with existing lessons or extra curriculum. This policy is in line with the “safer schools” campaign.

6. LESSONS / ISSUES FROM PAST MAJOR DISASTERS

Raising disaster awareness of scientists and academia. Various disaster events, especially since Indian Ocean Tsunami in 2004, has widely raised public awareness of disaster. In the field of science and technology, it is characterized by the growth of disaster study centers and also civil society who are concerned about disasters. Cooperation between scientist and academia with other stakeholders in disaster risk reduction have formed.

Building capacity in the early warning system. Indian Ocean Tsunami in 2004 has spurred development of early warning system technology. The involvement of research institutions, universities and technical institutes in an integrated team is the manifestation of the application of the science of disaster in practice. The early warning system is developed not only for tsunami, but also for other hazards such as volcano eruptions, floods, landslides, forest fire etc.

Building capacity in disaster risk assessment. Making risk assessment is the basis for preparing a disaster management plan. Therefore, science and technology needed to support the creation of risk assessment is indispensable, such as: remote sensing, GIS and informatics.

Building capacity in damage and losses assessment. Every disaster event has required the calculation of damages and losses caused by the disaster. Learning from Indian Ocean tsunami 2004 and Mt. Merapi eruption 2010, knowledge of the damage and losses calculation has been formulated, which later formed the basis for the preparation of the Post Disaster Need Assessment.

Revision of Seismic Map of Indonesia. From many results of research on seismic measurement in some areas in Indonesia, some seismologists agreed to renew the seismic map (Peak Ground Acceleration) of Indonesia.

7. SFDRR PRIORITY AREAS

SFDRR Priorities		Relative level of involvement of Science and Technology				
		1	2	3	4	5
1	Understanding disaster risk					
2	Strengthening disaster risk governance					
3	Investing in disaster risk reduction					
4	Enhancing disaster preparedness					

8. SHORT AND LONG-TERM GOALS (3 SPECIFIC ACTIONS FOR BOTH SHORT AND LONG-TERM GOALS)

1. Strengthen the network among agencies and actors in integrating research on disasters in Indonesia.
2. Establish a standard method of disaster risk assessment for major hazards in Indonesia.
3. Develop disaster science and technology to be used by stakeholders at the local and community level.

1. Toward research and technology for disaster as the basis for the determination of disaster management policies and national development.
2. Establish research collaboration in disaster management with the various countries in the region and globally.
3. Toward Indonesia as a center of excellence in research on disasters in Southeast Asia sub-region.

9. HIGHER EDUCAITON STATUS

Higher education in the major of disaster management at the master's level has started in the 1990s and growing rapidly since 2005 until present. Initially disaster education is more emphasis on the process of the occurrence of hazards, such as aspects of geology, hydrology, meteorology, geomorphology, geophysics and civil engineering. Recently some universities have developed disaster study programs from the aspect vulnerability and risk.

Most of the disaster education programs status is in a post-graduate study under other education programs, for example, the graduate programme in civil engineering, earth sciences, social sciences, management sciences, medical and health sciences, environmental science and public policy. While the disaster study centers are usually under the Community Research and Development Institute (LPPM) of the university.

The incorporation of Directorate General of Higher Education into the Ministry of Research Technology and Higher Education by the end of 2014, will improve the coordination and integration of education and research for various sectors of development, including disaster risk reduction.

1. PROFILE / CONTEXT*

Iran

I.R.Iran is a disaster-prone country. While earthquakes account for the greatest mortality and economic damage, drought is the most widespread, affecting the greatest number of people. Flood is ranked second in all categories of damage. Recently, dust storms have become a serious problem in large areas of the country. Furthermore, due to political stability, Iran has hosted millions of refugees over past two decades. The 2003 Bam earthquake was a leap forward for institutionalization of DRR in Iran including capacity building for DRR science and technology. As the result, several research and higher education institutions/programs have been established. DRR scholars assist the national government with advices required for policy making, legislation, planning, and guidelines. As an example, the Research Center of the Islamic Parliament closely worked with DRR scientists to revise the Disaster Management Act.

2. STATUS

	Attributes of Science and Technology to Disaster Risk Reduction (DRR)	1	2	3	4	5
1	**Science and Technology in decision making**					
1.1	Presence of Science and Technology advisory group to DRR nodal ministry and or/related ministries		■			
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2	**Investment in Science and Technology**					
2.1	Existence of grant support by the national government to researchers in disaster related topics that focus on Science and Technology		■			
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2.3	Presence of national research institutes and organizations for disasters				■	
2.4	Investment/support by the national government in national/international conferences and events on disasters for knowledge sharing			■		
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3	**Link of Science and Technology to people**					
3.1	Availability of a hazard map to people, developed based on scientific knowledge	■				
3.2	Scientific validation of indigenous knowledge	■				
3.3	Involvement of Science and Technology group in developing program for evacuation drills				■	
3.4	Availability and participation of Science and Technology group in community discussion as facilitator or advisor/commentator			■		
3.5	Dissemination of science based early warning and forecast to people			■		
3.6	Involvement of Science and Technology group in developing disaster related education curriculum				■	
3.7	Existence of facilities such as museum and events such as expo to disseminate disaster knowledge and deepen understanding on disasters among citizens		■			

*This report is prepared by Professor Ali Ardalan (ASTAAG member) and Dr Javad Babaie (Tehran University of Medical Sciences) based on their knowledge, interpretation and interviews with Professor Mahdi Zare (International Institute of Earthquake Engineering and Seismology), Professor Amir Massah (Iran Environment Organization), Professor Shahrokh Fateh (National Drought Center), Dr. Behnam Saeedi (National Disaster Management Organization), Dr. Abbas Ostadtaghizadeh (Tehran Disaster Mitigation and Management Organization), and Dr. Ahad Vazifeh (Iran Meterological Organization).

3. SCIENCE AND TECHNOLOGY IN DECISION MAKING

In Iran, the scientists have opportunities to contribute in DRR policy and decision making through advisory groups and consultancy meetings organized by National Disaster Management Organization; Tehran Disaster Mitigation and Management Organization; Specialized Committees and Research Center of the Islamic Parliament; and member miniseries of Higher Council of Disaster Management. The Academy of Sciences and The Academy of Medical Sciences of I.R.Iran are two platforms that facilitate dialogue between DRR scientists and policy makers. Furthermore, there are examples that DRR scientists have held high level positions in the government.

Examples of contribution of Iranian scientists to DRR policy and decision making are: revision of the Disaster Management Act; development and revision of seismic building code; design and evaluation of DRR integration into national health system; development and endorsement of national disaster rehabilitation plan; revision of master plans in metropolitan areas; and endorsement of DRR regulations in design and implementation of infrastructural projects. The scientists also have opportunities to lead or consult DRR developmental projects including risk assessment, loss estimation, and early warning studies. Two main projects that benefited from scientific advices are Milad Tower in Tehran, and Bushehr nuclear power plant. Seismologists and climatologists are frequently consulted for forecasting/ prediction of earthquakes and extreme hydroclimatic events.

Despite aforementioned opportunities and good practices, there is still considerable gap between DRR scientific community, decision making and implementing bodies in Iran. The voices of scientists are often heard but not always applied. This can be explained by lack of common language, and the existence of competing interests such as time urgency. Scientists are expected to produce useful and usable science, but decision makers need to adjust their expectations with uncertainties in scientific studies/prediction.

Similar to national level, researchers and university faculties work with provincial government and organizations and assist them with technical inputs on DRR programs. Of course, the DRR science capacity varies considerably among different provinces, as it is mostly concentrated in the capital city, Tehran and some provinces like Kerman.

4. INVESTMENT IN SCIENCE AND TECHNOLOGY

Investment in science and technology is among the policies declared by the I.R.Iran's Supreme Leader. Accordingly, the fourth and fifth national 5-year development plan allocated regular budget levels to support research. In regard with DRR, the Disaster Management Act emphasizes on promotion of science and technology, however no particular budget line is defined yet. DRR researchers can apply for financial support through grant bodies and research institutes that all are basically governmental. This support, while is limited and not sufficient to answer all DRR questions in Iran, has been very helpful for promotion of research programs, supporting higher education studies, and enhancing research capacity.

DRR is a new subject to private sector of Iran so that there is almost no private fund available to support DRR research and related productions. It is necessary to develop a sustainable mechanism of fund availability, for instance, through setting a portion of annual budget in member ministries/ organizations of High Council of Disaster Management. While establishing this mechanism, development and strengthening of DRR knowledge-based companies should be given high priority. Iranian government strongly supports establishment of these private-based companies that can produce and sell their products to governmental agencies and private sectors too.

The country needs to invest on listed following priorities: risk assessments and modeling of disasters occurrence and impacts; expansion of seismic network; advanced technology for early warning systems; seismic proof construction; climate adapted urban planning; and socio-cultural community preparedness studies.

5. LINK OF SCIENCE AND TECHNOLOGY TO PEOPLE

Iran has extensively invested on public awareness for disaster preparedness through national media and programs carried out Iranian Red Crescent Society and Iran's health system. Community-based groups have been shaped including relief teams in Tehran (DAVAM in Persian); and village disaster committees that are expanded throughout the country. The latter was a result of a research program initiated by public health scientists. DRR subjects are currently included in school curriculum. School children also participate in annual earthquake drills.

Nowadays, people pay more attention to pre-shocks. This good behavior saved lives of thousands people in Lorestan earthquake. Furthermore, early warning of hydro-climatic hazards has improved significantly and people are sensitive to warning messages. In the 2016 torrential rains and severe floods that affected over five hundred thousand people, only four people died, two due to thunderstorms. Public awareness and education programs need to consider other types if hazards too such as landslides, and dust storms.

Despite aforementioned achievements, living in a disaster proof community/house is not a public demand yet, and people are not well aware about their safety rights. Households' disaster preparedness is 9.3 out of 100, according to 2016 national estimation. Most of the buildings are not earthquake resistant; buildings are being constructed in seismic high risk zones and flood prone areas; and newly built infrastructure can be damaged in moderate earthquakes as it happened for a district hospital in Heris.

Land use planning has benefited from updated knowledge, however, quality of execution and supervision are serious concerns. Over 25 percent of the population live in sub-urban areas while quality of houses/shelters and land use have made them vulnerable to disasters.

Academia needs to work more on culturally adapted solutions, and DRR knowledge translation to lay people. Interdisciplinary research focusing on social and sciences are highly needed.

6. LESSONS / ISSUES FROM PAST MAJOR DISASTERS

Improve building codes and strengthen supervision on construction process: Building destruction is the main cause of death due to natural disasters in Iran. Studies showed in the Bam earthquake there was no damage difference between new and old buildings, revealing poor supervision on construction.

Establish a national authority for disaster management: National Disaster Management Organization (NDMO) and Disaster Management Act were results of this lesson. NDMO is a coordination body that consists 14 working groups including miniseries and key organizations. NDMO structure and functions have expanded to provincial, district, and local levels.

Support educational and research programs: During the past decade, several research and higher education institutes have been established. There are few examples of interdisciplinary research.

Make DRR a public demand: No big change would happen until DRR becomes a public demand. This demand puts pressure on the policy and decision makers to operationalize DRR measures on the ground.

Public education and community-based approach: Local people are the first responders. They have indigenous knowledge to how mitigate and cope with disasters.

Promote the concept and practice of disaster resilience: preparedness is beyond the response capacity. Absorb and buffer capacities need to be taken into consideration as well.

Be prepare for extreme events due to climate change and environmental degradation: while earthquakes remain the deadliest natural disaster in Iran, the country witnesses more frequent and more severe hydro-climatic hazards including severe winter conditions; torrential rains and severe flooding at unexpected times. Dust storms have become a serious threat to functions, health and the quality of life.

7. SFDRR PRIORITY AREAS

SFDRR Priorities		Relative level of involvement of Science and Technology				
		1	2	3	4	5
1	Understanding disaster risk			■		
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4	Enhancing disaster preparedness			■		

8. LONG-TERM GOALS

1. Complete seismic network throughout the country to enhance accuracy of forecasting/prediction of seismic activities
2. Apply advanced technologies to enhance precision of early warnings for hydro climatic hazards
3. Define a sustainable source of fund for DRR research and capacity building

9. HIGHER EDUCAITON STATUS

In Iran, there are two ministries that are responsible for higher education: 1) Ministry of Science, Research and Technology (MSRT), 2) Ministry of Health and Medical Education (MoHME). All disciplines except health are covered by MSRT including engineering, humanities, social sciences, etc.

Under MSRT following programs master programs are available: Seismology, earthquake engineering, natural disaster management, natural hazards, post-disaster reconstruction, civil defense, and aircraft accidents. PhD programs are available for seismology and earthquake engineering. Helal Institute of Iran affiliated to Iranian Red Crescent Society has bachelor degree programs on search and rescue.

MoHME affiliated universities offer master of Public Health (MPH) with disaster concentration; and PhD in health disaster risk management. The programs initiated by Tehran University of Medical Sciences and expanded to other universities in Tehran and other provinces. The National Board of Health Disaster Higher Education under auspices of MoHME is responsible for policy making and accreditation of health disaster academic programs.

In both ministries, two-credit passive defense course is mandatory for all post-graduate studies. This course focuses on preventive measures that civilians should take for disasters and emergencies.

Post-graduate students contribute in enhancing the science and technology of DRR by choosing research questions from the real life problems and provide solutions using scientific methods.

Academic departments are limited to accept applicants through channel of the national exam where a written test shapes 70 percent of the total score.

1. PROFILE / CONTEXT*

JAPAN

Japan is vulnerable to different types of natural hazards, due to its crucial location in the Pacific Rim of Fire. Science and Technology has contributed significantly in reducing the risk to natural disasters. Science Council of Japan is the premium science body, which provides advice to the national government in terms of disasters. Japan also has a yearly Grant-in-Aid program for conducting research in the university and research institutions, apart from special grant program after major disasters. A few previous disasters have changed the course of disaster research in Japan: 1923 Kanto Earthquake, 1959 Isewan Typhoon, 1995 Great Hanshin Awaji Earthquake, and 2011 Great East Japan Earthquake and tsunami. Several of these disasters have urged new direction of implication of science into decision making, early warning systems and science policy dialogue.

2. STATUS

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2.2	Establishment of disaster related courses in higher-education			■		
2.3	Presence of national research institutes and organizations for disasters				■	
2.4	Investment/support by the national government in national/international conferences and events on disasters for knowledge sharing				■	
2.5	Support to collaboration with academia and the private sector for developing innovative technical solutions				■	
2.6	Support to collaboration with academia and civil society for developing innovative social solutions			■		
3	**Link of Science and Technology to people**					
3.1	Availability of a hazard map to people, developed based on scientific knowledge				■	
3.2	Scientific validation of indigenous knowledge		■			
3.3	Involvement of Science and Technology group in developing program for evacuation drills				■	
3.4	Availability and participation of Science and Technology group in community discussion as facilitator or advisor/commentator			■		
3.5	Dissemination of science based early warning and forecast to people				■	
3.6	Involvement of Science and Technology group in developing disaster related education curriculum			■		
3.7	Existence of facilities such as museum and events such as expo to disseminate disaster knowledge and deepen understanding on disasters among citizens				■	

*This report is prepared by Rajib Shaw and Takako Izumi, ASTAAG members from Japan based on their knowledge, interpretation and interviews with Professor Takashi Onishi, President, Japan Science Council, Professor Kaoru Takara, Director, DPRI, Kyoto University and Professor Fumihiko Imamura, Director, IRIDES, Tohoku University.

3. SCIENCE AND TECHNOLOGY IN DECISION MAKING

Japan, scientists are included as members of the Central Disaster Mitigation Council on DRR, which is the key policy support body to the national government. Their inputs are often applied for policy and decision making processes, however, not always. It is a major progress in Japan that such a mechanism and system exists to reflect the opinions and voices of scientists into practical decision making. Not only being included as members of the Council, but also there is a direct route to reach the Prime Minister if it is urgent and most important. On the other hand, more practitioners need to be included as the members to implement the policies and regulations.

In addition, under the Central Disaster Mitigation Council on DRR, it is possible to convene the Expert Examination Committee in various disaster areas when further detailed research is needed for a specific topic. Various assessments are conducted by the Committee.

At the local level, the province/ city governments request national/ local / private university professors and researchers to serve in the decision support committees to develop hazard map, early warning system, disaster resilient planning etc.

The area, which needs improvement of science linkage to decision making, is the modeling of unprecedented event (low/high probability, high consequence events), especially focusing on flood and volcanic disasters.

In case of damage estimation, scientific decision / tools are used for making government assets, however, it is also important to use the same methods for assessing private sector damages, and link it to the decision making process. Depending on municipality, the methodology and criteria of data collection is different.

4. INVESTMENT IN SCIENCE AND TECHNOLOGY

The Japanese Government has provided the generous support to science and technology researches such as Grants in aid for Scientific Research. While the amount is not fully satisfactory, such grants are very helpful and meaningful to strengthen research capacity in Japan and not many countries have such a system. There is a concern on a volcano observation capacity. The countermeasure and DRR for volcanic eruption is not sufficient.

It is necessary to establish a foundation that collects the fund from individuals and private organizations. In this way, the funds can be used for longer-term purposes. The support from the national level is rather for the short-term and it is a common procedure for the amount to be reduced after 3 years of the event.

Science – private sector relationship has been strong in the insurance sectors, where science based modeling helps in promoting insurance schemes. However, additional investment is required for developing innovative risk reduction products along with private sectors.

Investment in local government for science based risk reduction is still an area, which needs improvements. For example, out of close to 2,000 municipalities in Japan, close of 1,000+ local governments have science based flood hazard maps, and the rest needs to be developed in due course.

Science-civil society collaboration is another area, where increasing research grants are provided. These are mostly project-based involvement, which needs to be sustained over a longer period of time.

5. LINK OF SCIENCE AND TECHNOLOGY TO PEOPLE

The Japanese DRR measure focuses on major cities not local areas. How to strengthen DRR capacity for areas, for instance, where the population of elderly people is high is one of future challenges.

Detailed DRR strategy and countermeasure are not yet applied or developed. For instance, anti-seismic structure against earthquakes is popular, however, any DRR technology and measure to reduce landslides risks have not been developed yet.

Regarding at the disaster response stage, comfortableness at evacuation centers is not fully considered at the preparedness stage. It may lead to causing less-incentives of evacuation actions by citizens.

More research is required at the local level, especially focusing on social science and behavioral science, and to investigate on how the science base early warning system leads to people in safer place, well ahead of time. It is necessary for indigenous knowledge to be validated, however, due to the limitation of number of experts, it has not been done widely.

Disaster related subjects are currently included in the classes of history and geography under the current school curriculum.

Science people linkage needs to address the interface of the science base system and the people's reception. Thus, it is important to link technical and human society together. For instance, one of the challenges is how to deliver science to elderly people in a user-friendly manner. In addition, it is necessary to address the issue as a social and welfare matter not only just as a disaster related issue.

The traditional role of universities and academia was to develop advanced technology, however, it is widely acknowledged that to address DRR issues as social problems is necessary and to develop solutions with social approach is indispensable. To reform the way of thinking of academia and universities regarding their roles is necessary.

6. LESSONS / ISSUES FROM PAST MAJOR DISASTERS

Changes in building codes, major guidelines: The most important part of lessons from past disaster includes detailed scientific investing of the failure of structure and/or system. For example, after the 1995 Great Hanshin Awaji Earthquake, the codes for RC buildings, steel structure, highways were revised, through the analysis of structural damages of buildings and infrastructures. Moreover, the school facility codes were improved by investing the functional dimension of the schools as evacuation place after the disaster. The same process was observed after the 2011 Great East Japan Earthquake and Tsunami, where the evacuation drill guidelines were revisited and updated.

From building safety to human safety: One of the key lessons from past disasters is to decide on how to safe human, rather than how to save building. This has been core to engineering discipline.

Multi-disciplinary research: A major changes in multi-disciplinary research has been observed after the 1995 Great Hanshin Awaji Earthquake, which has prompted the incorporation of social and cultural studies of people and communities to be linked to engineering and science based research to make it effective for decision making.

System resilience approach: A system based approach has been promoted after the few recent disasters, which need to investigate the most weak or vulnerable point of a system (as against a structure in the earlier practice), and proper corrective measures to overcome the problem. In urban areas, major problems and weaknesses also need to be addressed in order to strengthen resilience. This is not fully understood. It may be understood at municipalities, however, not by citizens and private sectors. It is not possible for them to understand risks and how to avoid them.

Understanding limitation of science: It is important to know the limitation of science in uncertain and complex disasters. Thus, the key lesson is to know the limitation, share it with people and link it to their actions.

7. SFDRR PRIORITY AREAS

SFDRR Priorities		Relative level of involvement of Science and Technology				
		1	2	3	4	5
1	Understanding disaster risk				■	
2	Strengthening disaster risk governance		■			
3	Investing in disaster risk reduction			■		
4	Enhancing disaster preparedness				■	

8. SHORT AND LONG-TERM GOALS (3 SPECIFIC ACTIONS FOR BOTH SHORT AND LONG-TERM GOALS)

1. Network of different academic associations to form Japan Academic Network for Disaster Reduction, under the auspices of Japan Science Council (an initiative, which started after the 2011 East Japan Earthquake and Tsunami).
2. More precise prediction and decision making of volcanic and landslide risk reduction.
3. Linking customization and implementation of scientific research based on the details needs assessment analysis.

1. Develop universal / standardized DRR system, which serves both the aged community as well as technology oriented young generation, irrespective of gender, nationality etc.
2. Enhanced preparedness for larger and complex disasters, which have possibly not been visualized in the regular disaster risk reduction scenario.
3. More synergetic approach of engineering, science and social/ behavioral sciences, which will be more need based demand driven research, rather than expertise based supply driven research.

9. HIGHER EDUCAITON STATUS

The Japanese education system is clearly divided into two categories – social sciences/liberal arts and natural science/engineering. In Japan, departments in universities are developed based on the need for job opportunities. If there is a need and request from local governments to train disaster risk reduction managers/disaster management experts, the courses/departments for disaster management can be developed. However, the area of disaster management is currently covered by generalists, therefore, there is only minimum possibility to establish a disaster management course in universities. Nonetheless, how to strengthen expertise and specialization of generalists in disaster management is a challenge. “How to utilize existing workforces” is a major concern.

Some of the major universities are currently considering professional training program (Master course in disaster management), through a university network approach, which will target mostly professionals in Japan and abroad.

More focus on higher studies on volcanology is required.

Higher education should be accessible to common people, who are interested in the subject.

1. PROFILE / CONTEXT*

Malaysia is exposed primarily to climate induced hazards such as floods, landslides, thunderstorms, forest fires and haze. Earthquakes and tsunami events have also been experienced in recent years. Although flood and flash floods are most common, landslides have contributed to the highest fatalities in the country. The National Security Council Directive No. 20 is the main guideline for disaster management in Malaysia. The Directive prescribes the management mechanism according to the level and complexity of disaster and determines the roles and responsibilities of various agencies when handling disasters. It is complemented by sectoral legislation such as the Land Conservation Act, Town and Country Planning Act, Uniform Building by Laws, etc. in forming a comprehensive framework to advance disaster risk reduction. The Government adopted the Melaka Declaration on Disaster Risk Reduction in 2011, which calls for integration of disaster risk reduction and climate change adaptation, engagement of communities and building resilience at the local level. The institutional arrangement for disaster management has been strengthened and made more robust through the establishment of the National Disaster Management Agency (NADMA) in 2015 to keep up with the current disaster scenario and address future challenges. The National Platform on Disaster Risk Reduction is under the aegis of NaDMA and draws on the support of multiple stakeholders in the country. The report has been prepared by Universiti Kebangsaan Malaysia's Southeast Asia Disaster Prevention Research Initiative (SEADPRI-UKM) with support from NADMA based on the inputs of stakeholders. The report was presented and endorsed at a stakeholder meeting held on 15 June 2016 at Bangi, Malaysia.

2. STATUS

	Attributes of Science and Technology to Disaster Risk Reduction (DRR)	1	2	3	4	5
1	**Science and Technology in decision making**					
1.1	Presence of Science and Technology advisory group to DRR nodal ministry and or/related ministries				■	
1.2	Presence of Science and Technology group in DRR national platform				■	
1.3	Existence of inter-ministerial discussion/dialogue on science related issues				■	
1.4	Implementation of risk, needs and damage assessment with involvement of Science and Technology group		■			
1.5	Existence of early warning system and mechanism with Science and Technology knowledge and tools				■	
1.6	Availability of disaster data/statistics on damage and impacts and its data collection mechanism		■			
1.7	Involvement of Science and Technology group in infrastructure design			■		
1.8	Scientific revision/updating of regulations, policies and guidelines for DRR including building codes, disaster response and preparedness plan etc.			■		
2	**Investment in Science and Technology**					
2.1	Existence of grant support by the national government to researchers in disaster related topics that focus on Science and Technology				■	
2.2	Establishment of disaster related courses in higher-education				■	
2.3	Presence of national research institutes and organizations for disasters			■		
2.4	Investment/support by the national government in national/international conferences and events on disasters for knowledge sharing				■	
2.5	Support to collaboration with academia and the private sector for developing innovative technical solutions			■		
2.6	Support to collaboration with academia and civil society for developing innovative social solutions			■		
3	**Link of Science and Technology to people**					
3.1	Availability of a hazard map to people, developed based on scientific knowledge		■			
3.2	Scientific validation of indigenous knowledge	■				
3.3	Involvement of Science and Technology group in developing program for evacuation drills		■			
3.4	Availability and participation of Science and Technology group in community discussion as facilitator or advisor/commentator			■		
3.5	Dissemination of science based early warning and forecast to people			■		
3.6	Involvement of Science and Technology group in developing disaster related education curriculum				■	
3.7	Existence of facilities such as museum and events such as expo to disseminate disaster knowledge and deepen understanding on disasters among citizens			■		

*This report is prepared by Professor Joy Pereira and her colleagues in Malaysia, in consultation with the government agencies in the country.

3. SCIENCE AND TECHNOLOGY IN DECISION MAKING

Malaysia has integrated disaster risk reduction into the overall national development plan over many decades. Science and technology is delivered implicitly in the form of regulations, policies, guidelines, standards, procedures and early warning systems through the involvement of federal technical departments that operate at the state and local levels. Such agencies include the Departments of Meteorology, Drainage and Irrigation, Minerals and Geoscience, Public Works and Environment. Many technical departments also play a regulatory role in assessing the quality of science and technology solutions provided by the private sector for local level development projects. Scientists from academia are involved by invitation to implement projects or review specific initiatives.

The Town and Country Department has mobilised inter-ministerial inputs involving technical departments, research institutes, academia and professional bodies through the establishment of various task forces and inter-agency expert committees in developing guidelines for local authorities. The Ministry of Science and Technology took the initiative to establish an inter-ministerial committee on Extreme Weather and Floods in 2013. In 2015, the Office of the Science Advisor to the Honourable Prime Minister of Malaysia convened key science and technology stakeholders and established the National Scientific Expert Panel for Disaster Risk Reduction. Upon formalisation, the Panel will serve as the primary platform for the application of science towards disaster management under the aegis of a national council chaired by the Prime Minister to provide timely and evidence-based inputs to support the National Platform on Disaster Risk Reduction, which comprises stakeholders from government, non-government organisations, civil society, academia and the private sector.

4. INVESTMENT IN SCIENCE AND TECHNOLOGY

The “Five Year Malaysia Plan” has always allocated substantial resources for structural flood mitigation. The 11th Malaysia Plan explicitly focuses on floods and other emerging hazards in a holistic manner, covering both structural and non-structural measures, where science and technology is an important component. Resources are channelled through various ministries and federal technical departments.

The Ministry of Science, Technology and Innovation and the Ministry of Higher Education also offers grants for research and development on disaster risk reduction. After the unprecedented floods of 2014, the Ministry of Higher Education allocated RM20 million to universities to conduct studies within several major river basins. This is the first nationally coordinated multi-disciplinary research in the country on floods. The plan is to transform the findings into action oriented initiatives in conjunction with practitioners from the public and private sector as well as the community.

In 2013, the National Science to Action (S2A) Initiative was launched by the Honourable Prime Minister of Malaysia, with the goal of delivering science for governance, science for industry and science for well-being. The S2A Initiative, which is implemented by the Office of the Science Advisor to the Honourable Prime Minister has delivered major programmes where disaster risk reduction is prominently featured to deliver science for community well-being. One such programme is the bilateral UK-Malaysia Newton Ungku Omar Fund, where the ultimate aim is to enhance public-private participation in transmitting science and technology for community well-being, focusing on the challenge of climate change including disaster risk reduction.

5. LINK OF SCIENCE AND TECHNOLOGY TO PEOPLE

Hazard maps are available in Malaysia. The terrain mapping exercise led by the Minerals and Geoscience Department delineates areas susceptible to landslides and other hazards for selected urban areas. The Drainage and Irrigation Department has developed flood risk maps while the Public Works Department have slope stability maps for major highways. Much of the information is too technical for the public and they are also of restricted access. Local level hazard information and multi-hazard maps have yet to be systematically established.

At present general advisories to the public that serve as early warning are available at the website of the Department of Meteorology for tropical depression, thunderstorms and heavy rains, strong winds and rough seas as well as earthquakes and tsunami. The Department of Irrigation and Drainage website provides information on the status of water levels of rivers as well as flood warning. The establishment of a one-stop source for early warning and dissemination of information for targeted groups will support swift decision making and response to protect the livelihood of communities.

Multi-disciplinary action oriented research that is context and area specific has to be enhanced at the local level involving disaster management practitioners, non-government organisations, the private sector, schools and community based organisations. Such research should be well coordinated and implemented in conjunction with the Local Authority so that relevant findings are easily channelled to improve existing administrative systems and processes to directly benefit the community. Efforts should also be made to scientifically validate local knowledge and enhance outreach on science and disaster management.

6. LESSONS / ISSUES FROM PAST MAJOR DISASTERS

Subsequent to the unprecedented floods of December 2014 floods, the following issues have been highlighted to advance science and technology for disaster risk reduction:

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.

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 relevant to all aspects of disaster management.

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.

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.

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.

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

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

7. SFDRR PRIORITY AREAS

SFDRR Priorities		Relative level of involvement of Science and Technology				
		1	2	3	4	5
1	Understanding disaster risk					
2	Strengthening disaster risk governance					
3	Investing in disaster risk reduction					
4	Enhancing disaster preparedness					

8. SHORT AND LONG-TERM GOALS (3 SPECIFIC ACTIONS FOR BOTH SHORT AND LONG-TERM GOALS)

1. Institutionalisation of the National Scientific Expert Panel for Disaster Risk Reduction to harness science and technology for preventing climate induced disasters and supporting the National Disaster Management Agency (NaDMA).
2. 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.
3. Development of protocols for multi-hazard assessments, information sharing, risk communication, disaster databases development, stakeholder involvement and community engagement at the local level.

1. 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.
2. 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.
3. 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.

9. HIGHER EDUCAITON STATUS

There are about six public universities offering higher education programmes on various aspects of disaster management. These are either through coursework at the Masters level or by research for both the masters and doctoral degrees. At the Bachelors level, there is significant coverage of disaster risk reduction within conventional programmes such as geology, planning, engineering, etc. Short courses are currently under development by bodies such as the Institute of Geology Malaysian and Malaysian Institute of Planners to be accredited by their respective professional bodies. Malaysia is contributing to building capacity at the regional level through the ASEAN Youth Volunteer Programme under the auspices of Ministry of Youth and Sports, where Universiti Kebangsaan Malaysia, Mercy Malaysia and several universities in the region are involved in developing training modules for creating ASEAN Youth DRR Leaders.

1. PROFILE / CONTEXT*

MYANMAR

Myanmar is prone to different natural disasters like earthquakes, cyclones, floods, droughts, landslides etc. Science Technology contribution to the disaster risk reduction approaches in the country has been differential over years. 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 Center (DMTC) provides a unique opportunity of collaboration with science technology academia sector.

2. STATUS

	Attributes of Science and Technology to Disaster Risk Reduction (DRR)	1	2	3	4	5
1	**Science and Technology in decision making**					
1.1	Presence of Science and Technology advisory group to DRR nodal ministry and or/related ministries		■			
1.2	Presence of Science and Technology group in DRR national platform		■			
1.3	Existence of inter-ministerial discussion/dialogue on science related issues			■		
1.4	Implementation of risk, needs and damage assessment with involvement of Science and Technology group	■				
1.5	Existence of early warning system and mechanism with Science and Technology knowledge and tools				■	
1.6	Availability of disaster data/statistics on damage and impacts and its data collection mechanism		■			
1.7	Involvement of Science and Technology group in infrastructure design			■		
1.8	Scientific revision/updating of regulations, policies and guidelines for DRR including building codes, disaster response and preparedness plan etc.		■			
2	**Investment in Science and Technology**					
2.1	Existence of grant support by the national government to researchers in disaster related topics that focus on Science and Technology	■				
2.2	Establishment of disaster related courses in higher-education		■			
2.3	Presence of national research institutes and organizations for disasters		■			
2.4	Investment/support by the national government in national/international conferences and events on disasters for knowledge sharing			■		
2.5	Support to collaboration with academia and the private sector for developing innovative technical solutions	■				
2.6	Support to collaboration with academia and civil society for developing innovative social solutions			■		
3	**Link of Science and Technology to people**					
3.1	Availability of a hazard map to people, developed based on scientific knowledge	■				
3.2	Scientific validation of indigenous knowledge	■				
3.3	Involvement of Science and Technology group in developing program for evacuation drills		■			
3.4	Availability and participation of Science and Technology group in community discussion as facilitator or advisor/commentator		■			
3.5	Dissemination of science based early warning and forecast to people			■		
3.6	Involvement of Science and Technology group in developing disaster related education curriculum		■			
3.7	Existence of facilities such as museum and events such as expo to disseminate disaster knowledge and deepen understanding on disasters among citizens			■		

* This report is prepared by Rajib Shaw, ASTAAG member through a series of interviews with Myanmar Engineering Society (MES) and several practitioners (both domestic and international) who have experiences in disaster risk reduction issues in Myanmar. This also includes the author's own judgment.

3. SCIENCE AND TECHNOLOGY IN DECISION MAKING

There is a newly formed National Spatial Data Infrastructure (NSDI) under the Ministry of Science and Technology, which develops science based national level spatial planning. The NSDI used drones to assess the conditions of landslides in some of the recent disasters, and the images were linked to the emergency operation center, which is located in the Ministry of Social Welfare, Relief and Resettlement.

For building code implementation, Myanmar Engineering Society (MES) is heading the Myanmar Earthquake Committee (MEC), which looks after the development and updating of the new codes. The committee also looks on the design and permission process of high-rise buildings. This is closely linked to the city governments in major urban areas.

MES has also been providing training to the government departments on different specialized subjects on disaster risk reduction. For doing that, MES has established 14 different regional offices, which work closely with the General Administration Department (GAD) and other regional offices of national ministries.

The limitations of science and technology should be perceived and acknowledged by reviewing the past disaster experiences.

4. INVESTMENT IN SCIENCE AND TECHNOLOGY

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.

5. LINK OF SCIENCE AND TECHNOLOGY TO PEOPLE

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.

The other issue / barrier of science technology is linking people and communities to the mindset of the academicians and technical people, reducing the impact on the ground. Therefore, more problem based research or a case study based analysis approach needs to be incorporated to bring the science technology to people.

The third point is the barrier of communication between the scientific community, government agencies and people. There needs to be an interface for science-policy-maker communication, and local non-government organizations or local universities can plan an important role there. In several cases, science data is not shared with the community in an easy to understand form. This means that there is a need for developing and updating local hazard and risk maps in the community levels.

6. LESSONS / ISSUES FROM PAST MAJOR DISASTERS

The Cyclone Nargis of 2008 has raised the awareness of disaster risk reduction to different levels in the country. Several international programs started focusing on holistic approaches of DRR in the country. One of the key focuses was to learn from the disaster experiences. The development / reevaluation of hazard maps of the country was done with the help from different technical groups inside and outside the country. The early warning system was evaluated and upgraded with overseas technical assistance, which also included the capacity building of technical staff in the related departments.

One of the key discoveries from Cyclone Nargis is the need to link technical and managerial skills. The Application side has been highlighted in different conferences and symposia, where experiences were shared. It also provided opportunities to collaborate with different external organizations. This discovery was used by some technical agencies like MES for better risk communication.

The technical people / government authorities who give early warning in local areas are not trained in proper risk communication language. The impact based early warning system is not in place. This needs to be linked and updated through past disaster experiences.

Innovative design competition was made with architecture students to upgrade building design after Cyclone Nargis.

7. SFDRR PRIORITY AREAS

SFDRR Priorities		Relative level of involvement of Science and Technology				
		1	2	3	4	5
1	Understanding disaster risk			■		
2	Strengthening disaster risk governance		■			
3	Investing in disaster risk reduction	■				
4	Enhancing disaster preparedness		■			

8. SHORT AND LONG-TERM GOALS (3 SPECIFIC ACTIONS FOR BOTH SHORT AND LONG-TERM GOALS)

1. Establish science based damage and loss assessment tools at local level.
2. Promote innovative as well as practical research on DRR, encouraging local institutions to contribute to this.
3. Develop extensive local level hazard and risk mapping with periodic updating system.

1. Curriculum and capacity development programs in the universities and technical institutions.
2. Updating, linking university research and capacity building to government based training programs like DMTC.
3. Making technology as means to disaster preparedness with science based public awareness programs.

9. HIGHER EDUCAITON STATUS

There are several universities who are interested in the disaster risk reduction programs as a part of the certificate courses in the universities. However, faculty capacity building is an important issue in this respect. MES has strong technical capacity, which can be used for enhancing the faculty members' technical knowledge in the related subject. There are several overseas cooperation programs with the universities, which also focuses on research and education upgrades, including curriculum and faculty development. There needs to be a strong link with the government established training center, which will ensure longer term sustainability of the education and training programs in the universities.

1. PROFILE / CONTEXT*

Pakistan

Pakistan has a long history of a 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 meager 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. The significance of DRR was realized and the national disaster management commission (NDMC) was established in 2006 to proactively respond to disasters. Eventually, national disaster risk management framework (NDRMF) was developed to provide guidelines for the key stakeholders. In this regard, national disaster management authority (NDMA), a focal body was assigned a task to implement DRR policies, strategies and programs. The progress on national disaster management plan 2012-2022 is in full swing. In the country, a network of Disaster management authorities has been introduced at all levels. The recent disasters have convinced the decision makers to mainstream science and technology in decision making and preparedness.

2. STATUS

	Attributes of Science and Technology to Disaster Risk Reduction (DRR)	1	2	3	4	5
1	**Science and Technology in decision making**					
1.1	Presence of Science and Technology advisory group to DRR nodal ministry and or/related ministries		■			
1.2	Presence of Science and Technology group in DRR national platform			■		
1.3	Existence of inter-ministerial discussion/dialogue on science related issues		■			
1.4	Implementation of risk, needs and damage assessment with involvement of Science and Technology group		■			
1.5	Existence of early warning system and mechanism with Science and Technology knowledge and tools			■		
1.6	Availability of disaster data/statistics on damage and impacts and its data collection mechanism			■		
1.7	Involvement of Science and Technology group in infrastructure design		■			
1.8	Scientific revision/updating of regulations, policies and guidelines for DRR including building codes, disaster response and preparedness plan etc.			■		
2	**Investment in Science and Technology**					
2.1	Existence of grant support by the national government to researchers in disaster related topics that focus on Science and Technology			■		
2.2	Establishment of disaster related courses in higher-education		■			
2.3	Presence of national research institutes and organizations for disasters		■			
2.4	Investment/support by the national government in national/international conferences and events on disasters for knowledge sharing		■			
2.5	Support to collaboration with academia and the private sector for developing innovative technical solutions		■			
2.6	Support to collaboration with academia and civil society for developing innovative social solutions			■		
3	**Link of Science and Technology to people**					
3.1	Availability of a hazard map to people, developed based on scientific knowledge		■			
3.2	Scientific validation of indigenous knowledge	■				
3.3	Involvement of Science and Technology group in developing program for evacuation drills		■			
3.4	Availability and participation of Science and Technology group in community discussion as facilitator or advisor/commentator		■			
3.5	Dissemination of science based early warning and forecast to people			■		
3.6	Involvement of Science and Technology group in developing disaster related education curriculum		■			
3.7	Existence of facilities such as museum and events such as expo to disseminate disaster knowledge and deepen understanding on disasters among citizens		■			

* This report is prepared by Dr. Atta-ur Rahman and his colleagues in Pakistan, in consultation with the government officials in the country.

3. SCIENCE AND TECHNOLOGY IN DECISION MAKING

The National Disaster Risk Management Framework has insisted on application of science and technology in collection, compilation, analysis and dissemination of risk information. The inter-ministerial discussion on DRR related scientific solution is slowly gaining importance.

There are many institutions/organisations such as Science and Technology, PASTIC, COMSTECH, Pakistan Science Foundation (PSF), Pakistan Agriculture Research council (PARC), Pakistan Engineering Council (PEC), Higher Education Commission (HEC) etc. are working to enhance the awareness of decision makers and to give priority to application of science and technology while handling DRR issues.

The NDMA is in the process of developing hazard based expert group to provide policy guidelines to help in decision making process. NDMA has recently established DRR expert groups for each hazard e.g. seismic expert group. At provincial and district level, there is need of national level replica in identifying scientists and technical experts to help the local disaster management authorities in disaster management process.

However, bridging NDMA, government organisations and scientific community is one of the poor section in disaster management system in Pakistan, which need due attentions of NDMA to properly mainstream the scientific and technical expert.

At national level, the National disaster management plan typically focuses on risk assessment and mapping, strengthening the existing forecasting and early warning system.

The disaster related data is collected through a rigorous process at gross root level. The revenue official bearer at village level (Potwari) is responsible to collect damage data, which is communicated to sub-district (tehsil) and then to DDMA and then to PDMA and finally to NDMA.

The national housing authority has revised building codes for the entire country. The government is now mainstreaming building regulations in the infrastructure planning process.

4. INVESTMENT IN SCIENCE AND TECHNOLOGY

In Pakistan, investment in Science and Technology is limited. In this regards, the decision makers need sensitization. The percentage of GDP spent on education, science and technology is one of the lowest amongst the south Asian countries. Research based investment in science and technology especially in DRR is either lacking or in fractions.

The existing investment is spread over wide range of organizations and departments with acute shortage of DRR expertise. Recently, the NDMA has devised project guidelines and insisted on the sponsoring agencies to keep NDMA in loop, while undertaking DRR projects.

NDMA has established exclusive DRR related National Institute of Disaster Management (NIDM), which supervises training and capacity building programs for managing disasters. NIDM has started database development of Disaster Management related capacity building and training initiatives being carried out by public, private and humanitarian community in Pakistan.

To address the concept of disaster and create awareness, different DRR Forums are also working at national and provincial/regional level with strong participation of practitioners.

The PDMA have allocated funds in their roadmap for Disaster Risk management 2014-2019 and invited research scholars to conduct research on Disaster Management.

The NDMA, SUPARCO and related organizations are applying Geo-informatics in MHVRA and mapping.

The Ministry of Climate Change has been vested with the mandate to comprehensively address Disaster Management along with spearheading national climate change initiatives of adaptation and mitigation.

The recent development includes Strengthening of Pakistan Meteorological Department, Global Change Impact Study Centre and establishment of Pakistan Scientific and Technological Information Center (PASTIC). In addition to academia, Geological survey of Pakistan, Federal Flood Commission, Flood Forecasting Division, Drought Monitoring Centre, Space and Upper Atmospheric Research Commission etc. are also working in DRR.

5. LINK OF SCIENCE AND TECHNOLOGY TO PEOPLE

The link between Science & Technology and the general public and their problems is a matter of discussion that needs to be highlighted. There is a gap between innovations, research, industries and people. In this regard, the Higher Education Commission (HEC) has established ORIC (Office of Research Innovation and Commercialization) in all private and public sector universities and degree awarding institutions. As a result, academia and an industry linkage program has been improved to some extent. However, this program needs government attention to further strengthen.

Looking to the importance of science and technology in disaster management, the government has taken good initiative such as establishment of well-equipped emergency response centers i.e. Rescue 1122. Similarly, to improve early warning systems, the government is launching advanced weather RADAR(s) at various locations to forecast the extreme weather events and disseminate early warning to the community.

Links between indigenous local knowledge and scientific development are missing. Proper dissemination of scientific data to local communities is at an initial stage.

Comprehensive data availability and access to, is either challenging or limited. In order to increase data accessibility, an open access web based system would be the most appropriate solution.

MHVRA assessment and mapping is part of NDMP and there needs to be a developed scientific knowledge base. The disaster management authorities should ensure availability of community based maps.

The disaster management authorities and academia are organising disaster management exhibitions and expo to disseminate disaster knowledge amongst the citizens. The existing organisations should regularly organise MOC and evacuation drill and the advisory/expert group need to be made part of the process.

6. LESSONS / ISSUES FROM PAST MAJOR DISASTERS

After 2005 Kashmir earthquake, a paradigm shift has been noted from reactive to proactive. It was the starting point of DRR awareness from national to local level. After 2005 Kashmir earthquake, a series of natural and human induced disasters proved an eye-opener for the general public, organizations and academia and created curiosity regarding DRR training and disaster education.

In follow-up, disaster management Legislations including DMO 2006 and DMAct 2010 were approved by the parliament. Wherein, at national level NDMA, at Regional/ provincial level PDMA, at district level DDMA and in major urban centres emergency response i.e. Rescue 1122 were established.

At national level, National Disaster Management Plan (2012-2022) was developed, whereas at regional/provincial level disaster management authorities are planning for devising long-term plans. However, the progress on district disaster management plan is quite productive. Similarly, every year Monsoon contingency plans are prepared at national and provincial tier.

The tags organisations, NDMA and PDMAs issue alerts and disseminates early warning to the masses both on web and cell phones.

There is a dedicated financial resource mechanism for disaster mitigation, preparedness and response. Effective rapid/damage needs assessment.

Linkages between academia/ scientific community and disaster management authorities were established and the role of academia in DRR was recognized as a scientific component.

Development of new building codes, legislative coverage through building code policy 2007 and its infusion in reconstruction and recovery process.

A radical shift has been noted towards multi-disciplinary, multi-hazards and multi-sectoral disaster risk management approaches.

7. SFDRR PRIORITY AREAS

SFDRR Priorities		Relative level of involvement of Science and Technology				
		1	2	3	4	5
1	Understanding disaster risk					
2	Strengthening disaster risk governance					
3	Investing in disaster risk reduction					
4	Enhancing disaster preparedness					

8. SHORT AND LONG-TERM GOALS (3 SPECIFIC ACTIONS FOR BOTH SHORT AND LONG-TERM GOALS)

1. Striving for a Disaster Resilient Pakistan
2. Multi-Hazard, Vulnerability and Risk Assessment and Mapping at national and local level
3. Implementation of building codes, enforcement of land use zoning and regulations

1. Strengthening and Capacity building of DRR related line agencies
2. Expedite reconstruction and rehabilitation of recently disaster affected population
3. Establishment of District Disaster Management Authorities (DDMAs) and development of District Disaster Management Plans.

9. HIGHER EDUCAITON STATUS

The status of higher education is sensitization and infusion of DRR education and awareness.

The National Curriculum Review Committee (NCRC) has developed curriculum for BS and MSc degree program in disaster management, but currently very few universities are offering degree programs/ disaster management education.

There is a positive change and trend towards disaster and climate change education and gaining importance due to the increasing occurrences of geo-physical and hydro-meteorological events.

Amongst the degree awarding institutions, the first ever Centre for Disaster Preparedness and Management (CDPM) was established at University of Peshawar in 2008. It was followed by other universities including a BS programme in Climate change and Disaster management at the University of Swat, MS program in Disaster Management at the National University of Science and Technology, MS program in Disaster management at the Riphah International university, Climate Change Centre at Agriculture University Peshawar, Earthquake Engineering Centre at the University of Engineering and Technology Peshawar, Courses on Earthquake at NED Karachi, Courses in Pakistan Forest Institute.

Parallel to this, the Higher Education Commission are also sponsoring research projects on DRR, providing finances for organizing conferences, workshops and symposia.

PHILIPPINES

1. PROFILE / CONTEXT*

The Philippines is highly exposed and vulnerable to all major natural hazards. The Department of Science and Technology is the lead policy development and executive body for hazard mitigation. Socio-economic impacts of extreme weather events such as Durian (2006) and Ketsana (2009) catalyzed government investments in early warning systems and the reorganization of the National Disaster Risk Reduction and Management Council (2010). Under this law, the DOST is the lead agency for hazard prevention and mitigation. Leadership, early warning science and technology and lessons learned from Haiyan (2013) have led to decreases in the loss of lives in 2014-15. The 2010 law is now under review.

2. STATUS

	Attributes of Science and Technology to Disaster Risk Reduction (DRR)	1	2	3	4	5
1	**Science and Technology in decision making**					
1.1	Presence of Science and Technology advisory group to DRR nodal ministry and or/related ministries			■		
1.2	Presence of Science and Technology group in DRR national platform			■		
1.3	Existence of inter-ministerial discussion/dialogue on science related issues		■			
1.4	Implementation of risk, needs and damage assessment with involvement of Science and Technology group					
1.5	Existence of early warning system and mechanism with Science and Technology knowledge and tools				■	
1.6	Availability of disaster data/statistics on damage and impacts and its data collection mechanism		■			
1.7	Involvement of Science and Technology group in infrastructure design	■				
1.8	Scientific revision/updating of regulations, policies and guidelines for DRR including building codes, disaster response and preparedness plan etc.			■		
2	**Investment in Science and Technology**					
2.1	Existence of grant support by the national government to researchers in disaster related topics that focus on Science and Technology			■		
2.2	Establishment of disaster related courses in higher-education		■			
2.3	Presence of national research institutes and organizations for disasters	■				
2.4	Investment/support by the national government in national/international conferences and events on disasters for knowledge sharing			■		
2.5	Support to collaboration with academia and the private sector for developing innovative technical solutions	■				
2.6	Support to collaboration with academia and civil society for developing innovative social solutions		■			
3	**Link of Science and Technology to people**					
3.1	Availability of a hazard map to people, developed based on scientific knowledge			■		
3.2	Scientific validation of indigenous knowledge	■				
3.3	Involvement of Science and Technology group in developing program for evacuation drills			■		
3.4	Availability and participation of Science and Technology group in community discussion as facilitator or advisor/commentator		■			
3.5	Dissemination of science based early warning and forecast to people			■		
3.6	Involvement of Science and Technology group in developing disaster related education curriculum		■			
3.7	Existence of facilities such as museum and events such as expo to disseminate disaster knowledge and deepen understanding on disasters among citizens	■				

* This report was prepared by Antonia Yulo Loyzaga of the Manila Observatory, Dr. Emma Porio, Justin See and Jerome Azul of the Ateneo de Manila University with contributions from Dr. Carlos Primo David of the DOST-PCIEERD and Dr. Gregorio Tangonan of the Ateneo Innovation Center.

3. SCIENCE AND TECHNOLOGY IN DECISION MAKING

The National Academy of Science and Technology is an attached agency of the Department of Science and Technology. It provides advice and recognizes achievements in science and technology in the Philippines. With the support of the private sector, it organizes annual climate change conferences for academicians and research scientists. There has been no similar effort for disaster science. Moreover, there is no formal institutional linkage between these proceedings and decision-making needs at the local level. Major projects such as DREAM LIDAR and Project NOAH were designed and implemented by the DOST at the national level. While these capabilities are being cascaded downwards through local governments and universities, their value to local communities is still limited.

Local government units, civil society and the private sector augment government information and tools with knowledge and expertise from state and private universities and research institutes. However, contextualizing hazards and risk assessments formulated at the national level as inputs into decision support systems remains a challenge.

Data quality, access and technical capacity in formulating integrated risk assessments are enhancing disaster risk reduction across sectors at the municipal and community level but more advocacy on this is still needed.

4. INVESTMENT IN SCIENCE AND TECHNOLOGY

Government spending disaster risk reduction has historically been heaviest in the building of infrastructure such as flood management systems. This has shifted in the last five years toward early warning and its support systems. The DREAM LIDAR, Project NOAH, Diwata microsatellite projects, and the updating of the Risk Analysis Project for Metro Manila are among the national government flagship projects. The LIDAR mapping of Metro Manila and selected major cities and river basins was designed to complement the investments in the Doppler radar-based assessment of flood hazards. The microsatellite project is part of a national government initiative to establish a national space agency.

While government-academe-industry linkage is still relatively weak, the Philippine Council Industry, Energy and Emerging Technology Research and Development of the DOST provides grants, networking and partnership opportunities to universities and research institutions in the areas of climate change and disaster risk reduction. New windows for funding trans-disciplinary collaboration are being tested and innovations in the application of radio, UAV and IT and other disaster response and recovery technologies are being presented to national and local governments and the private sector for support.

The council will prioritize proposals that have both a physical and social science foundation and that can be easily translated into evidence-based policies and programs.

5. LINK OF SCIENCE AND TECHNOLOGY TO PEOPLE

Government and civil society are leading various initiatives to communicate disaster risk and mainstream both science and technology in disaster risk reduction. Government efforts have been largely top-down in their approach and local governments and communities have expressed confusion when trying to decide which set of spatial data and mapping tools to use when developing their local decision support system.

Under the present system, risk governance is devolved to local mayors and their teams. Compounding this challenge is the lack of coordination between the different executive departments and the implementing agencies.

Civil society, academe and the private sector are now collaborating with both national and local government in identifying gaps and priorities in mainstreaming science and technology into local DRR plans and programs.

Locally, disaster risk reduction is still often understood as emergency planning and relief operations. There is a need to build a common understanding of risk reduction as a development challenge and the value of science and technology in insuring inclusive growth.

Local universities are important generators and repositories of DRR science and technology. Immersed in local challenges, they can contextualize, formulate and articulate local priorities to national government.

6. LESSONS / ISSUES FROM PAST MAJOR DISASTERS

Understanding and communicating the science of hazards can lead to critical failures that cost thousands of lives. The dynamics of exposure and vulnerability also need to be locally contextualized. While early warning systems were in place,

Typhoon Bopha, Washi and Haiyan illustrate how failures like these cost thousands of lives.

On earthquake preparedness, a trans-disciplinal and systems framework is needed. Efforts to build formal science-based multi-stakeholder collaboration based on the anticipated impacts of a 7.2 magnitude earthquake in Metro Manila are just emerging. These, however, have not recognized the potential social dynamics between the different exposed and vulnerable populations.

When preparing and responding to catastrophic events, decision-making mandates, structures and systems and the science needed at each level should be clarified and confirmed.

The roles and contributions of the private sector need to be clearly defined. Institutional mechanisms should be put in place to reflect inter-agency and multi-stakeholder collaboration.

Pathways for innovations in UAV, communications and information technologies need to open for possible mainstreaming in disaster preparedness, prevention, response and recovery.

7. SFDRR PRIORITY AREAS

SFDRR Priorities		Relative level of involvement of Science and Technology				
		1	2	3	4	5
1	**Understanding disaster risk** (Assessment, data, baseline, capacity)					
2	**Strengthening disaster risk governance** (standards, certification, capacity building)					
3	**Investing in disaster risk reduction** (innovative products with private sector)					
4	**Enhancing disaster preparedness** (guidance, instruments)					

8. SHORT AND LONG-TERM GOALS (3 SPECIFIC ACTIONS FOR BOTH SHORT AND LONG-TERM GOALS)

1. Build greater understanding of the complexity of disaster risk through interaction and planning with executive departments and agencies.
2. Work directly with communities on identifying and articulating shared risks and preparing at the level of self, household and community.
3. Link science to policy and practice through legislation and local action.

1. Link science and technology to strategic development planning at the national level.
2. Establish and institutionalize pathways for public-private collaboration in disaster risk reduction for national resilience.
3. Build industry-academe-government ties for DRR and inclusive development.

9. HIGHER EDUCAITON STATUS

A national scoping of DRR and DRR related science and technology courses has been completed. The Manila Observatory currently leads the work stream on DRR education and training for UNISDR ARISE in the Philippines. Under this work stream, the Manila Observatory and the Ateneo de Manila University committed to collaborate in order to design certificate and degree programs to respond to science, policy and practice gaps in disaster risk reduction. These graduate courses are designed to build a trans-disciplinary foundation in disaster risk reduction for academe, industry, government and practitioners. Offerings will include course work and research mentorship with other university partners.

1. PROFILE / CONTEXT*

Vietnam is located in South-east Asia, comprising complicated terrains including mountains, hills, deltas, rivers, coastal lines and continental shelf. The diversity of Vietnam's land and water areas make it vulnerable to various disasters especially floods, typhoons, droughts, and landslides. Disaster risk reduction (DRR) is considered an important task in every stage of the country's development. The National strategy for Natural disaster prevention, response and mitigation to 2020, issued in 2007, highlighted the application of modern science and technologies as one of the important measures for DRR. Vietnam also warrants an annual budget for the Program on science and technology development for DRR.

2. STATUS

	Attributes of Science and Technology to Disaster Risk Reduction (DRR)	1	2	3	4	5
1	**Science and Technology in decision making**					
1.1	Presence of Science and Technology advisory group to DRR nodal ministry and or/related ministries		■			
1.2	Presence of Science and Technology group in DRR national platform	■				
1.3	Existence of inter-ministerial discussion/dialogue on science related issues		■			
1.4	Implementation of risk, needs and damage assessment with involvement of Science and Technology group		■			
1.5	Existence of early warning system and mechanism with Science and Technology knowledge and tools			■		
1.6	Availability of disaster data/statistics on damage and impacts and its data collection mechanism				■	
1.7	Involvement of Science and Technology group in infrastructure design			■		
1.8	Scientific revision/updating of regulations, policies and guidelines for DRR including building codes, disaster response and preparedness plan etc.				■	
2	**Investment in Science and Technology**					
2.1	Existence of grant support by the national government to researchers in disaster related topics that focus on Science and Technology			■		
2.2	Establishment of disaster related courses in higher-education		■			
2.3	Presence of national research institutes and organizations for disasters				■	
2.4	Investment/support by the national government in national/international conferences and events on disasters for knowledge sharing				■	
2.5	Support to collaboration with academia and the private sector for developing innovative technical solutions		■			
3	**Link of Science and Technology to people**					
3.1	Availability of a hazard map to people, developed based on scientific knowledge		■			
3.2	Scientific validation of indigenous knowledge		■			
3.3	Involvement of Science and Technology group in developing program for evacuation drills	■				
3.4	Availability and participation of Science and Technology group in community discussion as facilitator or advisor/commentator			■		
3.5	Dissemination of science based early warning and forecast to people		■			
3.6	Existence of facilities such as museum and events such as expo to disseminate disaster knowledge and deepen understanding on disasters among citizens	■				

* This report is written by Dr. Nguyen Ngoc Huy (ISET Vietnam) and Dr. Tong Thi My Thi (HUNRE Vietnam) based on reviews from relevant documents and reports and interpretation from interviews with Mr Dang Quang Minh, Deputy Director of the Disaster Management Center - DMC (Ministry of Agriculture and Rural Development - MARD), Prof. Dr. Le Anh Tuan, Dragon institute, Can Tho University and Ms. Nguyen Thi Thu Ha, Head of education and technology department, DMC, MARD.

3. SCIENCE AND TECHNOLOGY IN DECISION MAKING

At national level, the Ministry of Science and Technology (MOST) and the Vietnamese Academy of Science and Technology (VAST) are the two bodies taking the main responsibility for the programs and projects of enhancing science and technology application capacity for disaster management in Vietnam. Of which, space technology for DRR led by the Institute of Geography, VAST. In reality, applying Science and Technology to decision making is limited and with less participation of scientists in the planning meetings, there is less application of research results for planning and implementation.

The National strategy for natural disaster prevention, response and mitigation to 2020 (NS-DPRM) highlighted the development of science and technologies related to natural disaster prevention, response and mitigation as one of important solutions for DRR with focus on the application of advanced scientific and technological achievements to improve capacities of disaster forecast, prediction, warning, and communication; to improve research capacities to observe the Earth's variability and natural changes in the region and territory; encourages the application of advanced technology and new materials for disaster prevention, response and mitigation.

The main strategies of MOST for DRR during 2011-2015 focused on the application of modern science and technology to improve disaster forecasting, prediction, warning, and disaster communication systems. Especially for typhoons (forecast within 4-7 days), floods in Central regions (forecast within 3-4 days), droughts (forecast within 3-6 months), landslides (forecast within 2-5 days).

4. INVESTMENT IN SCIENCE AND TECHNOLOGY

The National strategy for science and technology development in 2011-2020 set the target to increase public annual investment for science and technology up to 1.5% GDP in 2015 and 2% GDP in 2020. Among of this, there are very few funds allocated for science and technology related disasters.

The Vietnamese State has policies to take advantage of ODA and FDI for disaster prevention and mitigation projects, giving priority of non-refundable ODA utilization for capacities strengthening and technological and management experience transfer. Most of these budgets are allocated to infrastructure. There are few projects that have allocated funds for improvement of forecasting and early warning.

The National strategy for Natural disaster prevention, response and mitigation to 2020 stated that Vietnam should provide preferences and to protect legitimate interests of organizations and individuals investing in disaster prevention, response and mitigation, to encourage national and international organizations and individuals to invest in researching and applying science and modern technologies in combination with traditional methods.

5. LINK OF SCIENCE AND TECHNOLOGY TO PEOPLE

In Vietnam, advanced science and technology for DRR was prioritized for developing warning system to people, strengthening staff capacities and upgrading working places for steering agencies/ bodies at all levels.

Since 2001, the State has set up a computer based information link between Central Committee on Flood and Storm Control (CCFSC), Disaster Management Unit (DMU) and the Hydro-meteorological Services (HMS), connected to the provincial CFSCs of all 61 provinces of Vietnam. This linkage was used to provide timely warnings to local people, to respond to emergency relief requests, and to disseminate information of disaster management.

A computer-graphics based weather and disaster warning system was designed for the Central Vietnam Television.

Flood and inundation maps were developed for all Central provinces of Vietnam, using the most up-to-date GIS technology.

A river flood alert system was set up on the most flash flood prone rivers in the Central Vietnam to give advance warning of impending flooding.

In addition, space technology for DRR has recently researched and applied, including satellite image processing, information integration, database establishment and programming, environmental issues solving.

Autonomous real time salinity monitoring systems is installed in some areas in the Mekong delta to provide information to people.

In 2013, when the Typhoon Haiyan hit Vietnam, all people in the effected areas received early warning SMS from telecom companies.

6. LESSONS / ISSUES FROM PAST MAJOR DISASTERS

Review and supplement building codes: Huge structural damages recorded from major disasters such as tropical storm Linda 1997, typhoon Xangsane 2006 urges the Vietnamese government to review, amend, and complete building codes in line with natural disaster characteristics in each region. The NS-DPRM included the project to ensure that the development planning and building codes of socio- economic structures and residential areas in places frequently affected by disaster suit to regional standards for flood and storm control

Strengthen warning system for earthquake and tsunami: advanced technology for DRR countermeasures in Vietnam focused merely on common disasters such as floods and typhoons. However, after a warning on earthquake and tsunami was issued during typhoon Xangsane 2006, a system of earthquake and tsunami warning system was first established in Da Nang City with 10 alert stations. In 2016, there are 532 alert stations for earthquake and tsunami warning will be built in 13 coastal cities facing a high tsunami risk.

Building scientific and technological capacity for staff in disaster management: understanding the importance of high-qualified staff relevant for advanced technology establishment, Vietnam promoted annual training activities on the usage of modern equipment and updated space technology in early warning system for disaster management officials at all levels.

7. SFDRR PRIORITY AREAS

SFDRR Priorities		Relative level of involvement of Science and Technology				
		1	2	3	4	5
1	**Understanding disaster risk** (Assessment, data, baseline, capacity)					
2	**Strengthening disaster risk governance** (standards, certification, capacity building)					
3	**Investing in disaster risk reduction** (innovative products with private sector)					
4	**Enhancing disaster preparedness** (guidance, instruments)					

8. SHORT AND LONG-TERM GOALS (3 SPECIFIC ACTIONS FOR BOTH SHORT AND LONG-TERM GOALS)

1. Enhance the capacities of forecasting flood, storm, drought, and seawater intrusion, of which the focus is given to increase the early warning of storm and tropical depression to 72 hours in advance.
2. Research and develop modern scientific and technological system of informing earthquake, of warning tsunami and extreme hydro- meteorology phenomena.
3. Improve information and communication systems and management of boats and ships at sea.

1. Modernize early warning systems from central, regional to local levels, focusing on efficient communication methods.
2. Apply new materials and technologies to construction of several disaster prevention and mitigation structures.
3. Develop scientific sectors related to disaster: emergencies, disaster management, sustainable development, health care, post-disaster environmental and production recovery.

9. HIGHER EDUCAITON STATUS

The Vietnamese Higher Education system has expanded in both scale and scope- driven by labor market demand since Doi Moi period. There are now over 1.3 million Vietnamese enrolled in 230 higher education institutions, increasing access to a wider population.

Due to the shortage of skilled labor informed in the recent year, many universities transformed their curriculum to meet the society's demand for green industry.

Hanoi University of Natural Resource and Environment is the first university in Vietnam to provide specialized course on Climate Change at Bachelor degree level. However, there is still an absence of content on disaster management in the curriculum.

CASE STUDIES

Science and Technology for Disaster Risk Reduction

25. Case Study: Cross Boundary Flood Risk Management
26. Case Study: Digital Radio
27. Case Study: Disaster Resilient House and Schools
28. Case Study: Ecosystem

01

The Study on GLOFs (Glacial Lake Outburst Floods) in the Bhutan Himalayas

Miki Inaoka, Japan International Cooperation Agency (JICA)

What is the initiative?
The titled Project carried out the following: a potential assessment using satellite images, development of a database of dangerous glacial lakes, establishment of an assessment criteria based on verification of former condition in topography and water level of once broken lakes, compilation of an inventory of historical glacial lake expansions, climatological analysis on historical expansions of glacial lakes, understanding of the expanding mechanism of glacial lake through interaction of ice and water, assessment of risk factors and triggers of GLOF in/around glacial lakes, evaluation of the vulnerability to dam collapse, simulation of glacial lake break and floods, hazard maps, and finally proposal of an effective early warning system

Why needs science and technology?
No evidence-based research method regarding glacier and GLOF had been established.

How was science and technology applied to the initiative?
The Project carried out field surveys, geophysical surveys and analyses. As a result the Project concluded that there were few glacier lakes that had an immediate risk of GLOF, and that early warning systems might be more effective than separate measures to drain the water from glacier lakes. The Project also identified annual floods a larger risk to the community that required mitigation measures, comparing to GLOF.

What was the difference by applying science and technology in terms of resilience building or policy making on disaster risk reduction?
Application of satellite images for initial assessment, and surveys carried out by experts were a new challenge and developed a new comprehensive knowledge about GLOF.

Why is it considered as good practice and what kind of key factors that contributed to the success?
The achievements were transferred to the local authority. The detailed information and data that were obtained through the Project enabled the warning system to be designed in careful consideration of local settings, actual speed of flood, etc. These all contributed to provide the real perception of the risk of GLOF to the government agencies, and will enable the government to mitigate the risk not only from the disaster of GLOF but also from other disasters including floods and landslides.

What will be the challenge if one to replicate the application?
These results might not always apply to all countries that have glacier lakes, considering the size and number of glaciers or the population to be protected.

02

Science Technology Advancement in China

HU Junfeng, MCA, China

Improvements to China’s monitoring, early warning, and risk assessment system

China has carried out a series of research projects (e.g., on meteorology, earthquakes, geology, oceanic conditions, hydrology, agriculture and forestry, and integrated disaster prevention and reduction) via various types of science and technology programs such as The National Basic Research Program (the “973” Program) and the National Natural Science Foundation Key Projects. Such projects emphasize public safety, with a particular focus on “major natural disaster monitoring and prevention”, as outlined in the National Mid- and Long-term Plan on the Development of Science and Technology (2006–2020). This plan has unified and integrated resources in academia to strengthen the capacity of technology innovation and production in disaster monitoring and prevention in related fields. This signals a significant improvement in scientific support for disaster response. The national disaster management system (Fig. 1) utilizes and integrates modern communication systems, computers, and information management technologies.

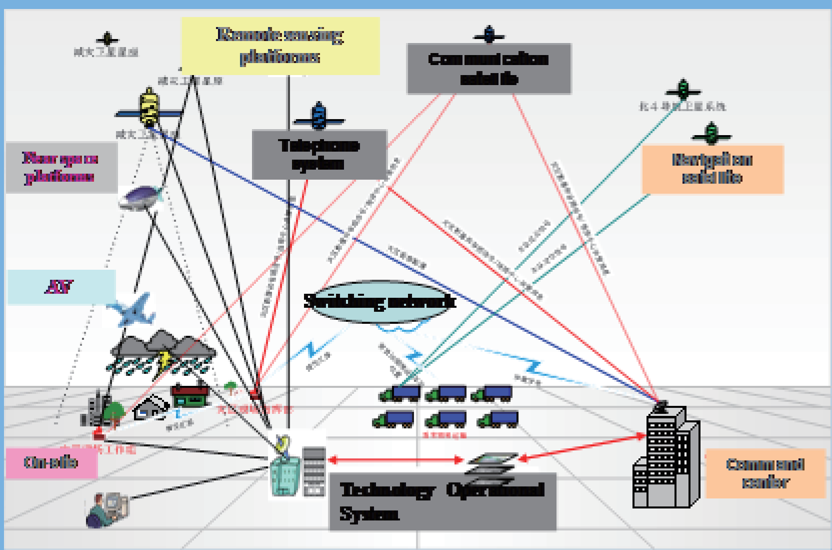


Fig. 1 Illustration of China’s natural disaster monitoring and early warning system

The established systems for natural disaster monitoring include remote disaster monitoring, meteorology forecasting, early warning and monitoring of hydrology and flood events, earthquake monitoring, forest and gralss land fire monitoring, and geological and environmental monitoring. The capacity to monitor and detect early warning signals for natural disasters has been greatly improved. For example, more than 31 provinces, 236 cities, and 1210 counties have set up inter-departmental monitoring and early warning information platforms for geological disasters. Altogether, nearly 5000 forest fire risk monitoring stations and forest fire risk-factor collection stations have been built to identify and present early warnings for forest fires and forest pests. A five-grade disaster statistic system has been established and developed. Within 2–6 hours of a disaster, disaster information officers can report relevant information to higher-level authorities for management and appropriate decision-making. Ministry of Water Resources constructed the command system for flood control and drought relief. More than 90 thousand water condition monitoring sites were established nationwide, providing real-time information collection, summarizing and reporting of rainfall, water resources, flood hazards and disaster losses, to support the decision-making in flood control and drought relief. The development of a widespread earthquake network has been set up to monitor tsunami around the South Sea; thus, China's early warning tsunami system is further improved.

Effects:

As a result of the above inputs, China has made solid progress in exploring the occurrence, cause, and evolution of disasters. It has also enhanced its technical capacity in respect of, for example, disaster monitoring, early warning, risk assessment, and emergency management. Remote sensing, geo-spatial information systems, satellite navigation, communication, and broadcasting technologies have all played an important role in the response to major disasters. Disaster prevention and reduction institutes have been established and a science and technology support platform is now in place. By studying relevant forefront technologies, updating disaster prevention and reduction equipment, and strengthening relevant IT construction, China has substantially improved its modern technologies. Thus, disaster management is no longer a rudimentary and manual operation; it has been transformed into a precise and elaborate mechanism.

The strengthened risk assessment of different types of disasters in major industrial sectors

Since the introduction of the UN International Disaster Reduction Campaign in 1989, Chinese universities, academia, and institutes have undertaken research and published an atlas series outlining natural disasters in China. The Atlas of Natural Disasters in China was first published in 1992. This was then updated and improved in 2003, titled the 2003 Atlas of Natural Disaster System of China, and again as the Atlas of Natural Disaster Risk of China in 2011 (Fig. 2).

Fig. 2 Atlas series of natural disasters in China

The Chinese government has conducted and developed two important surveys: a land resources survey and a geological disaster and environmental survey. National, provincial, city, and county geological disaster databases have been established, and national geological disaster risk maps complied. Based these developments, group monitoring, prevention networks, and monitoring and early warning platforms have been established. The government has also conducted flood risk mapping, mountain torrent surveys, and identified high-risk hot-spot zones. Mountainous flash flood monitoring and early warning systems were constructed for 2058 counties nationwide. Flood risk maps have been completed in 56 pilot regions, and are under compilation for major river basins, key flood control and protection zones, national flood retention zones and critical medium and small basins. Furthermore, earthquake intensity maps have been updated to a 4th version (Fig. 3). Map of China Active Faults (1:400 million) was complied. Active fault detection and earthquake hazard assessments have been carried out in 86 cities, providing basic information for earthquake risk mapping for local communities. Major natural disaster risk assessment maps (1:1,000,000, covering earthquake, typhoon, flood, drought, sandstorm, landslide, tidal wave, low temperatures and freezing hazard, snowstorm, forestry and grassland fire, eco-hazard, and climate change) and a comprehensive natural disaster risk assessment map have also been devised.

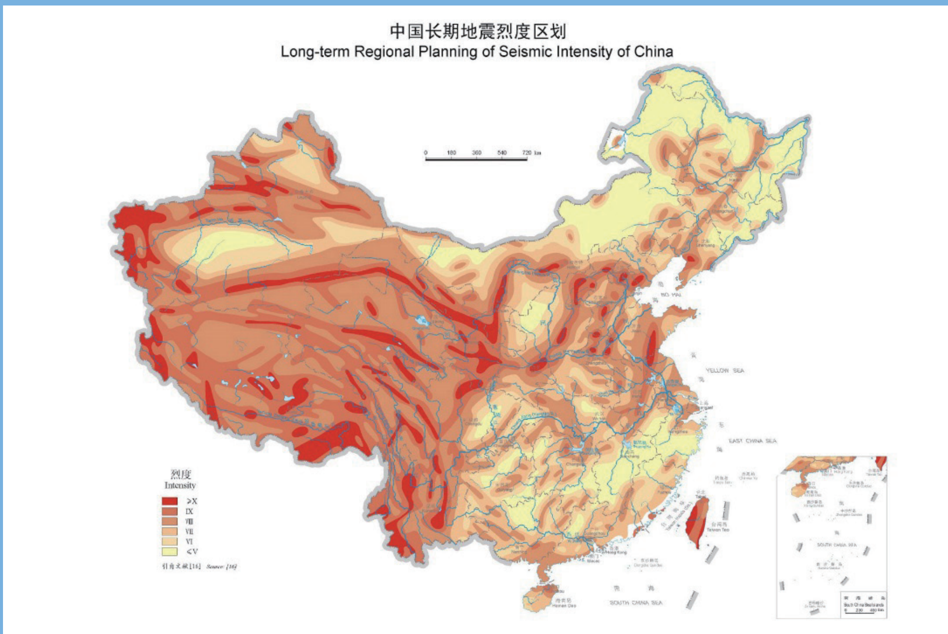


Fig. 3Long-term regional planning of seismic intensity in China

Disasters and environmental risks induced by climate change have been recognized. The National Evaluation Report of China's Climate Extremes and Disaster Risk Management and Adaptation has pointed out that in the context of climate change, China's meteorological disasters appear to have to be worsened. There is a significant increase in annual highest and lowest temperature and the number of hot days, while the number of cold days and regional extreme cold events (with a rate of 1.99 per decade) are decreasing. The number of freezing days is decreasing with a rate of 0.9 days per decade. The frequency of nationwide cold waves experiences significant decrease from 2.0 events per year (1955-1990) to 1.2 events per year (1991-2013), while regional and local cold spells and freezing events still often occur. The frequency, intensity and affecting areas of severe rainfall events are increasing. The number of medium or higher levels of drought days is increased by 24%, 15% and 34% in Northeast, North and Southwest of China respectively. Although the number of typhoons decreases in Pacific Northwest regions, the severity of landed typhoons in China increases significantly and more than half of those events in the 21 century experience wind speed higher than level 12. East and Southeast of China experience increasing rainfall induced by typhoons. The frequency of sandstorms is fluctuating but decreasing. The average annual occurrence of sandstorms decreases by 58% in recent 25 years after 1983 comparing to the 25 years before 1983.

Effects:

Since 1997, the atlases have been used in the development of the Chinese Government's National Comprehensive Disaster Prevention and Reduction Plans. In 1997, the Atlas of Natural Disasters in China (1992) supported the development of the 2000–2005 plan, and the 2003 Atlas of Natural Disaster System of China served the development of the plan for 2005–2010. In 2011, the Atlas of Natural Disaster Risk of China was similarly used in the development of the plan for 2011–2015.

According to the Environmental Protection Law, during the site selection of big projects, risk and environment impact should be assessed to avoid areas with high disaster frequency and reduce any negative impact on the environment and sustainable social development. During the construction phase, disaster risk evaluations should be conducted for engineering projects such as dams, irrigation systems, and scenic spots, and countermeasures against possible disasters should be taken according to the evaluation results. The anti-disaster capacity of the infrastructure should be consolidated according to post-disaster loss evaluations after a disaster strikes. For instance, during the construction of the Three Gorges Dam project, a risk assessment of natural disasters such as earthquake, geological disasters, and floods was carried out to guarantee the safe operation of the project.

With the support of the atlas series and a huge amount of data, Chinese governments at various levels have engaged in systematic and focused regional disaster prevention and reduction practices. Furthermore, such information has ensured the raising of reinforcement standards and preparedness capacity in high-risk regions. Special care was taken with regard to population-dense regions, and earthquake and geological disaster-prone mid-sized and large cities. Atlas data has also been used to support projects to renovate rural homes and school classrooms and the agricultural natural disaster insurance.

03

Use of satellite data for Drought Assessment

What is the initiative?

Drought is a major disaster which strongly affects agriculture. Since the irrigation percentage in Asian countries is low and large proportion of population is dependent on agriculture the impact of drought is extremely high in Asian countries.

Drought being a very complex phenomenon, assessment of drought is difficult. In this context, initiative has been taken for use of various types of data and modeling technique (field, meteorology and satellite) for drought assessment.

Why it needs science and technology?

Since the field observation related to crop loss, sowing deviation and crop yield is laborious and time consuming, assessment of drought impact is difficult. Hence use of satellite data will help in supporting the assessment.

How was science and technology applied to the initiative?

Under a programme called NADAMS (National Agriculture Drought Assessment and Monitoring System) multiple satellite derived parameters, rainfall data, sowing progression (from ground and satellite), soil moisture Index (through modeling) and irrigation percentage are combined through a logical modeling approach for district/sub-district level drought assessment. The technology for this has been developed by Indian Space Research Organization which is being operationalized by Ministry of Agriculture & Farmers Welfare through its Centre (Mahalanobis National Crop Forecast Centre).

Difference by applying science & technology

By applying this approach, it has helped the state governments for contingency planning and drought declarations. Many state governments are pro-actively using drought assessment of NADAMS programmes for drought declaration.

Key factors for success

Use of various parameters, not only a single input or index.
Providing regular inputs/reports to concerned agencies.
Making the approach/output/data available to various concerned agencies.
Operationalization/institutionalization of this technology by Ministry of Agriculture by creating a Centre within it.

Challenges in Replication

Availability of data (satellite, ground and weather) at the level at which drought assessment needs to be carried out.
Building capacity and infrastructure for satellite data analysis.
Acceptance by planners and policy makers to use the technology.

04

Warning Systems for Disaster Resilient Housing for landslide prone hill communities

Subrat Kar, Indian Institute of Technology (IIT), Delhi, India

What is the initiative?

Hill communities in landslide prone areas tend to suffer the most in disasters such as landslides due to poor building construction practices, lack of standard resilience factors which can reduce casualties and a glaring absence of warning systems (individual and community level alerts) which provide an escape / evacuation window of about 120 to 600 seconds.

Why it needs science and technology?

Sensor networks and relevant instrumentation can reveal the beginning of a landslide event and log these events. Alert protocols and standard evacuation protocols and drills can then be invoked in a timed and systematic manner, saving lives. This is an effective use of S&T for pro-active disaster reduction.

How was science and technology applied to the initiative?

We can build low-cost warning systems to be installed (retro-fitted) in existing houses to warn of impending land mass movements – we have built systems in IIT Delhi which would cost no more than Rs.1000 when mass-manufactured and are, thus, very affordable. At the community level, we have also started building more comprehensive (and more expensive) land movement monitoring mechanisms such as centralized monitoring using sensor networks and optical monitoring of landmass movements with machine learning + data mining to generate community alerts using SMS and twitter.

What was the difference by applying science and technology in terms of resilience building or policy making on disaster risk reduction?

We are in the process of seeking funds for developing these systems on a scale large enough and in numbers. Once we get the funding, and fabricate and deploy these systems, we can estimate the difference they make to a disaster scenario.

Why it is considered as good practice and what kind of key factors that contributed to the success?

Building (or even retro-fitting) warning systems into the housing of susceptible hill communities is an excellent pro-active way of disaster risk reduction. Our proposed deployment zone is Kalimpong-Kurseong-Balasun and we are helped considerably by the presence of an active Kalimpong-based NGO (SaveTheHills) who helps us with the local logistics needed to deploy these systems. Local sensitization by the NGO Partner M/s SaveTheHills (President: WgCdrPraful Rao) workshops have helped considerably in raising local awareness for what we are doing.

What will be the challenge if one to replicate the application of science and technology?

Finding funds to initiate and sustain (i.e deploy, replicate, maintain) is a challenge. To get hill communities to purchase and deploy even the low-cost warning systems, government subsidies would help greatly – a majority of such communities are also from the economically weaker sections. Ultimately, the pro-bono subsidy helps the Government as it reduces the loss of life and consequent compensation. Since, in India, it is the Government who is the first and prime responder in case of a disaster, such a proactive measure should be welcomed and put into place at the soonest.

05

Sensor Based Community Warning Systems for Disaster Risk Reduction in landslide prone hill communities

Subrat Kar, Indian Institute of Technology (IIT), Delhi, India

What is the initiative?

We are designing systems for non-invasive and non-contact monitoring of landslide movements in Kalimpong and adjoining areas. Monitoring of the landslide is conducted from over a distance of 1 kilometer away, with the logging of the data done to a central database in New Delhi. Alert protocols will be local and community oriented, allowing targeted warning to be generated to the specific affected populace, providing heightened awareness of the possibility of a landslide and allowing them to initiate systematic evacuation procedures in case of landslide event.

Why it needs science and technology?

Such sensitive instrumentation can reveal the beginning of a landslide event in advance (capturing initial movements as small as 0.2 mm) and log these events. Alert protocols and standard evacuation protocols and drills can then be invoked in a timed and systematic manner, saving lives. This is an effective use of S&T for pro-active disaster reduction.

How was science and technology applied to the initiative?

We have started designing these more comprehensive (and more expensive) land movement monitoring mechanisms such as centralized monitoring using sensor networks and optical photogrammetry based monitoring of landmass movements with machine learning + data mining to generate community alerts using SMS and twitter.

What was the difference by applying science and technology in terms of resilience building or policy making on disaster risk reduction?

We are in the process of seeking funds for developing these systems. Though each system is expensive (about Rs.15 lakhs each to build, plus Rs.2.0 lakhs annually to deploy and maintain), we need only about two of them for a town like Kalimpong in West Bengal India. Once we get the funding, and fabricate and deploy these systems, we can estimate the difference they make to a disaster scenario.

Why it is considered as good practice and what kind of key factors that contributed to the success?

Deploying such 'eyes-on-the-ground' type of instrumentation and coupling it with regular drills and evacuation response training helps a community hone its preparedness for a potential diasaster. In our proposed deployment zone is Kalimpong-Kurseong-Balasun and we are helped by the presence of an active Kalimpong-based NGO (SaveTheHills) who helps us with the local logistics needed to deploy these systems. Local sensitization by the NGO Partner M/s SaveTheHills (President: WgCdrPraful Rao) workshops have helped considerably in raising local awareness for what we are doing.

What will be the challenge if one to replicate the application of science and technology?

Finding funds to initiate and sustain (i.e deploy, replicate, maintain) is a challenge. Ultimately, the installation of such systems helps the Government as it reduces the loss of life and consequent compensation. Since, in India, it is the Government who is the first and prime responder in case of a disaster, such a proactive measure should be welcomed and put into place at the soonest.

06

Application of Science and Technology in Hazard Resilient Construction: A case study on Mid Term Shelter Construction post Kedarnath floods, Uttrakhand, India

Society for Environment Protection (SEP), Ahmedabad, Gujarat, India

What is the Initiative?
Mid Term shelter construction post Kedarnath aftermath in Rudraprayag district.

Why needs Science and Technology?
Post disaster, in long-term reconstruction takes long time. In between, what is required is an immediate response program which provides mid term shelter to the affected community so as to help restore their life and respect. It has to be quick, safe and climatically suitable. Uttrakhand is a hilly terrain, tough to construct and also disaster prone and eco sensitive zone, so building back, fast, safe and also green was the focus.

How was Science and Technology Applied to the initiative?
Based on the field visit and ground assessment, a model of midterm shelter was evolved using local context. The choice of technology was evolved though study of available local materials, skills and also requirements viz. a via earthquake, cyclone kind of disasters. The model also was further customized with the application of technologies which are appropriate for hilly terrain, easy to construct and requires less material to be transported from main land. Rounds of discussions were done with community to ensure its acceptance at social (science) level too.

Foundation: Using waste stone available as a part of debris from floods
Walls: Using stonecrete blocks made on site with debris from flood by community themselves
Roofing: Ferrocement insitu roofing

What was the difference by applying science and technology in terms of resilience building?
The model of semi construction shelter constructed, was like a permanent shelter and hence provided required protection against all climatic adversity. Also, the nature of reconstruction, used lot of local material

and skills and hence, gave a boost to local economy rotation adding to different level of resilience of the community. The building process, had minimum impact on environment. Also, the technology used for mid term shelter had all the DRR features ensuring required resilience of the building. Ferrocement is a technology which has is very light weight and has very high ductility. It provides condition of light roof (though giving a solid roof feel) and hence provides excellent performance during earthquake. Also, with weldmesh kind of well distributed reinforcement inside, give added protection against falling objects/stone on roof and any possible impact due to it. Ease of technology was such that, all houses were made by community themselves and hence actual technology transfer and adaptation phenomenon occured. It will be important to mention here that because of technological feasibility, the model was build in competition and financial feasibility of tin based mid-term shelters conventionally made in the region.

Why is it considered as Good Practice & what kind of key factors that contributed to the success?

Viability and feasibility of the selected technology in the given context is the roots of success and key factor. Also the ease which it provided in implementation with respect to hilly region (in terms of transfer of material) was remarkable. Adding to it, the whole process of rebuilding gave them mid term shelter which was strong as a permanent shelter, was easily upgradable to permanent shelter and at the same time easy to construct and had minimum impact on environment.

What will be the challenge if one has to replicate?

Replicability and main streaming of technology is quite easy. In the present context, since huge debris is available due to disaster, the ease of getting stone and other material out of debris is very easy for the time being. Another major challenge will be to ensure the quality Ferrocement making process. It will be very important when one want to use FC in permanent housing. But is manageable easily by the required level of skill and capacity trainings.

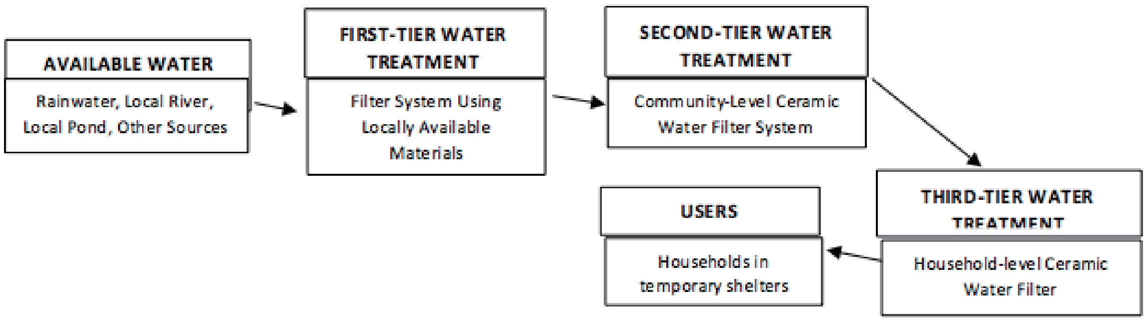
07

Research into energy-efficient water treatment technology for effective disaster response

Andreas Subiyono, SHEEP, Indonesia

Water is one of the most essential basic needs for human survival. In Indonesia, almost one in two people do not have access to clean water, and 70% Indonesians depend on potentially contaminated water for their living.In recognition of this critical aspect, SHEEP Indonesia Foundation is conducting a research that would allow a technological breakthrough in bringing water closer to people who need them most in a most efficient way. The research focuses on developing ceramic water filter that is highly portable and easily installed anywhere using locally available water sources to provide energy-efficient potable water for people who need water most. At the moment, SHEEP has already completed first-stage research, and developed a prototype of household ceramic water filter. This filter has undergone laboratory test for its ability to reduce E-Coli, total Coliform and harmful chemicals (NO3) and user-test in Papua, East Nusa Tenggara, West Sumatra, and Java. The result shows its ability to reduce E-Coli by 98.62%, total Coliform by 82.61%, NO3 well below maximum standard defined by the Indonesian Ministry of Health. Test amongst individual household users shows the filter's ease of use and maintenance (cleaning), and safety (no smell, no taste, and no sediment).

The next stage would be to conduct research for community-level ceramic water filter and water distribution system for use in temporary shelters and/or communities with little access to potable water. The research framework would follow a three-tier water treatment system as illustrated in the following.



The aim of the proposed research would be to develop portable, easily-installed and energy-efficient community-level water-treatment units that could provide 500 liters of potable water supply for around 100 households per day (per unit), within a two-year period. The major benefit of the proposed system would be to ensure consistent, self-sustaining water provision system that could become basis for building back better in rehabilitation, recovery and reconstruction. Together with the household-level ceramic water filter, the system can become critical instrument not only for environmental, and personal health but also for future sustainable lifestyle. For this reason, success of the proposed project would hinge not only upon technological breakthrough, as suggested by the research, but also by active community engagement for lifestyle change and building better resilience in the future. The most critical challenge for this endeavor would be to promote critical partnership between SHEEP, survivors and other stakeholders involved in disaster management actions.

CASE STUDY 08
Indonesia

08

The Accessible Motor Bike for Livelihood Rehabilitation Program for People affected by Earthquake (to be disable people) in Yogyakarta and Central Java Province

Rogatianus Anang Setiyargo, KARINAKAS, Indonesia

What is the initiative?

Many people affected by the Java earthquake on 27 May 2006. Some of them to be Disable People due to have SCI (spinal court Injury) which causing their mobility limited because now they have to use assistive devices like as wheel chair. Providing Accessible Motor Bike is making them have access to appropriate vehicle where no public transportation that be able to accommodate their need.

Why needs science and technology?

There is no public transport that accessible for People with Disabilities (PwDs) and not any Motor Bike in local market that accessible for them. The way to solve this situation is to modified the standard motor bike using the science and technology that mastered by the local people to be accessible motor bike (there cycle motor bike).

How was science and technology applied to the initiative?

The people that have ability to modify the standard motor bike to be the accessible one can be found in Yogyakarta and Central Java province. KARINAKAS funded by Caritas Germany assisted People with SCI to have accessible motor bike by providing stimulant fund. Collaboration with local workshop and developing workshop that managed by PwDs KARINAKAS assisted some PwDs to have the accessible motor bike.

The PwDs were modifying standard motor bike to be an accessible one.

A PwD was riding the accessiblemotor bike.

What was the difference by applying science and technology in terms ofresilience building or policy making on disaster risk reduction?

In term of Rehabilitation stage, by having the accessible motor bike the PwDs have more chances to improve and or create their new livelihood strategies and in term of preparedness stage they are able to participated on DRR program and able to do self evacuation. Recently many them (not caused by Disaster) using this vehicle to many purpose (e.g. going to school and office, supporting heir income activities like as salesman, taxi motor driver and etc.)

Why it is considered as good practice and what kind of key factors that contributed to the success?

In Yogyakarta and Central Java Province and most of Indonesia, the stigma on PwDs are still high, the public facilities (included public transport) are not accessible and no principals of Motor cycle in Indonesia producing accessible vehicle. Modifying standard motor bike to be the accessible one is one of many ways to solve the problem on unavailable accessible transportation facility in this region and even in the country.

What will be the challenge if one to replicate the application ofscience and technology?

The challenge is many PwDs and families are poor people; their access to the accessible motor bike is limited. Without assistance from outsider they cannot have accessible motor bike with price is 7 to 10 million rupiah.

09

Promoting Public Participation in Earthquake Risk Reduction by Implementing "Safe Schools, Resilient Communities" Program

Kambod Amini Hosseini, International Institute of Earthquake Engineering and Seismology (IIEES), Iran

What is the initiative?

Developing resilient communities that is prerequisites for attaining resilient cities; linking a network of adaptive capacities and adaptation after a disturbance or adversity.

Why needs science and technology?

Promoting resilience needs knowledge, awareness and ongoing actions. It is a constant process of learning and engagement; recognition of the most important risk which threatens the community, in other words, “Resilience of what to what?” in this case taking actions for risk reduction and capacity building specially in case of earthquake.

How was science and technology applied to the initiative?

Schools are perfect nodes for raising awareness and providing risk knowledge to the public since they are education hubs in each community involving parents, children, teachers and education specialists alike in different temporal and spatial scales. The interaction between local parents and school teams help build social capital, community involvement, civic awareness and social cohesion.

What was the difference by applying science and technology in terms of resilience building or policy making on disaster risk reduction?

This program was initiated by International Institute of Seismology and Earthquake Engineering (IIEES) that is a scientific and research entity in Iran in cooperation with relevant governmental institutions such as National Disaster Management Organization (NDMO), Ministry of Education, Red Crescent Society (RCS) and Islamic Republic of Iran Broadcasting (IRIB). The program was developed to be implemented in local communities and called as “Safe School- Resilient Communities”. Production of series of instructions for risk assessment for each neighborhood which include vulnerability check and recognition of each neighborhood’s weaknesses and strengths from risk point of view was the main part of the program that incorporated knowledge and technology in relevant fields. Safe schools are set as centers for evacuation and response in cases of earthquakes and may act as storages for basic need for the first three days after the disaster. In addition, they are education centers for each neighborhood to provide relevant knowledge. This will initiate introduction of schools as nodes for disaster management in communities.

Why it is considered as good practice and what kind of key factors that contributed to the success?

In 2015, the program was implemented in few communities in Tehran and some other Iran's cities as a pilot attempt to produce a series of interventions for specialists stand people alike. This program was implemented successfully in the pilot areas and it was decided to be extended in the following years gradually. The results showed that even after the performance of the program, the process of neighborhood betterment and vulnerability reduction will be continued by the people and neighborhood managers.

What will be the challenge if one to replicate the application of science and technology?

Capacity building and providing necessary trainings to local residents needs understanding of socio-economic as well as physical conditions of each communities that may differ site to site.

10

Dust storm network based integrated system of forecast and forewarning (DuSNIFF)

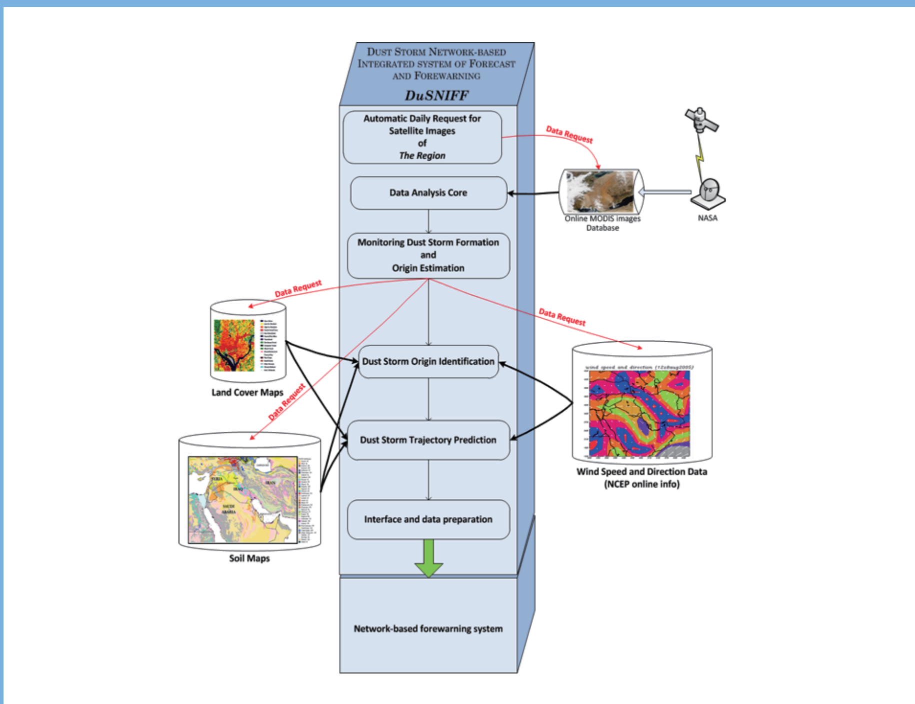
Ali Darvishi Boloorani, University of Tehran, Iran
Fardin Mirzapour, SADRA, Iran
Roozbeh Rajabi, Qom University of Technology, Iran

What is the initiative?

Dust Storm Network-based Integrated system of Forecast and Forewarning (DuSNIFF) is totally based on the using of free available internet data and images. System specifications are illustrated in the figure below:

System Inputs: Daily satellite images of the desired region, such as NASA online database (MODIS), Instantaneous wind speed and direction, and surface pressure data from online databases such as NCEP, Multi-level wind parcels trajectory, Soil Maps, Land-cover Maps.

System Outputs: The origin of dust storms, The predicted path of the storms, Network-based early warnings.



Why needs science and technology?

Due to complexities of the sources of dust, broad temporal variations of occurrences and diverse spatial expansion of dust storms, there are several local, national, regional and international frameworks for handling monitoring, forecasts, observations, forewarning, information and knowledge exchanges. Therefore, to deliver precise and near real-time data and information of monitoring, forecasts and forewarnings a scientific based technology system is needed for providing useful information to users in the easiest and most applicable ways.

How was science and technology applied to the initiative?

The science of data and information combination and fusion for modeling a dynamic phenomenon like dust storm in combination with data sharing and availabilities using internet and the synergy of very advanced technologies of remote sensing satellite imagery are the main cores of the DuSNIFF.

What was the difference by applying science and technology in terms of resilience building or policy making on disaster risk reduction?

Scientific based real-time data and information of monitoring, forecasts and forewarnings of dust storms is good based for economic and health costs of the events that makes the baseline and framework for better policy decision making in combating against dust storms.

Why it is considered as good practice and what kind of key factors that contributed to the success?

Easy accessibility of information and free sources of data make it successful.

What will be the challenge if one to replicate the application of science and technology?

Combine and integration of new available data from satellite images and developing the data combination methodologies.

11

Seismic hazard analysis and risk maps of Iran

Mehdi ZARE, International Institute of Earthquake Engineering and Seismology (IIEES), Iran

What is the initiative?

Seismic hazard analysis and risk maps for Iran

Why needs science and technology?

The field of earthquake hazard risk studies in Iran is followed up and updated since 1975 and the expertise in Iran is developed based on updated scientific methodology. The output of such studies has always been the input of earthquake resistant design of the buildings and major infrastructures. The database on the seismicity and seismic hazard and risk of Iran and the region is formed and published in the highly cited scientific international journals.

How was science and technology applied to the initiative?

A courses entitled as "Engineering Seismology" (for the undergraduate level), and "Seismic Hazard Zoning" (for graduate level) is developing since the end of 1990's by Dr Zare in the Iranian Universities in order to build a capacity to use and apply the methodology and then developed in needed technologies. The seismicity of Iran, importance of seismic risk, seismic risk reduction was the major subtitles in such courses (then developed separately as independent courses) in order to apply the science and technology in the scientific and technical community of Iran. Some computer codes has been written and developed in this regard. The public concepts on seismic hazard and risk mapping are promoted specially in last ten years using the social networks (Facebook, Linkedin, Tweeter and Instagram). This popularization of the subject has been initiated since 2003 using the weblogging, and using the Iranian State media in order to share the information on seismic hazard and risk in Iran and to disseminate the information on the occurred earthquakes in Iran in order to give the very early information and transmit the public awareness scientific messages to the people in the prone areas.

What was the difference by applying science and technology in terms of resilience building or policy making on disaster risk reduction?

The application of science and technology facilitated the improvement of Iranian Science Building Code (Code No.2800) in order to directly improve the quality of resilience construction, however it is not yet such effective in improvement of policy making (maybe because of less available trained decision makers in this field, to be familiar with new means of science and technology.

Why it is considered as good practice and what kind of key factors that contributed to the success?

The application of science and technology has provided for Iranian scientist a basis and tool to be up-to-date comparing to the improvement in this field of seismic hazard and risk zoning in the developed world.

What will be the challenge if one to replicate the application of science and technology?

The major challenge is the accessibility of new tools and technology (soft wares databases and formats, … etc) for Iranian experts as well as involvement of Iranian Scientifics and experts in the international scientific communities.

12

Climate resilient agricultural practices

Kenji Tanaka, Japan Conservation Engineers & Co., Ltd., Tokyo, Japan

About the project / initiative

Climate change increases weather related disaster risk in many countries. At the same time, urbanization and other factors bring residences, infrastructure, lives and livelihoods close to exposed slopes and landslide-prone areas. Furthermore, drought, floods, and other factors contribute to environmental degradation, of forests, agricultural land, and waterways, which further increases disaster risk.

The new humus technology enabled artificial mass-production of fulvic acid made from both thinning wood resources in Japan and organic acids derived from the charcoal production process. The application of fulvic acid goes beyond slopes, forests, and brown fields. Seaweed beds have been re-formed on bare sea-beds in closed water systems, and humus material has also been used to increase agricultural yield. And the availability of fulvic acid adds an environmentally friendly, effective, and cost-effective option for disaster risk reduction.

Contribution from Science and Technology

Fulvic acid is a nature's limited resource accumulating only one centimeter in a hundred year. Our newly developed methodology, patented in Japan, however, produces humin and fulvic acid, two of the three main beneficial compounds of humus.

With its chelating and high ion exchange properties, fulvic acid increases plant's nutrients uptake which stimulates metabolism and plant growth. It also buffers soil pH often fluctuated by rainfall; hence it minimizes plant stress. Such properties can be used for increasing slope stability by accelerating revegetation, detoxifying contaminated land, desalinating agricultural land, and improving a degraded aquatic environment. Several cases of greening and desalination have been implemented in Japan and overseas with successful results.

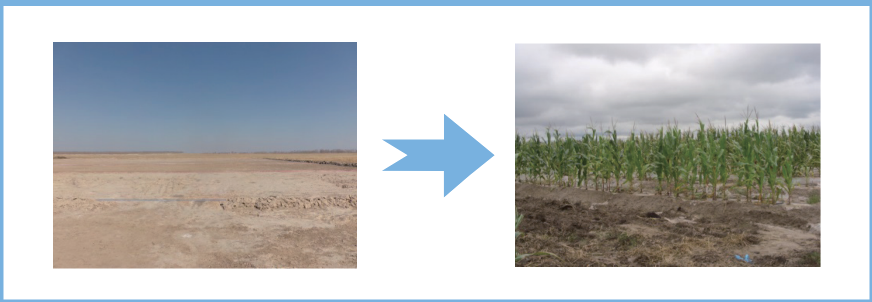


Photo.1 Example of improving environment in the high salinity land.

How the case contributes to implementation of SFDRR?

The case contributes to Priority 3 and 4: This project/initiative offers a green solution that is maintenance-friendly of slope stabilization over the long term. And more, especially against weather hazards would contribute to increased resilience, and indirectly contribute to reducing economic loss.

13

Older Persons in Emergency Situations: A Case Study of the Great Hanshin-Awaji Earthquake

Jostacio Moreno Lapitan, World Health Organization (WHO), Kobe, Japan

What is the initiative?

The initiative is a case study entitled “Older Persons in Emergency Situations: A Case Study of the Great Hanshin-Awaji Earthquake: Technical report (WHO, 2013)” (1) which scrutinized the situation of older people as survivors of the Great Hanshin-Awaji Earthquake (GHAE), Japan in 1995. It highlights the importance of documentation of lessons learned from older people’s experiences themselves as well as application and institutionalization in risk governance, emergency disaster risk management for health, and measures enhancing disaster preparedness for effective response their own story telling since 2012 at the Disaster Reduction and Human Renovation Institution or DRI, Kobe/Hyogo, Japan (2).

Why needs science and technology?

By 2020, the world population is projected to reach 7.6 billion. By that time, persons over 60 years of age will be around a billion people - outnumbering children less than 5 years of age. Specifically, those aged 60 and above will comprise 13.28% of the global population, as compared to children less than 5 years of age (657 million or 8.58% of the global population). In 1995 during the GHAE, Japan had 20.33% of its people aged 60 years old and above, yet in 2012 (3), the proportion has increased to 31.92% and growing, which means that current and future implications for health, welfare and other sectors in Japan as well as in other countries could be enormous and the role of older people in disaster risk reduction would be played well if informed and guided by science and technology. Knowledge management and education through science and technology may include but is not limited to: demographic statistics; evidence base (e.g., preserved earthquake relics and background photos/stories/profiles in the DRI museum); educational technology through simulation and films.

How was science and technology applied to the initiative?

This initiative was based on research - a literature review - that was conducted and completed by Professor Tomoe Watanabe, RN, MS, University of Hyogo, Research Institute of Nursing Care for People and Community. Dr Jostacio M. Lapitan, Technical Officer, WHO Centre for Health Development (WHO Kobe Centre/WKC); Dr Louise Plouffe, former WHO staff; and Dr John Beard, Director, Department of Department of Ageing and Life Course (WHO HQ ALC) reviewed and finalized the case study for web publication in 2013 (1).

What was the difference by applying science and technology in terms of resilience building or policy making on disaster risk reduction?

Applying science and technology provides the solid technical foundation of the initiative as collecting, analysing, synthesizing and publishing a literature review about the role of older people at the GHAE would resonate to policy-makers at all levels, professionals and the whole-of-society to be more aware of and taking sustainable actions on reducing vulnerabilities and risks on one hand as well as capitalizing and maximizing on resources of older people, on the other hand. Resilience building requires commitment to achieving the sustainable development goals 2015-2030, as well as that of healthy ageing (4). The GHAE was well documented and this case study is one among a number of researches that highlighted the role of older people in resilience building and policy making.

Why it is considered as good practice and what kind of key factors that contributed to the success?

This case study on the GHAE which occurred 21 years ago can be considered as a good practice and as a "living case study" based on the fact that older people who have survived the GHAE remain to be the storytellers at the DRI until the present time. It documents in writing via online publication, accessible to all researchers and students, a primary focus on the increasing and active role of older people in the disaster cycle and enumerated measures perceived to be necessary in terms of health emergency preparedness, response and recovery; and specific concerns for older people during evacuation, temporary shelter and permanent relocation (1). Key factors to the success of this research were the expertise of authors and reviewers, its presentation at an international conference and that excerpts of the case study were cited in another publication (5).

What will be the challenge if one is to replicate the application of science and technology?

There should be no problem if done in Japan, except perhaps the language as some sources of information are written in the Japanese language only. The main challenge, if done in another setting, would be the availability and accessibility of research literature on-line on the same topic or other hazards. Another challenge identified would be the use of a targeted lens, proactive and innovative framework on older people and their role – actively participating in health and development in general; and engaged in disaster risk reduction, preparedness, response, recovery and resilience, in particular.

References

1. Older Persons in Emergency Situations: A Case Study of the Great Hanshin-Awaji Earthquake: Technical report (WHO, 2013). http://www.who.int/kobe_centre/publications/older_persons_in_emergency_2013/en/. [Accessed on 5 April 2016].
2. Disaster Reduction and Human Renovation Institution. http://www.dri.ne.jp/english/. [Accessed on 5 April 2016].
3. UNDATA: a world of information. http://data.un.org/Data.aspx?d=WHO&f=MEASURE_CODE%3aWHS9_92. [Accessed on 5 April 2016].
4. World Report on Ageing and Health (WHO, 2015). http://apps.who.int/iris/bitstream/10665/186463/1/9789240694811_eng.pdf. [Accessed on 5 April 2016}.
5. Hutton, David. Older People in Emergencies: Considerations for action and policy development (WHO, 2008). http://www.who.int/ageing/publications/Hutton_report_small.pdf. [Accessed on 5 April 2016].

14

Enhancing effectiveness of local government's response in case of disaster

Abe Yoshiko, Kokusai Kogyo Ltd., Tokyo, Japan

About the project / initiative

As a business with a large number of Japanese local government clients, we have considered how our products may be improved to address lessons learned from the 2011 Great East Japan Earthquake.

Noting a study which indicated that local government workers had to spend many hours on acquiring information (Figure) 1, we sought to reduce this amount of time spent in two ways: real-time and reliable predictions based on latest technology, and development of user-friendly information sharing tools (Figure 2).

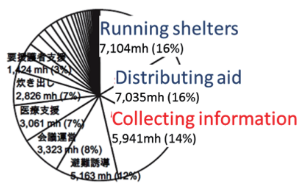


Figure 1: Allocation of time by local government workers during GEJE

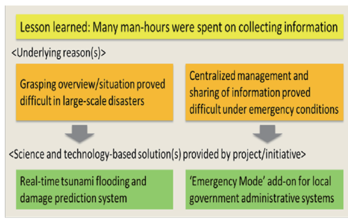


Figure 2: Overview of issue and solutions

A real-time tsunami flooding and damage prediction system has been developed through academic-private sector collaboration 2 and delivers information visually through a Web GIS system. The system, now going through a pilot phase, is expected to aid priority setting and planning of emergency actions. The 'emergency mode' add-on to existing local government information systems allows workers to upload, download, and view information via a familiar platform, enhance communications across divisions and departments, eliminate duplicate attempts to collect information, and is expected to result in improvement of services to the community by freeing up more time for action. The add-on is available as an option to our clients.

Contribution from Science and Technology

The real-time tsunami prediction system utilizes cutting-edge technology. The 'emergency mode' add-on utilizes strengths of GIS technology through customized applications.

How the case contributes to implementation of SFDRR?

The case contributes to Priority 1: Understanding disaster risk (by delivering reliable science-based information in an understandable manner for local government workers, who are a key user group), is an investment in resilience (Priority 3) and an enhancement of disaster preparedness for effective response (Priority 4) by local governments.

1. Study by Tokyo University (reference tbc). Time spent on emergency response activities by Ishinomaki City workers during 5 days post GEJE. mh stands for man hours.
2. Collaboration between Tohoku University (IRIDeS, Cyberscience Center, Graduate School of Science and Faculty of Science), NEC Corporation, A2 Corp, and Kokusai Kogyo Co., Ltd.

15

Digital archive of disaster experiences and memories: Initiative of Tohoku University

Takao Izumi, International Research Institute of Disaster Science (IRIDeS), Tohoku University, Sendai, Japan

About the project

In collaboration with the private sector, government, and academia, the International Research Institute of Disaster Science (IRIDeS) of Tohoku University launched its archival project, "Michinoku -Shinrokuden." It aims to archive every possible memories, records, case histories, and knowledge relating to the 2011 Tohoku Earthquake and hand down the disasterography to national and international communities as well as future generations. The project also generates viable working models for analyzing intricate dynamics of the triple disasters and disseminates knowledge concerning the post disasters reconstruction processes.

Contribution from Science and Technology

It is crucial to include both natural and social sciences perspectives into DRR implementation. It has been addressed the importance and needs for passing on the experience and lessons from the past disasters to the next generation after a major disaster happens. This project combines the uniqueness of natural and social sciences, and accumulates the information and data gained through high-tech tools such as mixture of ground and aerial photographs as well as row data and information including memories, records, case histories and knowledge obtained through personal interviews and a questionnaire survey. This project contributes to developing a new approach and research outcomes based on the collected data and will lead to further involvement of academia, science and technology in DRR.

How does this case contribute to implementation of SFDRR?

SFDRR encourages strengthening technical scientific capacity to consolidate existing knowledge and to develop and apply methodologies as well as promoting dialogue and cooperation among scientific and technological communities, other relevant stakeholders and policy-makers. This project can contribute to implementing these elements by .

Collecting a wide range of information and data without fixing any parameter of their possible future uses as well as sharing these materials globally;

Sending the quasi-real time status of ongoing post-disaster rehabilitation and reconstruction activities with various spatiotemporal coordinates;

Provide educational information and materials for disaster prevention and mitigation in various learning environments (such as e-Learning);

Activating dialogue among different stakeholders to discuss issues and challenges highlighted through the materials collected through this archiving system and leading to building a strategy to improve the situation for prompt and effective recovery.

International symposium of the 2011's disaster digital archive

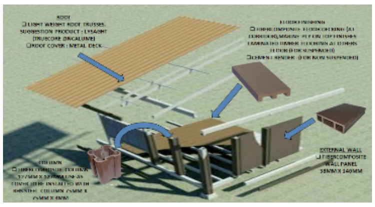
16

Eco Transit Homes for Disaster Relief

Sivapalan Kathiravale, Malaysian Industry-Government Group for High Technology (MIGHT), Malaysia

What is the initiative?

Eco Transit Homes are resilient and eco-friendly houses that can be built quickly by volunteers in disaster and crisis affected areas. Eco Transit Homes are built mainly from waste agricultural materials but can accommodate waste material from disaster zones, thereby resolving the issue of debris build-up. The Do-it-Yourself (DIY) concept of Eco Transit Homes enables volunteers to be trained quickly to assemble or disassemble these homes in disaster areas.



Why the need for science and technology?

Disaster victims are currently supplied with temporary tented shelter but in some cases victims may continue to live in these conditions for up to 6 months or even several years. Science and Technology is needed to find a solution that will provide improved living conditions with lasting structure that can be deployed easily and quick to be put up at an affordable price.

How was S&T applied to the initiative?

Science and technology was the foundation for converting waste agricultural material into building material. The engineered wood is made of paddy plantation waste and plastic waste, which are recycled, ground and compressed into any shape and length required for construction purposes. The resulting engineered wood is heat resistant for up to 2 hours, water resistant and termite proof.

S&T enables the transformation of waste to engineered wood.

What was the difference by applying S&T in terms of resilience building or policy making on DRR?

Eco Transit Homes are designed to be built on a ‘Do It Yourself’ (DIY) concept and can be pre-manufactured into compact collapsible pallets (similar to the IKEA concept). They can be mass pre-manufactured and stored; ready for easy deployment to disaster areas as they are light and compact. Training can be conducted to volunteers across the world who can then assemble the houses in disaster areas. Science and technology has created high quality engineered wood that gives long term quality shelter to disaster victims, which can be easily be deployed and put up in disaster areas by trained volunteers including youths.

Why is it considered as good practice and what kind of key factors contributed to the success?

The of the Eco Transit Homes concept is the ability to pre manufacture, light weight so as to facilitate easy deployment and quick build concept for easy assembly at disaster sites by volunteers. Engineered wood from agriculture waste used in the manufacturing also helps paddy farmers in gaining a small income from their waste material, which would otherwise have been burnt openly contributing to air pollution. Eco Transit Homes can even accommodate material extracted from disaster zones, thereby reducing environmental strain on the area while resolving the issue of debris build-up in disaster zones. A key success factor will be the proposed financing of the Eco Transit Homes, which is to be done based on crowd sourcing and CSR funding. This can be done based via international foundations that will use Eco Transit Homes when providing disaster relief.

What would be the challenge if one is to replicate the application of S&T?

The technology used in producing the engineered wood, the design of Eco Transit Homes and the financing scheme for such homes are well established models that are currently employed in many other sectors. Thus, duplicating such a system is easy in many countries. It is envisaged that the funding for the Eco Transit Homes can be obtained from international corporate sponsors as well as government and non-government sources.

17

Classification of Tropical Peat Soils: The Foundation for Preventing Widespread Fires

S.Paramananthan, Fellow of Academy of Sciences, Malaysia

CASE STUDY 17
Malaysia

What is the initiative?

The Malaysian Unified Peat Classification System has been developed to better characterise and map tropical peat soils. Application of the classification system enables systematic and detailed mapping of peat soils to facilitate targeted solutions that prevent widespread fires during land clearing for agriculture purposes.

Why the need for science and technology?

Current classification of peat soils draws primarily on temperate parameters and have limitations when applied to tropical conditions. Tropical peat soils have varying characteristics with depth as well as the presence of both decomposed and undecomposed wood. The drive for economic and social development compounded with the poor understanding of tropical peat soils has resulted in indiscriminate draining and clearing, contributing to widespread seasonal fires, air pollution (haze), greenhouse gas emission and land degradation.

How was S&T applied to the initiative?

The characteristics of tropical peat soils vary with depth and they may consist of both decomposed and undecomposed wood. The Malaysian Unified Peat Classification System has been developed based on field investigation of tropical soils over the past four decades. The classification system has detailed criteria, recognises depth classes, differentiate the presence of wood as well as its level of decomposition and identifies the underlying mineral substratum. Such classification enables systematic and meticulous mapping of tropical peat soils to delineate peat areas with undecomposed wood that are unsuitable and not economical for planting oil palm so that they are not developed.

What was the difference by applying S&T in terms of resilience building or policy making on DRR?

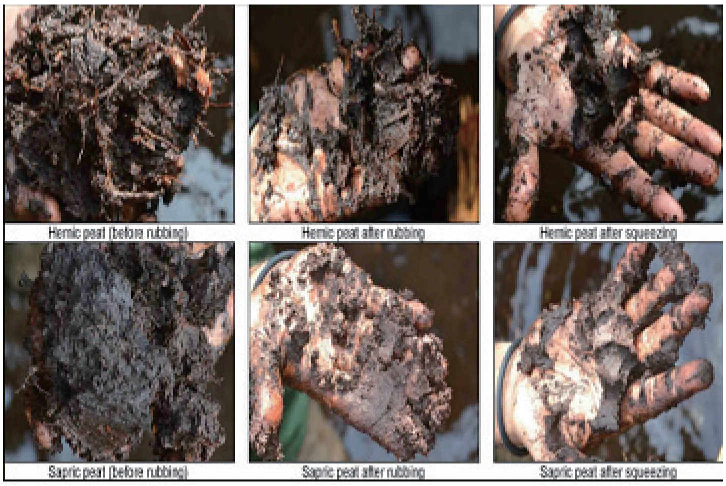
The Malaysian Unified Peat Classification System enables systematic and meticulous mapping of tropical peat soils. Research by the Malaysian Palm Oil Board reveals that the mapping of peat soils using this classification system enables targeted solutions for management and conservation of water and soil, which facilitate the re-establishment of biodiversity. It is also useful for identifying cost effective solutions for preventing widespread fires during land clearing.

Why is it considered as good practice and what kind of key factors contributed to the success?

Agriculture development particularly oil palm is wide-spread on tropical peat soil. Such areas cannot be ignored as they will need to be replanted in the future to maintain economic growth and social development. Unless the current management and conservation practices are improved to prevent widespread fires, seasonal haze occurrences will continue unabated. Application of the Malaysian Unified Peat Classification System provides the foundation for transforming the management and conservation of tropical peat soils, where areas that are suitable for planting oil palm can be identified while unsuitable terrain can be rehabilitated and preserved.

What would be the challenge if one is to replicate the application of S&T?

The Malaysian Unified Peat Classification System is pivotal to management and conservation of tropical peat soils. The System has been published and with training of skilled personnel it can be widely applied to identify targeted and economically viable solutions for preventing future fires in tropical peat soils.



Peat soil types can be easily identified in the field by rubbing and squeezing.

18

Approach of dzud risk reduction influenced to national security provision

Boldbaatar Shagdar, Mongolia

What is the initiative?

Dzuds have occurred throughout Mongolian history.The Dzud is one of type of disasters, it's impact effects to Mongolia's social and economic sector as well as to many other key development issues such as public health, migration, urbanization, rate of poverty and unemployment even to the National security. In the winter of 2009-2010, Mongolia was struck by a dire dzud for the fourth time in ten years. With a death toll passing 7.8 million heads of livestock, or 22% of the national herd, it represents the worst dzud since 1945. However, the huge level of livestock loss is only the most visible part of the damage that the disaster wreaked on the country. Impoverishment of thousands of herder households, rural depopulation and urban migration, and negative impacts on public health are among the other consequences of dzuds which, although less visible in the short term, deeply affect the country and its population. However, dzud is not such a kind of type disasters as earthquake which strikes without notice and is not allowing preventing and has sudden hit population within few minutes. On the contrary, dzud is a quite predictable phenomenon that is also a very slow process, which leaves time for preparation and organization and one of types of disaster to see and anticipate actions to cope with it and allow limiting its consequences and impacts.

Considering increase of dzud frequency and its negative impact trends to be become more serious characteristic due to Global and country's climate change, the subject to determine appropriate approach to enhance dzud disaster risk assessment and improve disaster risk management still remains one of the curial aspect.

Why needs science and technology?

There are many researcher and scholars who had been studied dzud as natural phenomenon and its classification, dzud assessment, methodology of assessment livestock loss perished by dzud. Even though, there are many studies and research works regarding drought and dzud as natural phenomenon and disaster, but there is lack of studies on basic theoretical aspect, principle of disaster risk management, no any analysis for implementation status of dzud risk management, as well as identification of solution and options to improve the dzud risk management.

How was science and technology applied to the initiative?

The overall goal of this research work was to analyze factors of dzud's influence to the National Security Provision to judge and study theoretical and methodological issues of disaster risk management, their solution and to identify a model of improvement for disaster risk management and institutional framework.

To achieve the overall goal of the research work, following objectives were accomplished:

1.Factors of dzud's influence to the National Security Provision and basic concept and outline of theory and methodology for dzud risk management identified;

2.The lesson learnt of dzud risk management and its current provision analyzed;

3.Improving the dzud disaster risk management solution for reducing the influence to National Security Provision defined.

Developing recommendations based on a model for the improvement of management and institutional framework of disaster risk and analyzing the basic outline of theory and methodology for dzud risk management theirs issues to be solved, the study was supported the national capacity building and enhancement of collaboration and coordination of shareholders and partners in field of dzud disaster risk reduction.

The approach and outline of research work would be theoretical conclusions of natural science and disaster research study, intellection of scholars and concepts and principles of policy documents of Mongolian National Code, Concept of National Security Provision, Law on Disaster protection, National Program on support deal with drought and dzud, National Policy on Rural Sectors etc.

What was the difference by applying science and technology in terms of resilience building or policy making on disaster risk reduction?

An approach of system analysis and structural and operational analysis, common methodology of empiric and theoretical study would be applied in this research work. As a result of study of basic context of dzud risk management and focusing on challenges of theoretical and methodological aspects and identifying a solution to those issues, the research work will propose a new model for enhancement of disaster risk management and institutional framework.

The recommended a new model for enhancement of disaster risk management and institutional framework has a practical essence of direct application to government organizations involved in coping with disaster as well as enterprises, herders and local communities.

Taking into account objective and subjective factors that effect to the potential risk of dzud, the research work will allow linking development policy and planning of livestock sector with identified adequate model and strategy of disaster risk reduction.

Why it is considered as good practice and what kind of key factors that contributed to the success?

Dzud disaster risk management should be implemented along with market economy and supported herders to prevent and reduce dzud potential risk. Dzud risk reduction measures identified in clear and unclear or acceptable and unacceptable condition. In order to promote linkage between risk reduction measures and reliable weather forecasting information all these identified risk reduction measures should be enriched by hydrometeorology information for winter season prediction and potential hazards events as well as remote sensing analysis.

In case of condition of an occurrence of dzud would be clear (verified that dzud will happen or will not happen), it is needed to estimate preparation of hay and fodder on base of evaluation of pastureland carrying capacity, capability of human and technical resource, transportation, and local marketing demand and capacity. A methodology, guidance, procedure and rules for disaster risk assessment and damage and loss assessment should be developed and pursued.

A result of research work will penetrate into practical work as innovative idea. For instance, to make decision on time for dzud risk reduction measure taking into account a negative impact of dzud to socio-economy and livestock sector, to make cost benefit analysis due to urgent response measures undertaken.

What will be the challenge if one to replicate the application of science and technology?

During dzud in 2000-2001 and 2009-2010 year, by theoretical and practical assumption, it was clear that could be prevent and able to face this phenomenon, and to successfully overcome its consequences, it still remained one question without sufficient answer and explanation is that why Mongolian Government and agencies, private sector, citizen and herder were not able to undertake dzud risk reduction and protection measures. That is the challenge to replicate the application of proposed recommendation.

19

Increasing DRR awareness of students in school through extra-curricular approach

SERJMYADAG Dalai, Institute of Disaster Studies, National Emergency Management Agency, Mongolia

What is the initiative?

Disasters are increasing not only in Mongolia but also worldwide in the recent years. In the event of a disaster, children are the most affected, schooling systems are disrupted, therefore affecting a fundamental right of children, the right to education. DRR education is one of the major pillars in building comprehensive school safety. But, the education system in Mongolia has not included disaster education in formal school curriculums. Disaster Risk Reduction Education can be instrument in building the knowledge, skills, and attitudes necessary to prepare for and cope with disasters, as well as in reducing vulnerability and building resilience.

Why needs science and technology?

In the first priority Understanding disaster risk of Sendai Framework for Disaster Risk Reduction 2015-2030 states that `Promote the incorporation of disaster risk knowledge, including disaster prevention, mitigation, preparedness, response, recovery and rehabilitation, in formal and non-formal education, as well as in civic education at all levels, as well as in professional education and training`. In the Mongolian National Policy on Disaster Protection (2011-2020) determined its priority as "To educate community on culture of safety". Many of the countries emphasize the importance of extra-curricular on DRR education, referring to activities delivered outside of the formal curriculum such as assemblies, after-school activities, student clubs, community meetings, exhibits, special events, competitions, and safety drills. Basic principles of opportunity of engaging to any student club and association in secondary school was stated in Mongolian Educational Law must have following `an educating technique and form, versions which meets student`s personal and growth features and needs, free and open` and in case of student rights and duties stated as `choose subjects which is not included in curriculum as mandatory subject`. Legal framework of teacher and children voluntarily joined to organize club and assossiation that subjected to disaster risk reduction activity is adequately provided in legal documents of Disaster management and Educational sector respectively.

How was science and technology applied to the initiative?

Institute of Disaster Research conducted survey on teachers of Secondary school. The survey research conducted to identify the needs the DRR education in school and to define the difficulties to teachers for delivery on extra-curricular DRR education. In the survey research involved 80% of all secondary school teachers from 21 provinces of Mongolia. The survey observed that:

To develop the DRR handbooks for students and teachers

To designate the teacher on DRR education

What was the difference by applying science and technology in terms of resilience building or policy making on disaster risk reduction?

In 2014, Institute of Disaster Research developed the extra-curriculum on DRR education for students of the peer educators` club. In Mongolia, peer educators club is named as `Junior rescuers` club. The ultimate goal of the extra-curriculum on DRR and is that getting knowledge of DRR and Disaster Response as well as in building skills of children in taking measures to reduce the impacts of future disasters and get appropriate response during and after disaster. The extra-curriculum is divided into 2 levels such as elementary and advanced level. The elementary level has 10 subjects and advanced level has 15 subjects.

Table 1: Extra Curriculum on DRR education in school

	1st week	2nd week	3rd week	4th week
January		L2: Safety tips on chemical accidents	L1:Preparing in strong storm	
February		L1:Preventing the building fire	L2: Preparing household emergency supply kit	
March		L2:Safety tips on forest and steppe fire		L1:Familiarization of Early warning System
April	L1:Preventing the forest and steppe fire	L2:Safety tips on flood	L2:Conducting first aid training	
May	L2: Understanding the rescuers and firefighters job	L2: Getting lost in outdoors		L1:Protecting thunderstorms
June	L1:Child protection during Emergency	L2:Survival/Outdoor living	L2: NEMA meeting	
July	Summer holiday			
August				
September			L1: Earthquake risk reduction	L2: Participating in rescue operation and conducting fist aid to victims
October	L1:Understanding the disaster	L2:Understanding Disaster Risk Reduction	L2:Preparing school DRR plan	
November	L1: Safety tips on Building fire	L2: Preparing Emergency escape plan	L2: Firefighting tools and Fire extinguisher	
December		L1: Participating in DRR the vulnerable groups	L2: Reducing Dzud Risk	

Why it is considered as good practice and what kind of key factors that contributed to the success?

In collaboration with World Vision Mongolia, NEMA has been developing DRR handbooks for teachers and children who are members of the peer educators` club in schools. Those handbooks aim to strengthen school safety and build the knowledge and skills of all students of schools through peer educators` club activity on DRR and Disaster Response. Although the handbook`s main user are the students, the activities in the handbook are supported by the school teachers and workers, community and local people, and family members. Each subject contains three sections that classroom activity (to get new knowledge and ability), community activity (to collaborate with their school, their household, and their community) and learn cases and facts. DRR cabinets also have been installed in some schools. The cabinets are used to educate the not only member students but also other students and community on DRR.

What will be the challenge if one to replicate the application of science and technology?

Sustainability of extra-curriculum and the peer educators` club is very important. For ensure sustainability, NEMA had been done several arrangements. These are:

NEMA had developed new Guidance activity for the peer educators` club.

NEMA has a year planner on DRR. This year planner is designed to help NEMA and other stakeholders for organize disaster risk reduction activity in each month. The extra-curriculum on DRR education is integrated with the NEMA`s Year planner.

NEMA will conduct annual competitions on disasters risk reduction, rescue and recovery among the peer educators` club, with prizes and certificates for successful schools and students.

The member of winner team will be awarded a certificate of open enrollment into Emergency Management School under Law Enforcement University.

20

Mobile Knowledge Resource Center (MKRC) and Water Knowledge Resource Center (WKRC)

Mitsuko Shikada and Shigehiro Shibata
SEEDS Asia, Kobe, Japan

CASE STUDY 20
Myanma

About the Project

MKRC is a DRR education center movable by a truck or ship and reachable to difficult-to-access communities. MKRC project was launched in 2009 in partnership with Myanmar Engineering Society (MES) after the cyclone Nargis in 2008 revealed lack of information and awareness of DRR in disaster-prone communities in Myanmar. It was imperative to help those communities to be become resilient to natural disasters through DRR education. Later, we discovered some remote communities were unreachable by vehicle, WKRC* started DRR education on a ship on 2nd May 2010, which marked 2nd anniversary of cyclone Nargis. When the MKRC or WKRC goes to a village, it usually conducts a two-day training. On the 1st day, a Training of Trainers (ToT) is provided for school teachers from different schools. The ToT includes how to: 1) explain the impact of hazards (cyclone, earthquake, flooding, tsunami, landslide, thunder lightening, tornado and fire); 2) provide safety tips; 3) conduct town watching; 4) develop hazard/resource map and; 5) utilize effectively DRR education materials provided by SEEDS Asia. On 2nd day, the trained teachers in turn provide DRR education for their own students with the materials. At the end the materials are given to schools so that DRR trainings can be sustainably provided by themselves based on their own needs.

*WKRC operated till September, 2014 and it has been already closed.

Contribution from Science and Technology

Visible and touchable education materials make it easy for training participants to understand mechanisms and risks of natural hazards as well as the way to response and take preparedness measures at community/school/individual level. The materials are in different forms such as miniature models, card games, picture-story show, posters, videos and exercise books, which are engineering technologies or hydrological/meteorological information but transferred into a form which enable small children to understand and take action. For example, a poster explains the mechanism of cyclone and then a miniature model able to provide a small blow demonstrates how cyclone actually can blow off a house roof and how to mitigate the risk by introducing locally applicable methods. Furthermore, another miniature model of housing structure teaches how to make housing safer against the cyclone. Thus, even though the contents of the training are sometimes technical and scientific, the combination of those materials makes it possible to provide DRR education in easy, enjoyable and effective manners.

How does the case contribute to implementation of STDRR?

a. MKRC/WKRC contributes to increasing the number of people who can receive DRR education by reaching difficult-to-access communities and also providing the ToT on DRR which enable communities continuously provide DRR education. As of March 2016, the number of beneficiaries of MKRC/WKRC is over 30,000 as of March 2016.

b. User-friendly and visible DRR education materials which are science and technology based, help teachers to provide DRR education at schools in an effective way and enable both teachers and students to understand scientific and technical contents of DRR. According to pre-and-post DRR quiz conducted during trainings, they have scored higher at the end than the beginning which indicates the improvement of their understanding.

21

Participatory Surveillance on evacuation site by local nurses and ICT in Nepal

Sakiko Kanbara, University of Kochi, Kochi, Japan

About the Project

At the time of disasters, one of the critical challenges for first health responder is data collection to generate reasonable information that can be used in predicting whether something is likely to outbreak communicable diseases. “EpiNurse” in Nepal was an action research project whose objective is to implement community health and environment status assessment by local Nepalese nursing workforce and the sharing of collected health information through real time communication with governmental and international relief agencies (health clusters) in order to ensure timely decision-making on the prevention of communicable diseases prior to the occurrence of an epidemic.

Contribution from Science and Technology

The projects was initiated within the framework of the J-RAPID Programs supporting urgent international collaborative researches by the Japan Science and Technology Agency (JST), in collaboration with three Nepalese governmental institutions in the aftermath of the disaster related to the magnitude 7.8 earthquake that struck Nepal in April 2015, The project consisted on the use of an ‘open tool kit’ that provides application program interfaces (APIs) for data integration and sharing with other health agencies such as the ministry of health (MoH) and WHO. The monitoring of community health status in disaster-affected districts is conducted by local nurses who were trained in Kathmandu on the utilization of the toolkit and dispatched in 26 camps in eight affected districts for four months: Kathmandu, Gorkha, Dolakha, Sindhupalchok, Nuwakot, Rasuwa, Bhaktapur and Laltipur. It was tested with composed of a simple software such as excel spread-sheets delivered in layman’s terms to Nepali nurses who perform the monitoring by using a paper and an ICT tool to carry out research/investigation that contributes to the collection of scientifically important but short-lived data, speedy restoration after disasters, as well as improvement of disaster preparedness in the future. The collected data were reported to appropriate organizations and analyzed with open data sources.

How does the case contributes to implementation of SFDRR?

SFDRR targets should focus on people, and their various cross-border relations should be understood in a more cross-sectional and comprehensive manner. This project proposes a realistic and fast monitoring tool for collecting community health status to be shared in a speedy and accurate manner. This study show that need for domestic health professionals like community health nurses to take urgent steps to make use of available and disaggregated data and develop a sustainable network as social capital to ensure that no one is left behind in disaster risk reduction.

22

"Mansehra model of Disaster Risk Management": A case study on best practices regarding application of science and technology on resilience building

Syed Harir Shah, JAD FOUNDATION, CHITRAL, PAKISTAN

CASE STUDY 22
Pakistan

What is the initiative?

The earthquake 2005, killed over 80,000 people, including 20,000 school children and injured over 150,000. In 2008, Disaster preparedness and management (DPMP) system was set up as a pilot project by German International Cooperation (the then GTZ) in the earthquake affected District Mansehra, Pakistan. It was based on the recognition of systematic and detailed assessment of the efforts of multi-stakeholders and the identified gaps in practices and application of both science and technology. A comprehensive and integrated disaster risk reduction and management system was set off by consolidating these efforts made by the multi-stakeholders under the platform of District Disaster Management Authority (DDMA) headed by District Mayor and administratively led by Dy. Commissioner. Over 80 officials of line departments, local government agencies, emergency responding agencies, NGO/INGOs volunteered themselves to strengthen DDMA functioning on policy, planning and emergency operation. Extensive capacity building training conducted, gears provided and scenario based integrated drills/simulation organized to overcome the gap in application of science and technology for resilience building to disasters. The existing training contents reviewed, consolidated, standardized and accredited to ensure minimum preparedness at all level, DRM and contingency plans at diverse level prepared and tested. Disaster Emergency Operation Center (DEOC), Incident and command system, early warning system established and made operational. Over 3000 students, 200 teachers trained, equipped in school safety program and the network of over 6,000 Volunteers linked with DEOCs for EW dissemination, action planning and disaster recovery program.

Why needs science and technology?

The Mansehra Model of disaster risk management is a process of acquiring systematic knowledge for risk assessment, observations, experiences, learnin g, and reflection in action and on actions and testing. Global and national wealth of scientific knowledge re-assessed in terms of their application in local prospective in context of ecological, socio-economic and ecological, geological narrative to ensure resilience building on disasters and sustainable development. The changed human behavior, attitude and environment in the society distinct application of science and technology on the basis of competency in the products and innovative tools, skills, systems, materials and communication for addressing disaster threats and challenges to the humanity in the district.

How was science and technology applied to the initiative?

The project, in recognition of the values of indigenous and scientific knowledge, developed tools, methodologies, and products through a systematic process to address the gap in science and technology. The project also took into consideration socio-economic and culture narratives and learning from the 20 year's practices, diversified skills, tools, methodologies, process, and procedure in the country. Application of science and technology in an innovative way in the projected well-heeled.

What was the difference by applying science and technology in terms of resilience building or policy making on disaster risk reduction?

Application of science and technology in consideration of local needs in local perspective was fully owned by all stakeholders. It ultimately ensured collective contribution to policy formation on DRR and integrated rapid response to emergencies at multi-level. The project reduced dependency syndrome on outside resources for response. Local resources pooled (human, technical and financial) enabled district authorities and the communities to plan and respond to emergencies effectively. Community disaster structure at local level was empowered with minimum standards for community preparedness and EWS. The DEOC, Incident and system, engagement of all stakeholders with clear SoPs and ToRs, working relationship through regular monthly meetings, simulation, drills, school safety programs, and organized response together contributed to resilience building to disasters.

Why it is considered as good practice and what kind of key factors that contributed to the success?

The project demonstrated varying degree of resilience and capacity to effectively response to disasters on self-sustaining basis after six years of the end of project in 2010. Search and Rescue team and the system established is still responding to localized disasters without external support and saved hundreds of lives. It is local resource based, collectively owned by government, NGOs, and community. It reduced dependency syndrome on outside support. Knowledge, skills and competencies acquired during the project life is still in use and transforming to the new generation. Accountability and transparency in deed and actions of the project implementers built the trust and confidence of the stakeholders in getting connected, learning from each other and the events, and remaining proactive to risk reduction and resilience building. Some of the key factors for the success include competency in science and technology, its application in local prospective, strong social mobilization, commitments and dedication of all stakeholders for a common cause.

What will be the challenge if one to replicate the application of science and technology?

The major challenges in replication and application of science and technology would be the key success factors mentioned above, if failed to apply in replication of any similar project anywhere.

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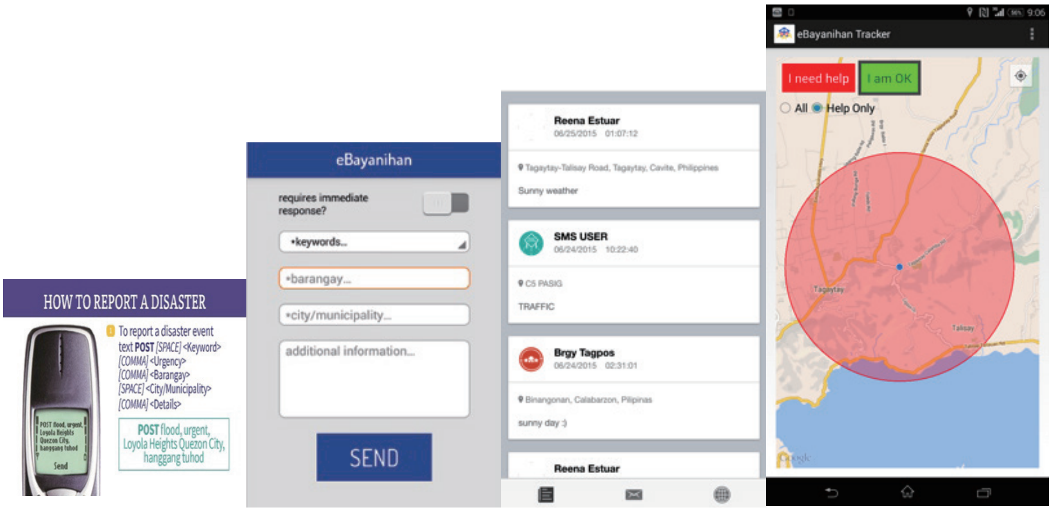
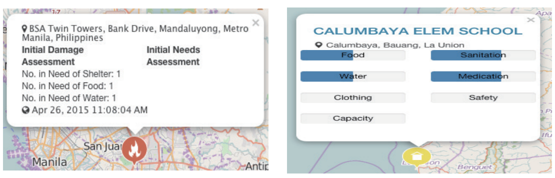
eBayanihan: web based participatory disaster management system

Maria Regina Justina E. Estuar, Ateneo de Manila University, Manila, Philippines
Sakiko Kanbara, University of Kochi, Kochi, Japan

In 2014, eBayanihan (ebayanihan.ateneo.edu), a web and mobile nationwide participatory disaster management system funded by the Philippine Council for Industry, Energy and Emerging Technologies Research and Development (PCIEERD), Department of Science and Technology (DOST), Philippines, and SHEREPO, a web and mobile based application shelter reporting system which captures and maps human security variables began with feasibility study of integrating human dimension and human security in a disaster management system, merging the two systems through the JRAPID Program, through the Japan Science and Technology Agency (JST). eBayanihan provides a technology inclusive platform that allows the public to report disaster related information using a bottom up approach. The system includes a volunteer management system to address the need to provide information on various types of services and skills needed during the response phase of a disaster.



The system has embedded SHEREPO to add the needed additional feature of providing near real time information on the human security variables, namely: food, water, clothing, shelter, sanitation and safety. The system has a notification feature that provides direct notification to persons and agencies managing the response clusters.



The system has been developed using an agile approach, incorporating features through modules and web services. The system serves as a base platform or an engine that can be modified to integrate or work with other similar systems, as tested during the 2015 Typhoon Lando (Koppu) where it has been made interoperable with Project AGOS of Rappler. Aside from data capture, the system also uses statistical and machine learning algorithms in modeling validation of crowd sourced reports, thematizing, visualization and reporting. The system is developed using open source technologies.

The project is an example of a multidisciplinary approach in solving a very complex problem such as disaster management. Initial approaches in disaster mitigation are single dimension, e.g. based on hazards. Inclusion of human dimension and human security provides information on resiliency or vulnerability status of a certain location. This integrated approach strengthens disaster management and mitigation as it provides a system that facilitates a two- way approach in the flow of disaster information. The system, designed as a social networking platform specifically for disaster, is designed to be dynamic, sustainable and scalable.

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Climate/Disaster Risk Assessment and Application of Risk Information in Development Planning

Peeranan Towashiraporn, Asian Disaster Preparedness Center (ADPC), Thailand

What is the initiative?

The initiative "Climate/Disaster Risk Assessment and Application of Risk Information in Development Planning" was aimed at equipping provincial governments with tools and knowledge on disaster risk for mainstreaming it into development planning. The initiative was piloted in 2 provinces of Thailand, namely Chiang Rai and Songkhla, with supported by UNDP in partnership with the Royal Thai Government.

Why needs science and technology?

Understanding disaster risk in the pilot provinces was the first crucial step of the initiative. Simple analyses of past disaster events was deemed insufficient to demarcate high-, moderate-, and low-risk areas in the provinces. Science-based risk assessment was brought on for better understanding of where the risk lies as well as the quantification of it. Subsequently, Geographic Information System (GIS) was needed for visualizing the risk for each of the districts in the pilot provinces.

How was science and technology applied to the initiative?

Science and technology was utilized in this initiative through hazard modeling, exposure analysis, and risk mapping. For examples, earthquake sources in Chiang Rai province were modeled scientifically to allow policy makers to understand where earthquakes can possibly happen in the province, and more importantly, which districts of the province can be impacted by them. Similarly, slow-onset hazard such as the coastal erosion problem in Songkhla province was also modeled using scientific approaches to demarcate a high risk zone for future erosion. Further, Geographic Information System technology was used to map out the disaster risk in the 2 provinces which make it easier to policy makers to visualize, understand, and use such information.

What was the difference by applying science and technology in terms of resilience building or policy making on disaster risk reduction?

The science-based risk assessment helped equip policy makers with a tool and knowledge on disaster risk in the provinces. Quantifying disaster risk to the level that is useful for integrating it into development planning process was not possible without the proper risk assessment. Decisions related to future risk reduction activities or development planning of the provinces now can be made based on scientific quantification of the disaster risk.

Why it is considered as good practice and what kind of key factors that contributed to the success?

The initiative is a pioneering effort in the region in bridging science-based disaster risk assessment and policy-making related to sub-national planning. The key element that led to the success of this initiative was the leadership in the provincial governments. The initiative engaged senior leadership, i.e., the governors of the 2 provinces, creating strong partnership from the beginning. The governor of Chiang Rai particularly was interested in the science-based approaches and was willing to take it forward into policy making.
f) What will be the challenge if one to replicate the application of science and technology.
The major challenge in replicating the effort in other areas will be to get key policy makers to buy into the use of science-based approach. It was found in this initiative that non-technical policy makers would be willing to try to understand the science if the messages could be tailored to the level they could understand and be supplemented by concrete examples. It is hoped that the success of this pilot initiative will be a great example for any attempt to replicate a similar approach elsewhere in Thailand or even in other countries.

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Living with the river: trans border approach towards flood risk management

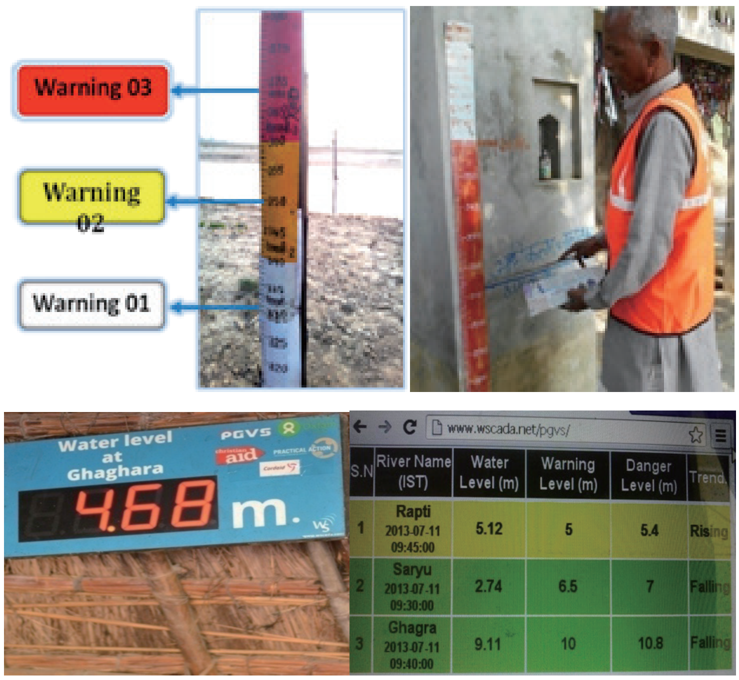
Shalini Jain, SEEDS India, Delhi, India

"Living with the River: Trans border Approaches towards Flood Risk Management" strongly advocates for establishing cross-border community based early warning systems between communities in Nepal and India along the Karnali (Nepal)and Ghaghra (India) rivers. It emphasizes on creating "people centered" system and empowered communities to act appropriately so as to minimize the losses from disasters. This innovation is being implemented by Poorvanchal Gramin Vikas Sansthan (PGVS), member organization of ADRRN partnering with local and regional CSOs lending social, technical and financial support.

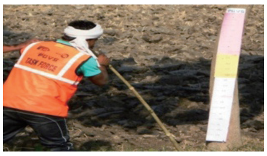
Warning services lie at the core of the system. Hence a need for sound scientific basis for predicting and forecasting hazards and a reliable forecasting and warning system that operate 24 hours a day was felt. Practical Action played a critical role in providing specialized scientific and technical input for analyzing natural hazard risks. PGVS conducted a threshold analysis of the Ghaghra and Saryu River under the facilitation of Practical action team. It gives clear information about the availability of appropriate lead time before evacuation.

PGVS with support of community and administration established River Gauge at community level and after analysis markings are made in each village separately. The data of each year helps to improvise the water level and maintain all the warning levels. This is the local method in which the markings are made on a steel plate in vertical standards and it is placed on a strong wooden thud (Balli). Then it is placed in the river at places and leveled through GPS system. In this way, if it is damaged also one can replace it with another at the same place.

River gauges have been established in 9 places in Bahraich and Gonda districts at cluster level on Ghaghra river for monitoring at downstream. There are River Stations in Nepal established primarily at Chisapani, Chepang and Kusum. PGVS with Practical Action established Digital River Monitoring Device that gives real time information about the level of Ghaghra River (Karnali River in Nepal). PGVS and the Panchayats have established early warning electronic river display systems in Bahraich in (Girgitti village of Mihipurwa) and Gonda (in Pure baloo village of Nawabganj). It is linked to Nepal hydrology and metrology departments through internet for monitoring of Upstream rivers like Karnali which is Ghahgra in India and Babai which is Saryu in India.



Information getting converted to warning



Reading of the upstream river level is done through digital river monitoring device at display station. If village river gauge shows water on white, yellow or red lining, this information is communicated to Sarpanch who declares warning after discussion with Gram Task force (GTF) members. Later he communicates with other clusters and GTF members using local systems issue warning in the village. CBEWS rely on the direct participation of those most likely to be exposed to hazards. A local, ‘bottom-up’ approach to early warning, with the active participation of local communities, enables a multi-dimensional response to problems and needs. In this way, local communities, civic groups and traditional structures can contribute to the reduction of vulnerability and to the strengthening of local capacities. Local governments must understand advisory information received and be able to instruct and engage the local population in a manner that increases public safety and reduces the possible loss of resources on which the community depends. Under CBEWS, information is shared with (DDMA) office. DDMA then shares the information to Tehsildaar in other blocks. Tehsildar shares the information to concerned Lekhpals. Lekhpals ensures the information is disseminated to Panchayat level.

This people-centered approach to early warning, promoted by PGVS, focuses on how communities must understand threats in order to avoid them. Disasters are partly caused by external hazards, but they also stem from vulnerability people being in the wrong place, at the wrong time, or without adequate protection or resources to respond to a warning. There is a consensus that communities must, at the very least, be active receivers of information, while some may even need to be engaged in monitoring so as to facilitate their adoption of protective actions. However, factors as diverse as knowledge, power, culture, environment, lifestyle and personality often determine whether people heed warnings. By engaging communities in the development of the early warning systems from the beginning many of these challenges can be addressed.

Pilots are planned to build greater outreach, for areas with similar conditions of natural cross border hazards within Asia.

https://www.ifrc.org/PageFiles/103323/1227800-IFRC-CEWS-Guiding-Principles-EN.pdf

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Digital Radio Mondiale - Emergency Warning Function

RUXANDRA OBREJA, BBC World Service Group, London, UK

Disasters are all around us. Whether natural or manmade between 2000 and 2015 they claimed 1.3 million lives globally, affected, 3.2 billion people, over 40% of the world population, and cost 2.1 trillion dollars. So preventing, managing disasters and rebuilding afterwards are preoccupying governments, organisations like UN or ITU.
Disasters need to be tackled with the utmost urgency. Very often telephone lines, cell phones towers and internet connections go first and even TV succumbs to the failing electricity supply. Radio is the last line of resistance in times of emergency and the obvious solution as it can work on batteries, car batteries and can also be served with transmissions from outside the affected area.

Digital Radio Mondiale (DRM) is one of the major ITU-recommended digital audio broadcasting standards. It is actually the only global, open digital radio standard for all frequency bands, both in AM (LW, MW, and SW) as well as in VHF. DRM is not the only audio standard with an in built emergency warning functionality (EWF). But because of its versatility and large range DRM, like no other radio standard in use, allows broadcasters to reach millions of people over vast areas and in remote areas, as well as locally. Broadcasters can also target specific areas affected by disasters by identifying the precise area that should get the message. They can do it from outside an area where the entire infrastructure might be totally destroyed. DRM enjoys universality and flexibility, key in disaster situations. DRM offers an excellent audio quality no matter which frequency band is used. The great innovation that makes it superior to analogue is that DRM has the inbuilt automatic feature to broadcast emergency warning messages both as audio and text content (in addition to other features like multi-media, traffic etc.). The EWF of DRM means that receivers can be ordered to automatically re-tune and present the emergency information, overriding any other programme that might be on the air at the moment of disaster. DRM can thus satisfy some of the key requirements in case of emergency: notify maximum number of people in the affected areas as promptly as possible over large areas with very high reliability, be as un-intrusive as possible for daily use, be continuously available and on air for the duration of the emergency, make emergency message available to widest possible audience, including the visually impaired and hearing impaired.

When an alarm signal is triggered by the authorities (authority or specific governmental departments lets broadcaster know that emergency messages need to be carried by transmitter or transmitters selected), all digital radios pick up this alarm signal and automatically switch to the indicated emergency broadcast. So in effect whatever programme is on will stop and switch to the emergency message. The emergency broadcast thus carries the announcement(s) as audio content and in addition presents short headlines (DRM Text Messages) and detailed background information and instructions possibly in several languages on the receiver screen. As a result, target listeners of the EWF can receive detailed text information through Journaline, supporting multiple languages and scripts simultaneously in one single broadcast, such as: the reason for emergency warning; instructions on what to do; contact details for further information; list of affected areas; list of affected people/population (search messages etc.).Turned-off receivers may switch on automatically. The ability of receivers to check on emergency warning signals being active should be a general requirement for receiver manufacturers, too. Then all the receivers in the incidence area of one or several transmitters will switch on automatically. This means we might need to alert or “wake up” all receivers in the whole country or just a specific region, if just one area is affected by a disaster. Going countrywide, when not necessary, might create unnecessary panic. Also if the infrastructure is totally destroyed in an area, we can use transmitters outside the affected area to transmit at large distance the necessary messages. The receivers, even the simplest ones (as long as they are digital, DRM) will respond.

There are a few steps that are required to implement on-demand disaster warning on DRM digital radios to:
Generate and feed an emergency trigger signal to the broadcaster by the national authority or body dealing with this.
Prepare content in advance for each possible emergency scenario so that it can be put on-air immediately when required on trigger signal.
Have available DRM Digital receivers for the public/target group.
DRM transmitters already installed have the provision for DRM's Emergency Warning Feature.
Disaster warning is an essential functionality of the DRM standard and should therefore be a mandatory core feature of all DRM radio receivers. While all components of the DRM EWF are standardized elements of DRM, some manufacturers might be tempted to simply not implement them all in some of their products. Therefore, to make the DRM EWF a reliable functionality built into all receivers, an appropriate policy for manufacturers and importers of radio receivers should be adopted. This will educate and motivate manufacturers to produce digital receivers with full Emergency Warning Feature support from the beginning. At the same time this will give authorities the certainty that in case of a pending disaster they can rely on and immediately achieve the widest possible reach through their DRM broadcast.

Using the EWF of DRM can really deliver, as we have demonstrated several times in Asia. With the right number of receiver and the right preparation digital radio has a big role to play in the mega effort of disaster prevention and management, which is ultimately all about saving lives.

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Building Disaster-Resistant Houses and Schools using Culturally-Appropriate Technology: A Case Study

Maribel F. Larracochea, Build Change, Philippines

What is the initiative?

Build Change develops simplified tools, training and technical resources for homeowners, builders and school officials to develop their capacity to build disaster-resistant houses and schools based on government codes and which meet accepted engineering standards---because disasters don't kill people, badly built buildings do. These technical tools and training programs improve on existing construction practices by making them safe, yet culturally-appropriate and cost-competitive. Build Change uses this approach in disaster-prone developing countries globally, including Indonesia, Nepal and the Philippines in Asia.

Why needs science and technology?

Although disaster-prone developing nations may have adopted building codes in theory, in practice these accepted standards for safety are not strictly enforced for residential houses and rural schools; due to limited awareness of risk, funds, and government intervention, construction is executed by local builders who lack training in disaster-resistant construction and in the absence of qualified technical supervision. Disaster-resistant design and construction principles are not commonly taught in local universities, thus are not usually practiced even in the rare case that engineers are involved in design and construction. Homeowners and local builders need simplified tools so they can build disaster-resistant houses/schools using existing, affordable and culturally appropriate construction practices.

How was science and technology applied to the initiative?

Build Change implements a homeowner-driven method on building disaster-resistant houses and schools applying accepted engineering standards. We design and build disaster-resistant houses and schools based on existing local practices and government codes using culturally-appropriate architecture; as well as develop and distribute simplified construction guidelines and manuals that are easy to understand and use by non-technical people – both processes are led by professional engineers with expertise in design for disaster-resistance construction and quality supervision. Our technical staff (i.e. engineers and builders) also facilitate capacity building activities for homeowners, builders and school communities on disaster-resistant construction techniques. As part of our holistic approach to successfully implement our homeowner-driven method, we stimulate demand by facilitating awareness-raising sessions of the effects of disasters and importance of disaster-resistant construction among homeowners, school officials and builders, and link homeowners to grants or subsidies sufficient to build safely.

What was the difference by applying science and technology in terms of resilience building or policy making on disaster risk reduction?

Houses and schools are built to withstand the effects of typhoons and earthquakes, preventing loss of lives and property, as well as injuries in the event of a disaster. Homeowners, builders and school officials also have the knowledge and skills on disaster-resistant construction which they can apply in other construction projects, thus allowing more disaster-resistant houses/schools to be built.

Why is it considered as good practice and what kind of key factors that contributed to the success?

Homeowner-driven construction using locally appropriate technology based on accepted engineering standards creates a permanent change in construction practices to those which are disaster-resistant. It is successful and sustainable because it uses culturally-appropriate and cost-competitive technology, which allows for easy understanding and application, even by non-technical people. This practice has already been adopted in post-disaster settings by the governments of India, Indonesia and Nepal.

Impacts to Date:

*Locally-appropriate construction guidelines approved in Colombia, Haiti and the Philippines
*Locally-appropriate curriculum approved in the Philippines
*245,000 people living and learning in safer houses and schools
*48,700 safer buildings
*25,300 people trained in the basics of safe construction
*12,000 local jobs created
*31 organizations using homeowner-driven model

What will be the challenge if one is to replicate the application of science and technology?

To be culturally-appropriate, cost competitive and to conform to government standards, technical resources, tools and training must be carefully adapted in different countries.

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Mainstream climate information application for disaster risk reduction (DRR) in Nilwala and Mekong River Basins in Sri Lanka and Vietnam

Senaka Basnayake, Asian Disaster Preparedness Center (ADPC), Thailand

What is the initiative?

Mainstream climate information application for enhancement of agro-ecosystem services and functions for disaster risk reduction (DRR) in Nilwala and Mekong River Basins in Sri Lanka and Vietnam funded by AusAID under Mainstreaming Disaster Risk Reduction into development in Asia (MDRD) from 2012-2105.

Why needs science and technology?

Understanding climate trends, current and future risks and develop adaptive measures for managing risks.

How was science and technology applied to the initiative?

The program was to mainstream climate information application, which generates and disseminates by the national level agencies (NHMSs) for enhancement of agro-ecosystem services and functions of Nilwala river basin in Sri Lanka and the Lower Mekong river basin in Vietnam and to develop science-based strategies, plans, regulations and programs. The program also envisages strengthening the capacity of professionals working in basin development for protecting and restoring agro-ecosystem to maximize its protective function, introducing trainings on science-based adaptive technological packages and on demonstrational programs.

What was the difference by applying science and technology in terms of resilience building or policy making on disaster risk reduction?

The use of science based information helped address the issues of the farming communities and the evidence from different analysis and assessment resulted in convincing the farming communities in adopting new technologies. Despite persistent challenges, science has led to improved outcomes for people over time by implementing more consistent, safe and effective policies and practices that affect individuals. This project allows to develop appropriate agriculture and livelihood options adaptable to agro-ecosystem to withstand weather and climate associated risks and build resilience.

Why it is considered as good practice and what kind of key factors that contributed to the success?

Most agricultural practices in developing countries are dependent on natural climate patterns. A slight change in weather pattern may have serious impacts on farmer's income and stability. Therefore, it is always encouraged to the farming community to follow best agricultural practices which includes adjusting the rice planting season depending on the climate pattern. The new rice varieties tolerant to floods and droughts introduced by the project were successfully adopted by the farmers. Active participation of extension officers and agricultural officers with farmers created awareness of farmers and help disseminate updated information at a much quicker pace. It also enabled us to draft recommendations on "mainstreaming weather and climate information and adaptive technological measures for enhancing agro-ecosystem resilience" to be included in country's National Agriculture Policy, in particular in Sri Lanka., which includes improving the existing mechanisms of local level decision-making through seasonal meetings. Formation of Management and Monitoring Committee (MMC) under the leadership of local government authorities to oversee the activities and to closely liaise with farmers could be the key success of this effort.

What will be the challenge if one has to replicate the application of science and technology?

Convincing farming community for effective utilization of weather and climate information and adapting to new technologies and methods will be challenging.

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