UNISDR Asia Science Technology and Academia Advisory Group (ASTAAG)

Integrated Research on Disaster Risk (IRDR)

Collaborating Centre for Oxford University and CUHK for Disaster and Medical Humanitarian Response (CCOUC)

Co-designing Disaster Risk Reduction Solutions:

Towards participatory action and communication in science, technology and academia

2017

Asia Science Technology Academia Advisory Group

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About this publication:

This publication is jointly developed by UNISDR Asia Science Technology and Academia Advisory Group (ASTAAG), Integrated Research on Disaster Risk (IRDR) and Collaborating Centre for Oxford University and CUHK for Disaster and Medical Humanitarian Response (CCOUC). A call for submission was made for co-designing disaster risk reduction focusing on participatory action and communication in science, technology and academia. This publication is supported by IRDR International Programme Office (IPO) and CCOUC. This publication is not the official voice of any country and the analysis presented in this publication is of the author(s) mentioned for each submission.

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Please refer this publication as:

Shaw R., Chan E., Lian F., Lu L., Shi P., Yang S., Chan G., Wong J. (2017): Co-designing DRR Solutions: Towards participatory action and communication in science, technology and academia, ASTAAG, IRDR and CCOUC, Hong Kong, China, 98 pages.

Sponsor:

The production of this publication is generously sponsored by the Croucher Foundation.

Croucher Foundation
裘槎基金會

May 2017

Preface

Following the adoption of Sendai Framework for Disaster Risk Reduction 2015-2030 (SFDRR) by the UN Member states on March 2015, it becomes more important to consider how the science, technology and academic communities can adopt participatory approaches with communities, civil society and other stakeholders in realization and co-production of the DRR solutions. This work has already begun to be promoted in Asia by the formation of UNISDR Asia Science Technology and Academia Advisory Group (ASTAAG, May 2015) during forum such as the Asia Science Technology Conference on Disaster Risk Reduction (ASTCDRR, August 2016), Regional Innovation Forum (RIF, December 2016).

This publication consists of 40 diverse case studies regarding multi-stakeholder and participatory approaches in DRR, with particular focus on the science, technology and academia contributions. The case studies reflect all levels of DRR policy and practice, from a local through subnational, national and regional level. This publication is a modest attempt to illustrate how the science, technology and academic communities can and should be developing participatory strategies to generate more understanding about disaster risk, develop solutions and effectively communicate this information to a variety of stakeholders. We thankfully acknowledge to all who submitted case studies. A special thank goes to colleagues in IRDR IPO, CCOUC and ASTAAG Secretariat for their support to the publication.

We hope that this publication would be a good reference document to understand co-designing disaster risk reduction resolutions and to share it with other disaster prone regions of the world.

Rajib Shaw

ASTAAG and IRDR

Professor, Keio University, Japan

Co-Designing Disaster Risk Reduction Solutions

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About ASTAAG

Asia Science Technology Academia Advisory Group

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/centers of excellences and engage them in sharing knowledge and experience

Members

ASTAAG comprises selected disaster experts from Asian-Pacific countries: Australia, Bangladesh, China, India, Indonesia, Iran, Japan, Malaysia, the Philippines and Thailand. 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, Disaster resistant building design, Disaster public health and Health emergeney and disaster risk management. 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 (countries are the ones, where they are based):

- Australia: David Sanderson
- Bangladesh: Jamilur Reza Choudhury
- China: Peijun Shi (Chair) and Emily Ying Yang Chan
- India: Vinod Kumar Sharma
- Indonesia: Sugeng Triutomo
- Iran: Ali Ardalan
- Japan: Rajib Shaw (Co-chair) and Takako Izumi
- Malaysia: Joy Jacqueline Pereira
- Philippines: Antonia Yulo Loyzaga
- Thailand: Frank Thomalla

About IRDR

IRDR
Integrated Research on Disaster Risk
www.irdrinternational.org

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

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

There are three research objectives:

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

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

- Disaster Loss Data (DATA)
- Forensic Investigations of Disasters (FORIN)
- Risk Interpretation and Action (RIA)

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

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

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

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About CCOUC

Collaborating Centre for Oxford University and CUHK
for Disaster and Medical Humanitarian Response
CCOUC 災害與人道救援研究所
www.ccouc.org

Collaborating Centre for Oxford University and CUHK for Disaster and Medical Humanitarian Response (CCOUC) has been established by the joint effort of Oxford University and The Chinese University of Hong Kong (CUHK) as a non-profit research centre to carry out research, training and community knowledge transfer in the area of disaster and medical humanitarian response in Greater China and the Asia-Pacific Region since April 2011. Housed in the Faculty of Medicine of CUHK, CCOUC draws on extensive technical expertise and collaborative networks of its supporting institutions.

Our vision

To minimize the negative health impact of disasters experienced by vulnerable populations in Greater China and the Asia-Pacific Region.

Our mission

To serve as a platform for research, education and community knowledge transfer in the areas of disaster and medical humanitarian crisis policy development, planning and response.

To achieve this mission, CCOUC

- Focuses our unique multidisciplinary public health research team on gathering and evaluating evidence to synthesise concrete knowledge and practical guidelines based on that evidence for disaster preparedness, relief, and response in Greater China and the Asia-Pacific Region;
- Provides training for both academic and frontline disaster-relief practitioners;
- Establishes academic internship and fellowship programmes to support and enhance technical and research capacity in Greater China and the Asia-Pacific Region;
- Delivers technical seminars to enhance understanding and knowledge transfer of disaster and medical humanitarian response experiences; and
- Publishes materials for teaching, research and historical reference.

Our team

The CCOUC team comprises experts from diverse background including public health, emergency medicine, midwifery, epidemiology, surgery, clinical psychology, radiology, nutritional sciences, development studies, public policy, anthropology and sociology. Together, the team engages in multidisciplinary research and academic and regional exchange to advance the field of evidence-based medical humanitarian actions and activities.

01.

Weather Information Dissemination during Cold Wave in a Subtropical Metropolis: A Case Study in Hong Kong

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Introduction

In the 21st century, extreme cold weather events are becoming more frequent, bringing higher risks of mortality and morbidity especially in low latitude areas. Hong Kong, an Asian subtropical metropolis, is characterized by high population density and the major ambient temperature increase for the past decades. Since awareness is one of prerequisites for public health prevention, a sufficient and effective weather information channel is important for the general public to receive weather information, increase awareness and promote preparedness. This case discusses weather information receiving channel by general public in Hong Kong and identifies lessons learned.

Cold wave in Hong Kong

Hong Kong Observatory (HKO) recorded a temperature of 3.1°C in the city on January 24 which was the lowest temperature for the past 59 years (Figure 1)(1). The temperature on Tai Mo Shan, the highest peak, dropped to -6°C. More than 100 people were trapped on the high ground during the cold wave and over 60 were taken to hospitals for treatment with a number of them suffering from hypothermia.

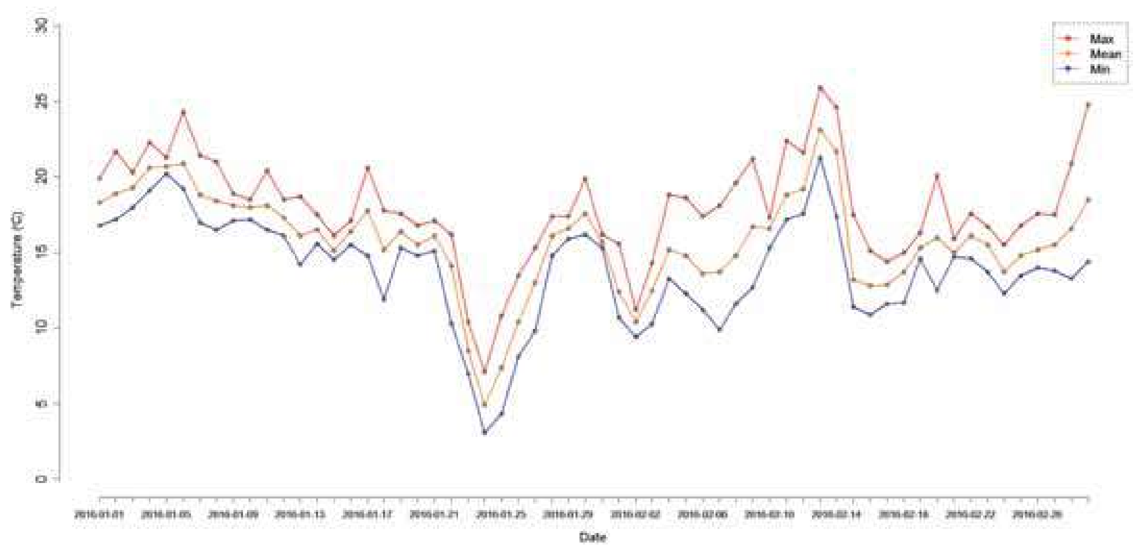

Figure 1: Daily Temperature in January and February 2016

Telephone survey and participants

A large-scale telephone survey between January and February 2016 was conducted to understand the weather information channel preference and behaviour in Hong Kong. This study targeted the general Hong Kong population and the participants were invited on the basis of the proportion of age, gender and living district, comparable with the 2011 Hong Kong Population Census. Exclusion criteria include those aged less than 15, non-Cantonese speakers, overseas visitors and those who were unable to answer due to medical reasons. Ethic approval of the survey was sought from the Chinese University of Hong Kong, and a verbal agreement was sought from each participant at the beginning of survey.

Channels of public's obtaining weather information

The study found that, among the 1,017 respondents, television (50.1%) was the most popular channel, followed by smartphone app (32%). Smartphone app (45%) was reported to be the most popular, followed by television (36.3%). There were around 70% were using their preferred channel while more than 16% of all respondents would like to switch to smartphone apps from other channels.

In the subgroup analysis stratified by age, radio was still an important channel for people older than 45, accounting for around 12% in both current and preferred channels. Interestingly, among those who are older than 45 and who do not currently use smartphone app to acquire weather infornation, 18.4% reported that they wanted to switch from current channel to smartphone app as their main channel of acquiring weather infornation. There was no gender difference in the use and preference of weather information obtaining.

Lessons identified

Because extreme weather events are expected to increase all over the world (2), they will bring heavy burden to the social and economic development to the local community especially when the society is unable to cope with it effectively (3). Located in a subtropical city, Hong Kong's average annual temperature is around 23.3°C, which is easy to make people let down their guard on cold preparedness. As weather reports are a part of daily life in Hong Kong population and people usually use the forecasts to plan their activities (e.g. planning how to dress), weather information providers should offer information in different channels to address the stratified information receiving pattern identified.

Conclusion

Effective channel for receiving information is important and necessary for public health protection. Although television is still the dominant mode of public communication, smartphone app attracts increasingly more people with its convenience and instantaneity, especially for the young. Smartphone app could be a suitable channel. Relevant public health strategies should tailor according to the pattern of technology use and tendency.

Acknowledgement

This research project was co-funded by the CUHK Focused Innovations Scheme - Scheme A: Biomedical Sciences (Phase 2) and the CUHK Climate Change and Health research project fund. The research process has significant contributions by Carman Mark, Sida Liu, Chunlan Guo, May Yeung, Gloria Chan and Jean Kim.

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02.

Enhancing Evidenced Based Action through Informed Decision: Example of 'Climate School' in Varanasi, India

Mitsuko Otsuyama, Suvendrini Kakuchi, Sanae Hayashi, Yuko Nakagawa and Rajib Shaw,
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Background and the key issues

Image1: Varanasi Flood in 2016

The trends of increase in number of extreme and disastrous weather events have been observed globally. In May 2016, the highest ever temperature was recorded in India with 51 degree Celsius, furthermore, the country faced floods in the rainy season. City of Varanasi with the population of 1.75 million (Government of India, 2011) in Uttar Pradesh State also recorded higher than normal temperature (1) in May and experienced severe floods in August, 2016. Although Indian Meteorology Department is forecasting weather information broadly on daily basis, there is no timely information on torrential rains and measures of rainfalls in micromesh of the city. The city faces traffic paralysis because of the unexpected torrential downpours which fell in stuffed and poor drainage system in the city (2). The pupils are being in trouble due to the blockage of the roads by inundation, and the parents are having no choice but to wait without any information. Since schools are also supposed not to keep their students till night time, it has been a major challenges for all the schools to decide when to flee their students before the accessibility is limited.

Participatory co-design process

Image 2: Automatic Weather Station at one of the Climate Schools in Varanasi.

In order to facilitate to solve the issues above, SEEDS Asia in partnership with Banaras Hindu University launched a three years project (October 2015- September 2018), "Participatory Community Based Disaster Risk Reduction Approaches in Varanasi" though establishment of Climate Schools (CSs) with the equipment to obtain scientific data on weather in order to build capacity on Disaster Risk Reduction of Varanasi and activating the citizen's DRR activities.

For data collection and risk management activities on climate disaster in schools and the residential community nearby, five CSs (3) are selected from five zones, and five Citizen Forums (CFs) are organized by formulating representatives from the surrounding community. Each CS is equipped with weather observatory devices such as CCD camera and automatic weather station (AWS) which can measure wind speed, wind direction, humidity, temperature and rainfall as well as derived readings include wind chill, heat index, dew point, etc. The members of CFs from the residential area became focal persons to receive the weather information from the CS nearby and to lead community based activities for disaster risk reduction in respective area. The observatory data are accumulated and recorded in CSs, being in a manner accessible to or observable for 24 hours to any by minutely, hourly, monthly and yearly basis through internet with application .

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Contribution of science and technology or academic community

Collection, evaluation and analysis of the data which are being obtained from the CS are beneficial to the academic community especially to the field of meteorological and disaster risk reduction in Varanasi. These researches are important for decision making at different level from individual to the planning of the city. The project focus at the grassroots level as initial stage, thus a series of trainings on understanding on weather and climates risk such as understanding of geographical features, rainfalls, town watching programme to understand the risk and resources of neighbourhood are conducted for each CS and CF. Based on their findings, mitigation measure are discussed and planned at community and school basis, then each school has identified the certain level of rainfalls when they decide to flee their students to home or to announce the cancellation of class in associated with the bad weather so that pupils would not be facing the flood unnecessarily. The accumulation of data will contribute to research outcomes, and mobile application made easy to anyone to access the timely and handy weather information, which enables them to take early decision and action.

Dissemination of result

Image 3: Launching ceremony of Prahari, attended by government officials, university, schools and community

One of the best outcomes of this project is the students of CSs who are aware of the risk of climate and taking initiatives to cope with. They are the main ambassadors to the people of the city and for the next generation. They publish 'Prahari' –Student Climate Newspaper to raise awareness on climate issues and promote DRR activities by sharing the collected data from AWS from CS, writing poems, quiz and reports on weather, introducing activities of CFs, etc. By engaging the school and students of CSs, the information reach out to their parents, and by involving CFs, tangible actions are also taken for improvement in their community, which are found in their active partition and relief activities during the flood in 2016. The outcomes shows that the project for Participatory Community Based Disaster Risk Reduction Approaches in Varanasi contributes Priority 1 of SFDRR: Understanding the disaster risk, through collecting of scientific data on weather and promoting of understanding the risk for enhancing disaster preparedness though participatory approach in school and community. This is a case how scientific evidenced data made people move into actions for enhancing the community resilience.

Reference

1. Average of temperature in Varanasi in May is 40 Celsius degree (1998 to 2012 base) https://weatherspark.com/averages/33932/5/Varanasi-Uttar-Pradesh-India

2. According the data accumulation and observation, if rainfall 20mm per hour continues for two hours, the urban flood would occur in the city.

3. The selected five CS are 1. Central Hindu Boys School, 2. Rajghat Besant School 3. Sant Atulanand Convent School, Shri Agrasen Inter College for girls, 5. The Aryan International School in the city.

03.

Case Study on Tsunami Early Warning

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Context

The past decade has witnessed a terrible loss of life related to large earthquakes and resultant tsunamis in the Indo-Pacific region. Technology based on Global Navigation Satellite System (GNSS) data and science now exist to detect tsunamis from earthquakes and to track them using the associated coupled ionospheric waves. These activities are aided by the development of practical, real-time earthquake forecasting technology that can be globally deployed.

Collaboration/ commercialisation

Multiple institutions have collaborated including Tohoku University, National Taiwan University, University of California campuses including Davis and Irvine. The forecasting technology has been implemented not only at a research level by APRU institutions, but also by commercial spinoffs such as the Open Hazards Group of Davis, California, USA (www.openhazards.com).

The activity has been successful as a result of APRU institutional involvement and support for the workshops such as the recent APEC Cooperation for Earthquake Simulations international symposium in Chengdu, China, August 10-14th, 2016.

Outcomes

The science and data are currently available to develop and deploy an operational prototype of a Global Navigation Satellite System (GNSS) Tsunami Early Warning System. Currently planned activities involve international workshops for planning, organization, and coordination, software development, education and the deployment of additional GNSS stations and satellites at test locations on the Pacific rim, primarily in Asia (Japan/ Chinese Taipei/ Indonesia), together with development of necessary data sharing agreements. The first workshop will be held in July 2017 in Sendai, Japan, co-hosted by NASA and the APRU Multihazards hub at IRIDeS and Tohoku University.

The workshop will be held in Sendai, Japan in collaboration with the Association of Pacific Rim Universities (APRU) Multi-Hazards Hub at Tohoku University in Sendai, and the International Research Institute of Disaster Science (IRIDeS) at Tohoku University. The international partners include the Asia-Pacific Economic Cooperation organization (APEC), and its principal committees, including the Policy Partnership on Science, Technology and Innovation (PPSTI), and the Emergency Preparedness Working Group (EPWG). Other important international partners are the Association of Pacific Rim Universities (APRU) which has a seat on the PPSTI of APEC, and its Multi-Hazards hub co-located at the International Research Institute of Disaster Science (IRIDeS) at Tohoku University in Sendai, Japan, and the APEC Cooperation for Earthquake Simulations (ACES) groups.

Broader impacts

Developing an international community of scientists in support of GNSS-TEWS could save countless lives, and would enhance many of the existing collaborations on tsunami science and awareness of these potential mega-disasters. It fits well with the recent United Nations UNISDR 2015 Sendai Framework themes to promote solutions for Disaster Risk Reduction around the Pacific Rim and elsewhere. These themes include improved building practices, improved response, and research for accelerating disaster science. More specifically there has been broad agreement on overall themes including:

- Building sustainable and resilient communities;
- Emergency preparedness and disaster management, including activities relating to the efficient movement of capital, goods, services and people;
- Substantially reducing global disaster mortality by 2030, aiming to lower the average per 100,000 global mortality rate in the decade 2020–2030 compared to the period 2005–2015;
- Substantially enhance international cooperation to developing countries through adequate and sustainable support to complement their national actions for implementation of the present Framework by 2030;
- Substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to people by 2030.

Priorities for action within the Sendai Framework across multiple layers of government at the local, national, and global levels include:

- Understanding disaster risk;
- Strengthening disaster risk governance to manage disaster risk;
- Investing in disaster risk reduction for resilience;
- Enhancing disaster preparedness for effective response and to “Build Back Better” in recovery, rehabilitation and reconstruction.

Further information

Open Hazards Group of Davis, Califoria: www.openhazards.com

ACES: www.aces.org.au

APRU: www.apru.org

Contact

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04.

The Journey towards Integrated Risk Assessment: The Case of the Philippines

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Background

In December 16 of 2011, Philippines was hit by Tropical Storm Washi. It came at the start of the Christmas season parties when the people of Mindanao was oblivious to the threat they were facing because the southern part of the Philippines, where Mindanao is located, is believed to be typhoon-free by its population. The slow moving storm and the accompanying heavy precipitation caused flooding and debris flow that killed at least 957 people and obliterated villages. In 4 December of 2012, Typhoon Bopha hit the Southern Philippines again with a fury at Category 5 and 175 mph killing over 1146 and leaving hundreds missing and a devastation of forests, plantations and other major livelihoods, settlements and infrastructure. In 7 November 2013, Philippines typhoon Haiyan which hit small islands in the middle of the Philippines claimed 6,201 (+1,785 still missing) with 28,626 injured (1) at Category 5, with wind speed of 195 mph and wind gusts of 235 mph.

The series of devastating typhoons were closely monitored by Philippine scientists but Manila Observatory (MO) did not only study the hazard. As early as 2011, MO, painstakingly, studied the reasons for the disasters --- studying the characteristics of the hazards, examined the level of exposure and characteristics of vulnerabilities in various dimensions, including social and institutional aspects. It was after the immediate analysis of Typhoon Washi that MO scientists observed that the characteristics of the hazards were not adequately communicated and that there were gaps in the country's communication protocols that may have contributed to the inefficient preparedness and response of the local government units (LGUs) and their communities. Disaster forensics that followed Typhoon Bopha, on the other hand, enhanced the understanding of the changing characteristics of Philippine typhoons. Bopha uprooted forests, flattened plantations and demolished villages at a scale many have not seen before in Mindanao. Consciousness of ecosystems-based nature of risk analysis and a better understanding of hazards and other risk elements such as exposure and vulnerabilities were enhanced through field analysis and direct consultations with local universities, civil society, the private sector and communities.

Evidence-based advocacy: science informing decision-making and action

The deaths, destruction and displacement due to Typhoon Washi and Bopha taught scientists at Manila Observatory that risk communication had to be further enhanced. With the evidence at hand, it explored the possibility of crafting a mode of risk analysis that can accompany the official documents that are released by the official warning agencies in the Philippines. Thus, MO scientists studied the preparation of a tropical cyclone advisory that presents multiple tracks, a historical analysis of cyclone paths, an analysis of exposed areas and populations according to elevation and ecosystems, an examination of vulnerabilities according to rates of poverty incidence, and a rapid comparative loss and damage resulting from tropical cyclones with similar tracks and strength. This type of analysis provided the LGUs and other stakeholders an appreciation of the contextual drivers of exposure and vulnerability to hazard impacts, especially on the poor, marginalized and coastal populations.

While Manila Observatory is a scientific institution collaborating with national and local government units, it is not an official warning agency. Thus, it cannot release such information publicly; but in its capacity as a scientific institution, it oriented its partners on the nature and dynamics of risk on order to help the build capacities of various stakeholders towards a better prevention, preparedness and response. Following Washi and Bopha, it provided risk analysis capacity building to the regional directors of the Office of Civil Defense, the stakeholders in Mindanao such as the Catholic church, local governments, the private sector and communities, themselves. Just before Haiyan struck, Manila Observatory released its risk analysis of Haiyan to inform its partners of its potential risks. However, since the reach of this information was very limited, the Manila Observatory scientists and research fellows have consistently advocated the institutionalization of the practice of pre-disaster risk assessment in Philippine risk governance. Without strong and sustained commitment of national and local government support, however, many communities and local governments continue to be challenged in terms of disaster risk reduction.

Rapid turn-over of responsibilities: challenge in Philippine risk governance

Part of the challenge in Philippine risk governance is the rapid turn-over in the leadership and personnel assignments in the country's leading disaster risk-reduction and management council coordinating secretariat. Unless formally mainstreamed into the system, protocols, lesson learned and capacities to undertake sound evidence-based risk assessments are often lost with the transfer of assignments of key personnel. These changes entailed sustained efforts by the Manila Observatory to engage with the new leadership and organizational structure of the Office of the Civil Defense during each of the past four administrations. This cooperation was intensified aftermath of Haiyan, until the pre-disaster risk assessment adopted as a tool for inter-departmental collaborations before hazards occurred. Prior to Haiyan, the prevailing practice in the Philippines risk governance was focused almost entirely on post-disaster risk assessments.

Addressing the challenge of institutionalization

The lessons from Haiyan triggered an interest in enhancing the preparedness measures in the Philippines. This led to the crafting of the National Disaster Preparedness Plan (NDPP) by the Department of Interior and Local Government and its partners. Manila Observatory saw the opportunity to share and institutionalize the science of risk assessment and governance that it had been using over the years. Internally, however, MO scientists and fellows continued to explore ways to introduce a more effective risk assessment system for the Philippines.

An opportunity for a fellowship to the National Science and Technology Center for Disaster Reduction (NCDR) in Taiwan was offered early in 2014 by the Pan-Asia Risk Reduction Fellowship Program (PARR), supported by START (global change SysTem for Analysis, Research, Training). It is in NCDR Taiwan that the fellows from MO learned how an integrated risk assessment system can be embedded in risk governance. This knowledge was immediately shared and incorporated in the crafting of the National Disaster Preparedness Plan of the Philippines and presented to the National Disaster Risk Reduction and Management Council for consideration --- just before the next powerful typhoon to hit the Philippines, category 5 180 mph Typhoon Hagupit. The system of integrating various assessments to present a more comprehensive pre-disaster risk assessment was utilized by the government in addressing the risks of Typhoon Hagupit. Moreover, the MO research team for the Coastal Cities at Risk (2) project shared the value of trans-disciplinary risk characterization and risk monitoring. All local government units (LGUs) that can be possibly hit by the Typhoon based on the analysis of multiple models were encouraged to prepare using the preparedness guidelines (LISTO) that accompanied the National Disaster Preparedness Plan that was being crafted. Although TS Hagupit was at category 5, only 27 deaths were reported. Damages and losses in assets, livelihoods, and infrastructure were substantial.

Policy to practice: institutionalizing integrated risk assessment

The National Disaster Preparedness Plan of the Philippines (NDPP) has been approved and adopted by the National Disaster Risk Reduction and Management Council in June of 2015. The NDPP now incorporates integrated risk assessment and risk monitoring as an essential part of disaster preparedness (please see figure below). While the integrated system has yet to be fully set up and made functional, the policy provides the government and other stakeholders to opportunity for risk governance to be well-informed by science.

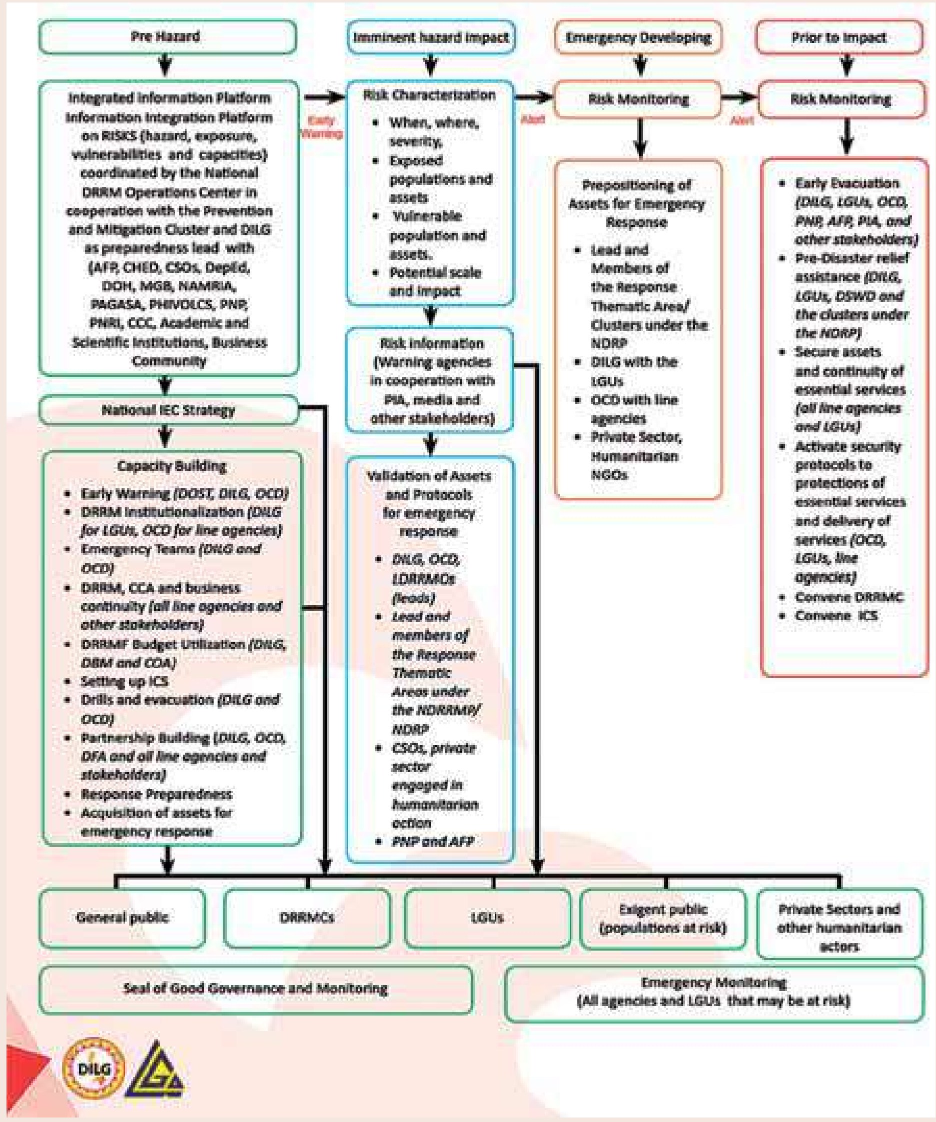

Figure 1: Disaster Preparedness Inter-operability System Philippines (from the National Disaster Preparedness Plan, June 2015)

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05.

Media Reporting Gaps in Disaster: The Case of 2011 Thailand Floods

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Introduction

The 2011 Thailand floods were one of the most damaging floods in the country for the past 50 years, affecting a wide range of sectors, including agricultural and manufacturing industries. In response to this disaster, the Thai government coordinated many relief and recovery activities, and issued a warning of disaster crisis to facilitate every sector to work together to tackle the floods (1). This case examines the role of the real-time news media in the context of disaster response and relief efforts during the first three months of the 2011 Thailand floods.

Disaster event and damage

Routinely, heavy precipitation during Thailand's rainy monsoon season leads to frequent flooding in its Northern and Central regions (2-4). However, in 2011, the rainfall was 28% higher than other years, and 20-60% above normal particularly in the North/North-eastern regions (3). This led to severe flooding starting late July in the Chao Phraya River and Mekong River basins of the Northern, North-eastern and Central regions, while the run-off, combined with a seasonal high tide, threatened Bangkok and its vicinity in October (3-4). At its peak in October, the flood severely affected 30 provinces, 223 districts, 1,532 sub-districts, and 11,605 villages (5-6). The floods resulted in a total of 774 deaths (7), 5.3 million affected people (8% of the population) (8), and approximately 767,000 cases of water-borne and flood-related diseases. In addition, 40,000 people developed symptoms of dengue fever post-disaster, of which 27 died eventually (9). Major highways and roads were flooded, 15% of food factories and over 3,000 educational institutions were destroyed, rice paddy seeds were washed away, and hundreds of thousands of jobs were lost (10-11). The total economic damages and losses were 1,425 billion THB (45.7 billion USD), impacting the manufacturing sector greatly, with 90% of the loss borne by private owners (12).

UNISDR guidelines for media reporting

The United Nations International Strategy for Disaster Reduction (UNISDR) proposed a guideline for media reporting in early 2011, encouraging the media to play a more crucial role in disaster situations, since media coverage can affect government decisions, influence public attitudes and save lives (13). The media is responsible to report disastrous events in a balanced and objective way so that appropriate evidence-based relief and recovery actions can be taken. Practical information should be provided for victims, donors and volunteers, such as weather information, places of shelter and provisions, as well as where to find news of missing peoples. This would help people know the latest situation and empower them to take appropriate actions. The media could also hold relevant bodies accountable for a disaster by exposing its root cause, including any human factors that triggered the disaster, worsened its impact, or hindered the process of relief and recovery (13).

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Role of media

The media was found to have played only a very limited role in disaster risk reduction during the 2011 floods. Sourcing information from Factiva, one of the most widely used news information database. Approximately one-third of the media reports (136 out of 348 items) were related to the business sector, focusing on the economic and financial implications of the floods. In addition, most of the region-specific coverage (78 out of 101 items) dealt with the situation in Bangkok and the surrounding areas in central Thailand, overlooking the more heavily affected Northern and North-eastern regions.

Lessons identified

From the analysis of publicly available media reporting in the first three months after the 2011 Thailand floods, the media tended to focus more on the impact on the capital city, as well as the economy and business sector. This narrow focus would have been at the expense of reports on essential survival issues of immediate concern for flood victims, such as shelter, food, water, health, and sanitation. Highlighting these issues is crucial to the safety of individuals in affected areas, so that they would know the current situation and where to seek help. Such reports would also assist the coordination among institutional bodies (i.e., the government, international organizations, and NGOs). Moreover, the media paid less attention to the situation in the Northern and North-eastern regions, despite being at greater vulnerability and more severely affected by the floods. Future reports should not be biased toward a region in the interest of reporting places of greater news value, but seek to give the public and institutional bodies a comprehensive picture of the disaster.

Conclusion

Previous experiences have shown that the media could play a leading role in terms of advocating for policy changes in disaster preparedness and response, raising awareness and education in disaster and its impacts, addressing vulnerabilities and thereby saving lives. The media reporting in the first three months of the 2011 Thailand floods seemed to fall short of its responsibility by mainly focusing on the capital city and the economic impact of the floods. To facilitate future response, relief, and recovery efforts, media reporting should follow the UNISDR guidelines more closely, and provide informative communication to the public in the immediate aftermath of disasters and emergencies.

Acknowledgement

This case study was funded by ZeShan Foundation. The study has significant contribution by Chi Shing Wong and Emily Y.Y. Chan.

More information

More information about the case study of Thailand flood is available at the website of Collaborating Centre for Oxford University and CUHK for Disaster and Medical Humanitarian Response (CCOUC), http://ccouc.org/disaster-case-studies.

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06.

Building Resilience to Cyclones and Storm Surge in the Coastal Region of Bangladesh

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Initiatives and key issues addressed

Bangladesh is vulnerable to various natural disasters like flood, cyclones, storm surges, drought, landslides etc. Among these, cyclones and storm surge are the most threatening disasters that Bangladesh faces on a regular basis (UNDP, 2012:16). As Bangladesh is situated at the end of the funnel shaped bay, with most of its deltaic plains less than 10 meters above sea level, coastal region of Bangladesh is highly vulnerable to cyclones and storm surge (Wahra, 2011). Hundreds of thousands of people have lost their homes, livelihoods and lives during cyclones during the last 5 decades and billions of dollars of financial loss have also been sustained.

UNDP defines resilience as "the ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of hazards in a timely and effective manner" (UNISDR, 2007). Disaster resilient housing is an alternative approach in disaster risk reduction targeting the most vulnerable communities in Bangladesh (Enam, 2015). BRAC, in partnership with UNDP and BRAC University, built one of the first disaster-resilient settlements in Bangladesh, designed to minimize damage during natural disasters (IRIN, 2011).

Participatory co-design process

In November 2009, Cyclone Aila washed away homes, lives and livelihoods in the coastal region of Bangladesh. Shyamnagar Upazilla under the district of Satkhira located in the south-western corner of Bangladesh was adversely affected and people living in the remote areas did not have enough time or the facility to resort to the cyclone shelter. The storm surge that came with Cyclone Aila inundated the area, marooning communities and severing even the tenuous connections that had existed (Charlesworth and Ahmed, 2015).

Image 1: Community participation in building disaster resilient houses (Source: Kabir, 2017).

After this devastating Cyclone Aila, BRAC partnered with UNDP to rebuild a village in Shyamnagar Upazilla. The project built 43 disaster resilient houses and a primary school, all of which have the strength to serve as individual cyclone shelter. Construction cost per house was USD 1500. These houses, built on 2m concrete stilts, are designed to withstand a storm surge of up to 2 meters and winds of up to 235 kph (IRINNEWS, 2011).

Image 2: Disaster resilient houses in Shyamnagar (Source: Kabir, 2017)

The community members participated in the design and construction of these houses with specific architecture to provide protection against strong winds and water surges (Images 1 and 2). The concept of tile-covered elevated houses, supported on reinforced concrete columns, provides a new option for disaster resilient habitats in exposed coastal areas. Safe drinking sources and sanitary latrine were also installed and are maintained by the community. This project followed a "build back better resilience" approach with a view to making communities more resilient for future disasters. For humanitarian context, individual resilient shelter can be defined in simple word as, a dwelling place or home considered as refuge which is structurally strong enough to survive against the highest magnitude of hazard ever experienced by the community and is equipped with necessary survival kits (Kabir, 2017; BRAC, 2016).

The community took the ownership and responsibility to maintain their houses. They even adapted the basic design into something better, e.g., some families extended the base frontiers of the houses to help provide better support to the structure; some cultivated varieties of plants and vegetables in the courtyards (BRAC, 2016). The community also planted different species of mangrove trees around their houses to prevent excessive erosion of land caused by water surges (Image 2; BRAC, 2016). These simple changes make a big difference.

Contribution of the science, technology and academic community

Planning, design and construction of resilient housing demands an in-depth understanding of the expertise and knowledge of avoiding and mitigating the effects of threats and hazards (Hemelin and Hauke, 2005, Enam, 2015).

Keeping this in mind, this project was initiated by academics from School of Architecture, BRAC University, Dhaka. It was funded by UNDP and BRAC. The students, academics, funding agencies and local communities worked as a team to build resilient houses. Through month long community consultations, BRAC University's design team involved local community to take part in making models of disaster resilient houses. The models indicated a desire for two-storey houses, reflecting the trauma due to cyclones each participant had experienced (Charlesworth and Ahmed, 2015; Kabir, 2017).

Image 3: Real house workshop with community, engineers and academia at BRAC University, Dhaka (Source: Kabir, 2017).

After the model making, 15 local construction workers and three women representatives were invited to BRAC University in Dhaka to participate in a workshop with design team and engineers from Bangladesh Housing and Building Research Institute. The workshop decided to build two-storey resilient houses in line with community preference (for details see, Charlesworth and Ahmed, 2015).

Proposed methods to disseminate results

Building disaster resilient houses is not an event, but a process. This process aims to create disaster resilient communities in disaster prone areas. For example, the same concept is replicated in Haiti to build earthquake resilient houses where 300 distinct houses were built led by the community itself. Similar process is now ongoing in Jhenaidah municipality of Bangladesh where community is fully financing and developing their own disaster resilient houses (Kabir, 2017). It is suggested that in disaster prone areas around the world, governments should promote this community driven disaster resilience process.

Acknowledgment

Sincere thanks to Khondaker Hasibul Kabir (BRAC University) and Gawher Nayeem Wahra (BRAC) for providing relevant information.

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Co-Designing Disaster Risk Reduction Solutions

07.

Harnessing Sunshine to Provide Safe Drinking Water in Disaster Prone Areas of Bangladesh

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Initiatives and key issues addressed

Bangladesh is widely recognized as one of the most vulnerable countries in the world due to climate change. In recent decades, the risks associated with climate change are increasing at an alarming rate; for example, intensity and frequency of various natural disasters like flood, cyclones, storm surges, drought, landslides etc. are increasing in Bangladesh. Fortunately, the communities of Bangladesh are developing innovating ideas and utilizing indigenous knowledge to cope up and adapt with the risks associated with different climate change induced disasters.

Access to right amount of water with right quality at right time is always more than a distant reality in the coastal region of Bangladesh where groundwater aquifer and soil are highly saline due to its proximity to the Bay of Bengal. In addition, excessive abstraction of groundwater for agricultural and industrial purposes and reduction of surface water during non-monsoon period due to unsustainable withdrawal and diversion by upstream countries sharing the common rivers with Bangladesh creates an enormous challenge to ensure safe water for drinking, sanitation and hygiene in the coastal areas (Rahaman, 2009; Rahaman et al., 2016).

This is even more challenging just after the cyclones when highly saline seawater enters in coastal regions of Bangladesh and infiltrates through the soil. This in turn makes existing water sources saline. Due to climate change and associated sea level rise, Bangladesh will face this challenge even more in future.

The south-western regional rivers of Bangladesh are subject to tides from the Bay of Bengal twice a day. The tides bring saline water through the rivers and overflow into the adjacent lands. Due to deposition of salt, the soil salinity increases. The intrusion of salinity inland is regulated by the upstream fresh water flow through the rivers (Shahjahan, 1998; Rahman and Rahaman, 2017). Withdrawal and diversion of fresh river water from upstream by India is one of the main causes of increased soil salinity in the topsoil of the coastal region (SRDI, 2012).

Participatory co-design process

Khulna is located in south-western coastal region of Bangladesh (Figure 1). Water in Khulna is highly saline and, thus, safe water for drinking, sanitation and hygiene is always scarce. In addition, due to lack of reliable electricity, existing traditional water pumps are not able to meet the full demand.

To solve this problem, BRAC's water, sanitation and hygiene (WASH) division has come up with an innovative idea. Through harnessing the sunshine, BRAC introduced the concept of solar water pump that will help vulnerable communities in rural areas in coastal region to take control of their own water supply and sanitation facilities (Figures 2, 3).

In Paikgacha of Khulna, water scarcity is less of a concern for three villages through which now a pipe network of 12,800 meters distributes water from a solar-powered pump. BRAC's WASH division brought the communities of three villages together to overcome the electricity scarcity and limited source of water available in the locality (BRAC, 2017).

Figure 1: Location of the project area (Paikgacha) (Source: Google Map, 2017).

Figure 2: Harnessing sunshine to provide safe drinking water (Source: BRAC).

Figure 3: Water tank (Source: BRAC)

The community contributed to BRAC's initiatives to construct the motor and pump which run on a 1200 watt solar panel. 81 tapping points are being shared among 321 households and the piping system has the capacity to support up to 5000 households. (BRAC, 2016).

Monthly contributions from each of the households help to maintain the pump system (BRAC, 2016; 2017). The engineering behind the solar powered water pump and involvement of the community in maintaining the system is a true model of sustainable and renewable energy solution.

Contribution of the science, technology and academic community

Technical team of Bangladesh Rural Advancement Committee (BRAC) led the planning, design and construction of the solar water pump. The water pump and distribution systems are managed and maintained by the local community, who were consulted in all phases of the project. This initiative is first of its kind where a renewable energy technology is introduced in a disaster prone area where people have lack of access to safe water for drinking, sanitation and hygiene after the various natural disasters, most notably floods and cyclones. Key technical information are presented in Table 1.

Co-Designing Disaster Risk Reduction Solutions

Table 1: Key technical information of solar water pump

Source of Water	Ground water
Type of pump	Submersible Pump
Specification of pump	2 HP
Discharge capacity	4,000 liters per hour
Total Head of pump	18.28 meters
Water Tank capacity	13,000 liters
Height of elevated tank	12.20 meters

(Source: BRAC, 2017)

Proposed methods to disseminate results

This solar powered water pump initiative was a pilot project of BRAC. The beneficiary communities provided tremendous positive response about this new initiative (BRAC, 2016; 2017). It is suggested that government should promote this technology in disaster prone areas where both electricity and water supply system are not adequate or absent. Depending on the local conditions, careful consideration should be given to issues related to capacity of the pump, numbers of beneficiaries, water quality, and, most importantly, availability of sunshine.

Acknowledgment

Sincere thanks to Gawher Nayeem Wahra and Mahmud Hossain from BRAC for providing relevant information.

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08.

Transdisciplinary Approach for Response and Risk Communication in 2011 Sikkim Earthquake in Nepal

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Introduction

Nepal is one of the most disaster-prone countries in Asia and its topography, geography, political situations, and developmental barriers make it highly vulnerable to disasters. The Sikkim earthquake was one of the biggest earthquakes that Nepal has experienced in recent 100 years. Although the disaster response for the event was adequate, gaps were revealed within the disaster response system, which will be highlighted in this paper. Also this case discusses the risk communication and the implementation limitations of bottom-up approaches for responding to the Sikkim earthquake.

Disaster event and damage

The earthquake occurred at 6:11PM on 18 September 2011 as a result of tectonic activity along the Main Boundary Thrust and the Main Central Thrust near the Nepal/India border in Sikkim province. With a magnitude (Mw) of 6.9 and a depth of 20km, the epicentre was located 272km east of Kathmandu in Nepal on the Alpine-Himalayan seismic belt. The mobile communication network coverage was jammed during the first few days and a landslide triggered by the earthquake blocked a section of the Mechi highway, blocking the way to some of the affected areas. Estimated 10 deaths and 88 severely injured were reported with 19,813 families being affected and 7,882 displaced (1)(2). A total of 7,746 houses were reported to be completely destroyed and 12,104 partially destroyed. In addition, 24 schools and health post buildings in four districts were reported to be damaged (1).

Transdisciplinary and multi-stakeholders approach for response

Various organisations and departments were involved in disaster response. A cabinet meeting was held immediately after the earthquake followed by Central Natural Disaster Relief Committee (CNDRC). The National Emergency Operating Centre was immediately activated, relief response was initiated and instructions were sent to all district authorities. The District Disaster Response Teams (DDRTs) carried out search and rescue operations and assessments along with security personnel including the police and military. The Ministry of Home Affairs (MoHA) coordinated and communicated with all of the affected districts. Assessments were conducted mainly through Nepal Red Cross Society (NRCS) and the International Federation of Red Cross and Red Crescent Societies (IFRC), while the CNDRC was in charge of identifying and assessing needs of shelter and food for displaced families.

Cluster approach was used to provide humanitarian response after the earthquake. The operational arrangements adopted included coordinating with national and local authorities, civil society and actors. All of the responding clusters continued to develop recovery strategies following the initial relief stage. A total of 62 districts out of 75 completed their disaster preparedness and response plans. In the recovery stage, the Ministry of Physical Planning and Works coordinated in order to carry out reconstruction of damaged buildings.

Risk communication

Although the relationship between hazard, risk, and vulnerability should be in the public conscience, information dissemination was insufficient at the community level in Nepal. The lack of information caused a fatalistic and complacent mentality in regard to disaster preparedness in some communities. In addition, conflict and displacement restricted people's access to information sources and community support. To enhance resilience, community acceptance of the standard building codes is an important component. Local authorities and those in the building trades had conducted public education seminars on the earthquake risk from collapsing buildings and had provided training to enable correct implementation of the national building codes. Disaster preparedness and early warning systems were also established to increase the capacity to cope with major earthquakes.

Lesson identified

The response to Sikkim earthquake demonstrated that Nepal was sufficiently prepared for a small-scale disaster but for large-scale events. It is important for Nepal to ensure that Disaster Risk Reduction is a national and local priority with a strong institutional basis for implementation. There should be a national legal and institutional framework focusing on risk reduction and identification of the roles of main stakeholders to prevent, mitigate and prepare the impact of hazards. The lack of efficient reporting can be a major barrier to the efficient and effective allocation of resources and should also be considered a priority in the disaster management act.

In addition, more focus should be given to disaster education of women and children at the local level, information flow between emergency operation centers and communities, community consultations, and community organizations. Currently, there are many community disaster reduction initiatives but they are usually short term and small scale albeit successful. Community empowerment is also low. The new Disaster Management Act should take this into account and translate this priority into a legal right. This would help communities feel protected and acknowledged, providing them with self-empowerment and trust in the system.

Conclusion

Nepal is a vulnerable and disaster-prone country in Asia. The risk of a catastrophic earthquake runs high but the continuously transient political environment slows the disaster policy implementation. While community-based projects are active, these efforts are not driven by the law as much as by need and importance. In the absence of legally mandated programs however, these projects will remain at the micro-level.

Acknowledgement

This case study was funded by ZeShan Foundation. The study has significant contribution by Jamie Rose Rodas, Chi Shing Wong and Emily Y.Y. Chan.

More information

More information about the case study of Sikkim earthquake is available at the website of Collaborating Centre for Oxford University and CUHK for Disaster and Medical Humanitarian Response (CCOUC), http://ccouc.org/disaster-case-studies.

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09.

Adapting with FREEDM; Flood Resilient Environmentally Enhanced Disaster Management in Bihar

Sustainable Environment & Ecological Development Society (SEEDS)

The Kosi Basin is prone to frequent flooding. With 50% of the silt load of Nepal flowing through the Kosi, the water used to have little depth and helped keep the land fertile. The situation has now changed dramatically. The construction of embankments and dams has increased the water depth. Instead of the earlier phenomenon where silt used to spread, it now piles up in limited locations. Over a period of time, the course of the river has also changed and therefore the old river beds are now dry. Increase in the siltation means the water already has less natural seepage; a problem compounded by unplanned development. Saharsa also faces the lethal combination of alluvial soil and water which leads to liquefaction. 42.4 lakh hectares of Bihar is prone to floods, covering 76% of its population. The massive Kosi floods of 2008 were an example of the devastating impact of floods in this area. The changing climatic conditions are wreaking havoc on poor vulnerable communities. The loss of agricultural land and limited livelihood options manifest in food insecurity. Usual disaster preparedness mechanisms also cannot cope with the complex new nature of floods.

The intervention area focused on Sonbarsa block of Saharsa district. Ten hamlets across two revenue villages of Biratpur panchayat and three revenue villages of Atalkha panchayat in the Sonbarsa block were selected. With many branches of the Kosi river flowing through them, these were two of the worst affected panchyats during the 2008 floods. The Flood Resilient Environmentally Enhanced Disaster Management (FREEDM) project, supported by Lutheran World Relief, attempted to do just that; helping communities adapt to the changing risks. The multi-pronged approach includes preparedness, risk mitigation and livelihood adaptation initiatives.

A community-led multi-tiered disaster management system was set up. This ensured maximum participation through divided responsibilities and allowed the community themselves to take on both implementation and monitoring roles. At the hamlet level, Disaster Management Committees (DMC) werewas formed with 20 community members each. These DMCs implement the initiatives under the project at their hamlet level. At the panchayat level, a Disaster Management Coordination Committee (DMCC) was formed to encourage the community to monitor and make project decisions themselves. The SEEDS project team's main role was to therefore facilitate and enhance capacity.

Task forces training across each of the ten hamlets, task forces were formed. Training was done on search and rescue operations, first aid, fire safety, evacuation and communication; and on relief and shelter options. Adolescent girls have been a major focus in the training.

A simple early warning system was set up to implement, comprehend and monitor at the local level. Water gauges have been installed in several low-lying areas. These locations where water levels can be accurately recorded were decided with GPS support. Consistently monitored, the gauges are marked with three colours. The white flag (level 01) indicates to the community that they need to be on alert. The yellow flag (level 02) is a sign to gather important possessions and be ready to evacuate. The red flag (level 03) is the call for immediate evacuation to a higher plain. A full evacuation demonstration was done where the community moved out with all of their clothes, utensils, livestock and other belongings. Early warning boards have been placed at a widely visible location in each of the ten hamlets and outside the Panchayat office. This helps ensure that the information stays alive in people's consciousness, even during peace time, so that the behaviour becomes a habit.

Linking ecological protection with livelihoods: Nurseries for bamboo and banana plants helped communities link ecological protection with an eco-friendly livelihood model. Seven bamboo and seven banana nurseries were established across the intervention area. The nurseries are run by community members who have been identified by the DMC. Bamboo and banana trees are useful in multiple ways for the villagers. Aside from being a buffer, they are also widely used to build boats, especially during floods.

The community disaster resilience fund (CDRF), a contributory little 'savings bank' within each of the ten hamlets was set up. The money that is collected is used to handle emergencies in a more efficient manner; including procuring first aid materials. The money itself is contributed by each family in each village on a monthly basis. The minimum amount has been set as Re. 1; though most families have begun contributing higher amounts. This money is also being generated through different parts of the project, including the banana and bamboo nurseries. Women's involvement in CDRF was a huge accomplishment in itself as they gain confidence through the collection and monitoring of the fund.

Insurance support can help deal with the contingencies faced almost annually in terms of loss of lives, livestock and crops. Linking with the government and insurance companies, the risk to major livelihoods in the area were minimised. Group insurance cover was introduced for 400 farmers; 50 families benefitted from livestock insurance for cows and buffalos; and another 88 were given life insurance.

Short-term cropping emerged as an option that allows famers to grow several different types of crops in one year; rather than only one season of traditional wheat, rice or maize. It presents great potential to grow flood resistant/shorter duration crops in the locality. With the introduction of the alternative short term crop technique, the fertility of the soil is replenished. Considering the small size of most farmer's fields, this is also a great way to increase yield; leading to greater food security. Based on scientific knowledge of local experts and in consultation with the DMCC, appropriate vegetables and techniques were selected. This includes chillies, cabbage, cauliflower, brinjal, ladyfinger and many others.

A bioshield element to the project is helping communities protect themselves against inundation. Over 2.5 acres of bamboo buffers and 8.5 acres of banana buffers have already been planted. Popular species of bamboo and banana plants were used as well as low-cost and appropriate technology. With inputs from the Bihar Agriculture University, Sabour, Bhagalpur, bamboo and banana nurseries were established.

Grain banks were established in all ten hamlets with clear regulations. Every family contributes a handful of wheat or rice; or more if they can spare it. The collection and recovery is done on a monthly basis. Proper records are maintained of every major and minor transaction including the deposits, allocations and recovery.

Reclaiming water bodies: Though wells have traditionally been a better source of clean water with less iron content; most wells lay abandoned or defunct. Through participatory planning and assessments, eight wells were identified by the community. With proper repair and retrofitting, these wells have been rendered usable again. The platforms for the wells were raised and catchment areas were created using reinforced cement concrete beams to ensure safety during floods. The wall thickness of each well was increased to 10 inches to increase earthquake resistance; an important facet as the area lies in seismic zone IV. Traditional purifying systems using limestone were adopted to cleanse the well water. Finally, awareness generation campaigns on the benefits of reviving and maintaining traditional well systems attempted to bring a change in the community mindsets.

The Saharsa Gram Vikas is a micro-level, multi-stakeholder citizen forum that helps the community bridge the gap with governance. The forum aims to bring the community together to identify, assess and engage with local issues. It creates concrete links with ongoing development programmes and national policies. It will also help mobilise greater citizen participation. The Saharsa Nagrik Manch is a united pressure group which brings together stakeholders from all walks of life. They have a definite structure, by laws, rules and regulations and are currently working on developing an action plan.

Women have taken a lead role throughout the FREEDM project. Whether in grain banks, community disaster resilience funds, short-term crops or community systems and task forces; women and young girls have been active participants. This is slowly making an impact on the social construct of the village with more women coming out of their homes and actively making their voices heard.

10.

Seismic Risk Assessment: The Case of a Multi-disciplinary and Multi-sectoral Collaboration in Iran

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The Vulnerability and Risk Analysis and Mapping (VRAM) process has been implemented in the Islamic Republic of Iran with the objective to strengthen the technical capacity of the health sector to be in the position to conduct geographically based risk assessments as well as serve as a practical demonstration on how better information management, including the use of GIS, can improve emergency preparedness and response in the country.

Thanks to the technical capacity that has been established at both the central and provincial, and the support of the two inter-sectoral and intra-sectoral coordination forums that have been established, the necessary data has been collected, compiled, homogenised and improved to perform the geographically based risk assessment over the Province of Kerman.

The pilot project was supported by World Health Organization and Ministry of Health and Medical Education (MoHME) of I.R.Iran, and technical contribution of Tehran University of Medical Sciences and International Institute of Earthquake Engineering and Seismology. The listed below organizations contributed in designing process and implementation, especially in regard with indicators of vulnerability and capacity assessments parts: Iranian Red Crescent Society, National Disaster Management Organization (NDMO), Emergency Medical Service, Police, etc.

The hazard exposure analysis first demonstrated that most of the infrastructures and population in the Province of Kerman are exposed to a high or very high hazard level. Thanks to the implementation of the Farsi Hospital Safety Index (FHSI) and Primary Health Safety Index (PHSI) over all the health care facilities in the Province of Kerman, the vulnerability/capacity analysis did itself showed infrastructure safety level. When it comes to the population, the combination of Shahrestan (district) level vulnerability/capacity indicators grouped into four categories (demographic, socio-economic, health status, availability of and accessibility to key infrastructure). Finally, the combination of the hazard and vulnerability/capacity analysis to obtain relative measure of risk.

While more in depth analysis should nevertheless be conducted, these results can already be used by decision makers to set priorities aiming at reducing the risk prior to a disasters as part of disaster risk reduction measures or plans as well as improve existing emergency management plans for the part of the risk that cannot be reduced.

The National Disaster Management Organization, and Ministry of Health and Medical Education have planned to extend the project to other provinces of Iran during a five year plan. Tehran University of Medical Sciences and other academic partners will continue their technical support from this national initiative.

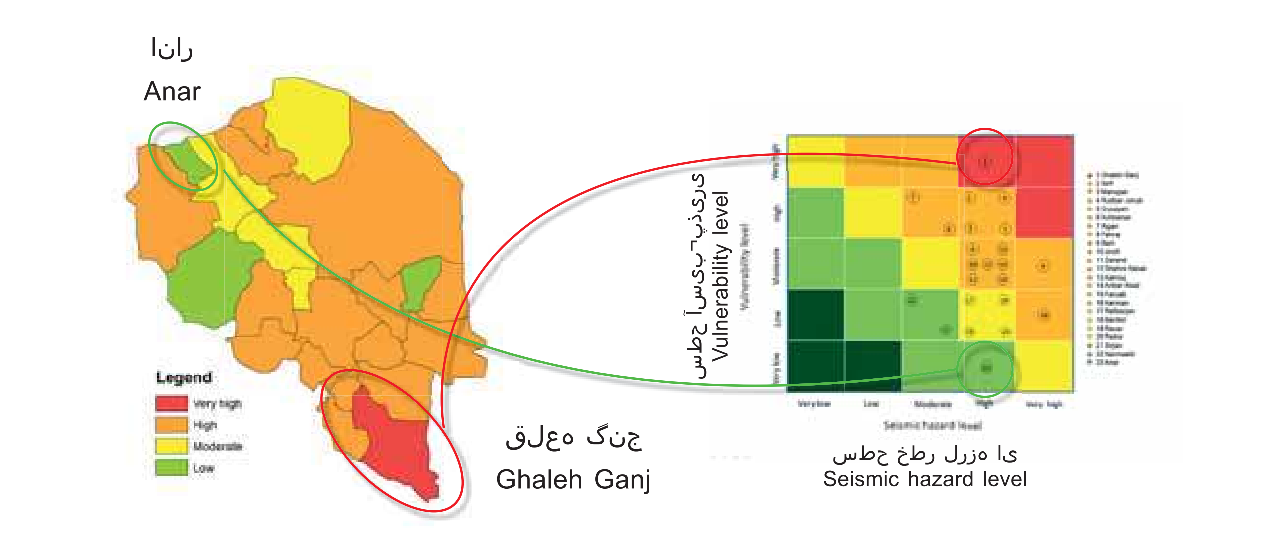

Figure 1: Seismic risk for the population over Kerman province, Iran

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11. Making DiDRR a Reality: A Three-Step Approach to Empowering People with Disabilities to Become Agents of Change and Resilience

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People with disabilities are highly vulnerable to disasters

People with disabilities (PWDs)[1] are among the most vulnerable groups during disasters. PWDs are four times more likely to die when a disaster strikes than those without disabilities [1]. Yet they remain largely unaccounted for in disaster risk reduction (DRR). This affects 650 million people with disabilities in Asia-Pacific alone [2]. The high vulnerability of PWDs is due to mutually reinforcing socio-cultural, economic and political barriers. In Southeast Asia, PWDs experience high rates of poverty and are subject to negative stereotypes that perpetuate existing cultural norms and beliefs [3]. The physical and social isolation of PWDs hinders participation in everyday life and encourages passivity, which in turn limits access to education and critical knowledge on disaster risks. Furthermore, PWDs are seldom represented in DRR efforts due to the exclusionary policies and practices of governments and other DRR stakeholders [4]. This leaves PWDs unaware of the potential roles they could play in shaping DRR strategies [5].

The Sendai Framework for Disaster Risk Reduction (2015-2030) mandates stronger inclusion of PWDs in DRR [6]. Yet pathways to achieving inclusion targets remain unclear due to limited disaggregated data on PWD needs during disasters, a disconnect between DRR policies and disability rights-based laws, and a lack of robust guidelines on how to mainstream disability-inclusive DRR (DiDRR) [6-9]. Consequently, DRR stakeholders have little knowledge on how to support disability inclusion and lack the skills needed to mainstream DiDRR [4, 7, 10-12].

Inclusion and DiDRR is a human right, but they require fundamental shifts in DRR strategy and practice [3, 13]. Funded by the Global Resilience Partnership, the Disability and Disasters project, seeks to support inclusion in Southeast Asia (specifically in Thailand, Cambodia and the Philippines) via three main objectives: to 1) produce a stronger evidence base on the challenges PWDs face in responding to disasters in Southeast Asia; 2) develop solid platforms for PWD empowerment; and 3) identify solutions to mainstream DiDRR.

A multi-stakeholder approach for DiDRR

Placing PWDs at the centre of DRR requires a systems approach. Systems approaches provide a holistic theoretical lens through which to identify and engage with the multiple contextualised factors and processes that collectively influence differential vulnerability and resilience patterns. Systems approaches demand multiple solutions that engage with interlinked components of the human-environment system that drive fluctuations in vulnerability and resilience over space and time [14, 15]. This project therefore targets change in three interconnected areas:

1. PWDs include those who have physical, mental, intellectual or sensory impairments which in interaction with various barriers may hinder their full and effective participation in society on an equal basis with others (as per Article 1 of the 2006 Convention on the Rights of Persons with Disabilities).

1. **Increasing knowledge & skills:** Creating a knowledge-base on the challenges of PWDs in responding to risk will inform effective resilience-building strategies. Through focus group discussions and workshops, PWDs and Disabled People's Organizations (DPOs) are engaged as co-producers of risk knowledge. Innovative training methods are being developed in disability-accessible formats to (i) empower PWDs and DPOs to increase their resilience through co-identified solutions, (ii) demonstrate how to be strong community champions, and (iii) train DRR stakeholders on the needs of PWDs and how best to support them alongside DPOs.

2. **Shifting attitudes & beliefs:** Using training exercises, we are working to build self-belief among PWDS, empowering them to see themselves as active participants of change in their own lives; and encouraging direct interactions between PWDS, DPOs and DRR stakeholders to facilitate a change in the way DRR stakeholders perceive and engage with PWDs.

3. **Strengthening inclusive governance:** This project is creating and strengthening supportive spaces where PWDs, DPOs, DRR stakeholders and governments can jointly achieve DiDRR. By improving the dialogue between these actors, more inclusive DRR governance processes can emerge—a prerequisite for achieving DiDRR. Indicators are also being developed for DPOs and DRR organizations to measure the inclusivity of their DRR plans.

A multi-stakeholder approach is essential to effectively integrate inclusion into DRR practice. This project fosters collaboration between PWDs, DPOs, regional DRR actors, as well as specialists from academia and research who focus on DRR, disability and community-based resilience. By engaging academics and researchers, in-country project teams can be supported to co-create high-quality research designs that elicit robust and reliable data. Academic partners are helping to uncover the role that context and culture play in reinforcing exclusionary practices in risk response processes. There is still poor understanding of how complex contextual and cultural factors and processes combine in different contexts to determine differential levels of vulnerability and resilience within and across places [16, 17], thus warranting critical research.

By working with PWDs and DPOs directly, academics can gain access to disability networks which they may otherwise lack the skills, experience or cultural understanding to engage with. Furthermore, PWDs are often distrustful of those outside their support networks, particularly those working for authorities due to a history of discrimination, misunderstandings and prejudices (conscious or not) [18], therefore making the need for collaboration even greater.

Achieving long-lasting and scalable impact

The project will achieve impact via three complimentary pathways:

1. Our focus on different disability types – people who are Deaf, with visual impairments, with mobility limitations and women with disabilities - enables us to develop a DiDRR toolkit that pairs general good practice applicable to various disabilities. This helps to create an evidence-based, comprehensive DiDRR toolkit that can be adapted by multiple next users within and beyond Southeast Asia to suit different circumstances. Lastly, the development of standardized indicators that DPOs and DRR stakeholders can use to measure how inclusive DRR plans are is a universal output that can be applied to all organizations and contexts.

2. All outputs for this project are being developed in collaboration with next users (e.g. PWDs, DPOs, DRR stakeholders and academics) to ensure relevance, effectiveness and sustained impact. This helps facilitate greater next user ownership and buy-in across all scales (local, national, regional and international). The outputs include information, education and communication materials (e.g. accessible DiDRR learning materials) and research and policy outputs (e.g. academic journal articles).

3. The impact and reach of the project is being extended by leveraging and mobilizing the wide-reaching networks of next users to: (i) widely disseminate information on the natural hazard-related challenges PWDs face and DiDRR best practice and (ii) promote the distribution and use of the DiDRR toolkit, a standardized Inclusive Resilience Scorecard and associated outputs in different locations and contexts. To further support dissemination of results, DiDRR network groups are being strengthened in all three Southeast Asian target countries.

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12.

Disaster Response and Health Risk Management during 2010 Hainan Flooding in China

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Introduction

Hainan Province is a tropical island located at the southernmost tip of China with a monsoon climate, making it especially prone to climate-related disasters such as typhoons, tornados, cyclones, gales and floods. Aging reservoirs, deforestation, and the poor drainage systems further render Hainan's vulnerability in the face of the impacts of climate change. Flooding on 30 September 2010 is the result of the longest recorded torrential rainfall striking Hainan since 1961 (1). This case examines the disaster preparedness and response of the flood in a tropical province, as well as identifying the lessons learnt and improvement needed for better preparedness against future flood disasters.

Disaster event and damage

On the evening of 30 September 2010, a torrential rainfall struck Hainan continuously for nine days (1). Average precipitation in Hainan during this period was 1040.6mm, 5.7 times the figure of the same period of the previous year (2). 70% of the reservoirs were at a dangerous risk of overflowing. Nearly 4 million residents on the island were affected by the floods and more than 700,000 people were evacuated. Not only over 20,000 houses were damaged and caused more than RMB 10 billion of economic loss, many roads, sanitation facilities and national resorts were damaged (3). In addition, more than 80 sections of the main highways along the east and west coasts were either destroyed or blocked. Electricity loss left 40% of the city without power. No outbreaks of infectious diseases were found (4).

Disaster risk governance with partnership at local and sub-national level

The Hainan Government issued a preliminary plan aiming to ensure the safety of reservoirs, people's lives and key infrastructures. On the morning of 15 October, a team of agricultural technology, machinery and animal epidemic prevention professionals was formed. By 18 October, all levels of health departments had sent a total of 438 medical teams of 36,362 professionals, providing medical treatment and psychological assistance. The Department of Health called on 6 epidemic prevention teams for surveillance of epidemic diseases such as diarrhoea, cholera, and haemorrhagic fever. By 20 October, the government raised RMB 1.96 billion of relief funds, of which 9.95% was from the central government, 37.14% from the provincial level and 37.70% from the county level. The Office of State Flood Control and Drought Relief Headquarters issued a RMB 40 million relief fund, 2.4 million woven bags, 60 assault boats and 20,000 life jackets. The Department of Housing and Urban Development sent out 18 professional teams to check and consolidate schools, hospitals and other residential houses in severely affected areas (5), as well as examine all the reservoirs in Hainan. The Department of Agriculture sent 30,000 agriculture machines, 10 million animal vaccinations, 300 boxes of disinfectants and 5,000 agriculture systems maintenance equipment to disaster areas after the flooding, in order to rescue flooded crops, speed up harvesting the 0.5 million acres of already-mature rice and reseed winter vegetables. Hainan also sought help from Guangdong Province especially in assessing the flooding status and co-operation in medical care.

Risk communication

Risk communication is effective to enhance preparedness of the local community. A warning system existed before the flood but there were reported uncertainties of what may be the appropriate corresponding actions that should be taken by stakeholders. It was also noted that many individuals in Hainan who had intended to prepare themselves for the disaster did not actually do so. During the disaster, the media provided continual updates, and internet and mobile phones also played a key role in disseminating disaster response.

Lesson identified

The preparedness plan failed to provide a clear idea of concrete actions of various departments involved, and mostly focused on infrastructure. More specific directions for immediate post-flood action would assist in providing timely and appropriate aid to the affected local population; and more directions on monitoring and preventing infectious diseases should be included in the plan to prepare for an outbreak. About preparedness of local community, Hainan itself was not sufficiently prepared for disasters. The local community, who is at the frontline responding to the disaster, needs to be better prepared for the relevant response actions. Residents should also have the awareness to prepare themselves for disasters, and take proactive measures in advance. In addition, disaster-proof factors should be considered when constructing highways and reservoirs. With the frequent occurrence of floods in Hainan, a valuable pool of information could be accumulated for effective research to achieve improvement.

Conclusion

The Central Government and Hainan reacted relatively quickly to ensure the safety of the people. Overall, Hainan had been able to control infectious diseases with its efforts, despite the lack of emphasis on public health in its contingency plans. Yet, Hainan has been growing fast economically. Its poor drainage system, old highways, mass of unsafe reservoirs and fancy new buildings only increase the cost of frequent hydrological disasters. More training is needed to better equip the local people. With the increasing trend of typhoons, the island needs to invest more for better long-term resilience.

Acknowledgement

This case study was funded by ZeShan Foundation. The study has significant contribution by Chi Shing Wong, Crystal Yingjia Zhu and Poyi Lee.

More information

More information about the case study of 2010 Hainan flooding is available at the website of Collaborating Centre for Oxford University and CUHK for Disaster and Medical Humanitarian Response (CCOUC), http://ccouc.org/disaster-case-studies.

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13.

Safe Schools, Resilient Communities: An Essential Approach for Promoting Public Participation in Earthquake Risk Management

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Resilient communities are prerequisites for attaining resilient cities. Community resilience is a process linking a network of capacities (resources with dynamic attributes) and adaptation after a disturbance or adversity. Promoting resilience needs awareness and ongoing action. It is a constant process of learning and engagement. Therefore, schools can be perfect nodes for raising such awareness since they are education hubs in each community involving parents, children, teachers and education specialists alike in different temporal and spatial scales. In addition, the interaction between local peoples and school teams help building social capital, community involvement, civic awareness and social cohesion.

Accordingly, Safe Schools – Resilient Communities program that has been initiated in Iran since 2016 is a new approach to address involving local people for promoting community resilience; using the capacities of safe schools at each neighborhood appropriately. The program is in line with SFDRR and prepared based on experiences gained in “Earthquake and Safety” Drills which were conducted annually in all Iran's schools since 1996. The main purpose of the program is to raise awareness towards resilience in local communities and to institutionalize safe schools as local disaster management centers at community level e.g. for evacuation, response and providing basic needs to the survivors in case of earthquakes occurrence. This will initiate introduction of schools as nodes for promoting resilience of communities and building an operational bridge between local residents, students, parents and school managers.

This program includes several elements. The first essential is developing series of practical instructions for assessment the risk index at each neighborhood. These guidelines will be used for site survey and then evaluating disaster risk level of each neighborhood. It will lead to performing vulnerability check and recognition of each neighborhood’s weaknesses and strengths from earthquake risk point of view. The survey should be implemented by local residents by conducting of assigned specialists and risk managers.

As results, risk maps for each zone are prepared and then will be printed and distributed to local residents living at the studied community to be used at emergency situations and getting necessary information about potential risks in their living areas. Image 1 depicts the procedure of community assessment and the final diagnosis map prepared accordingly.

Image 1: Preparing diagnosis map by local resident at the selected community

In the next step, a safe school located inside or around the selected community is assigned as local base for disaster management and then will be equipped with necessary materials for playing the relevant roles accordingly. For this purpose, Safety Council will be established at the school by presence of school's manager, local volunteers and some of the local relevant authorities. They will evaluate the earthquake safety of the school’s buildings, strengthen non-structural elements at the school and provide necessary materials for emergency situations by assistance of relevant experts and authorities. In addition appropriate trainings will be provided to different groups; from students to local residents. The training includes self-protection at the time of earthquake, rescue and relief, first aids assistance, emergency shelters, etc. Furthermore, the residents will get necessary information about the potential hazards in their living environment and how to reduce the existing risks. This will help them to try to reduce potential risks in their neighborhood before occurrence of an earthquake. Finally the provided trainings will be practiced in earthquake drills, as shown in Image 2.

Image 2: Implementing earthquake drill at the selected safe school

This program was initiated by the International Institute of Earthquake Engineering and Seismology (IIEES) in 2015 and based on an agreement between IIEES with Iran’s National Disaster Management Organization (NDMO), Ministry of Education, Red Crescent Society (RCS) and Islamic Republic of Iran Broadcasting (IRIB) they are cooperating in its implementation.

In order to develop this program, IIEES as an academic entity has implemented relevant studies on physical as well as socio-economic and cultural conditions in Iran and used the relevant best practices to assure the applicability of the methodology to increase resilience to earthquake in different communities in Iran.

This program is being conducted nationally yet with international involvement. This year, the drill will be conducted in several selected schools in the capital as well as main cities in Iran's provinces as a pilot attempt to produce a series of interventions for specialists stand people alike. According to the approved plan, this program will be implemented in all safe schools in Iran by the year 2025. In addition, neighboring countries will participate in this program through UNESCO, UNDP and UN-HABITAT Channels during the coming years.

This procedure will ensure that even after the performance of the drill, the process of neighborhood betterment and vulnerability reduction will be continued by the people and specialists alike with the help of the local people and neighborhood managers. The presence of academic partied along with DM authorities will ensure the use of science and technology in implementing the program.

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14.

Brazilian Strategy to Improve Risk Perception by Participative Monitoring of Precipitation

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Natural disasters in Brazil are mainly related to droughts, floods and landslides, which affect mostly the South, the Southeast and the Northeast of the country, resulting in significant economic and human losses. In order to prevent these disasters, since 2011 the National Centre for Monitoring and Early Warning of Natural Disasters (Cemaden) has been monitoring natural hazards, to enhance the response to disasters and to reduce the exposure of the population who live in risk areas. For this purpose, a national strategy was improved with the enlargement of the monitoring network, increasing the number of meteorological radars, rain gauges and hydrological stations. In a complementary way, the understanding that the engagement of the population had an important role in monitoring was considered. On this scenario we present the Brazilian strategy to enhance the risk perception of the population exposed to landslide and flood risk. The premise was that the participative monitoring of precipitation could enhance the risk perception of communities. Thus, the Cemaden launched the project Rain Gauges in Communities in Brazil, which consists of a national strategy to encourage the population, who lives in risk area, to monitor the rain by using semiautomatic rain gauges.

Basically, the target audience was institutions involved in natural disaster risk prevention, e.g. non-governmental organizations, civil defense, schools and universities. During the online registration, the participant indicated the place to install the rain gauges such as civil defense headquarters, community leader residences or schools.

The participant was responsible for installing the rain gauges. An adapted manual and a video were developed to allow no-technical public to comprehend the instructions. These materials showed each step with illustrations and un-formal language. Guidelines about preventive maintenance and how to change the batteries of the rain gauges were also explained. This equipment has the autonomy to store two years of data of precipitation, whose download is made by using a cable to a notebook.

After receiving the equipment, entities participated in regional workshops organized by Cemaden, with support of States Civil Defense. The main purpose of these events was to present the objectives of the project. On this occasion, strategies to promote the participative monitoring of the precipitation were discussed, because the majority of the counterparts did not have the experience to work together with communities.

From April 2013 to November 2016, approximately 1100 rain gauges were donated to 280 entities that were contemplated by the project from all regions of Brazil. An observational network was consolidated to monitor landslides and floods involving people from communities at risk areas. This is an unprecedented result achieved on national scale.

After two years of the project, the entities were invited to participate in a wide diagnosis focusing about equipment, actions in disaster risk reduction as well as difficulties faced by the institutions during the project. This diagnosis was available through online form made of 40 questions. Some aspects were stressed such as the profile of the participants of the project, the functioning of the rain gauges and the actions developed in disaster risk reduction.

Part of the criteria to install the rain gauges was the viability of communities dealing with the equipment periodically. In terms of the location indicated by the participants, 32% were schools and 23% were residences of local community leaders, the other part was at universities, associations and civil defense quarters. Many interviewees reported that the equipment was moved to another place for security reasons, to avoid damages or thefts.

The results from the diagnosis allowed monitoring how the project developed in the municipalities. When the participants were questioned regard the difficulties that they encountered to develop the project in their communities, the majority of the answers were related to the commitment of time during the project. Almost half of the participants admitted the need to develop more activities using the rain gauges, such as simulation exercises, workshops at schools and courses. In order to define the best approaches to improve it, the interviewees suggested the support with mobile devices, trainings and short courses to manage data precipitation. Other themes of interest were also quoted in the interviews, e.g. correlation between landslides and precipitation, weather forecast and meteorological monitoring instruments.

After concluding the first phase of the project Rain Gauges in Communities, we are developing strategies to promote the science popularization involved in monitoring the rain. First, an online national platform has been developed to promote the best interaction between the participants. It is expected the exchange of precipitation information and data as well as the local plans to support the risk perception established by the partners. Second, virtual meetings will be organized promoting the contact with the participants from all over the country. The main themes to be discussed in these meetings were defined during the diagnosis. Finally, support materials will be offered to the participants to incentive the wide use of the data.

Finally, it is important to emphasize that the project is fully aligned with the Sendai Framework approach, which is to build the resilience of nations and communities to face the disasters. There is still great motivation to spread the role of science and technology in the daily lives of communities, to build more resilient societies in Brazil.

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Co-Designing Disaster Risk Reduction Solutions

15.

Developing a GIS Based Model for Site Selection of Temporary Shelters after Earthquakes

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Earthquake, as a destructive hazard in unprepared community, could result in people homelessness. Besides housing which refers to return to normal routine activities, sheltering is a transitional process. Temporary sheltering denotes the activity of staying in a place aftermath a disaster for weeks to months even though daily routines are suspended (1,2).

As an emergency situation, it is important to shelter homeless people as soon as possible to provide residence, dignity and security for them. It needs to be planned in appropriate sites to decrease undesirable consequences such as resistance to acceptance of the site, secondary disasters, lack of safety, cultural or climatic inappropriateness, social problems and lack of organizational services (3).

Providing the dignity for affected people had been led to proposing some criteria, but all of them could not be used in deciding for sheltering site selection because they are related in the process of architecture or management of the camps. Site selection of temporary shelters should be done in preparedness phase because of limited time for decision making in response phase. Good results in such approach need to be applicable and measurable criteria and models. Applying such models would increase accuracy, quality and quickness of the operation. Defining these criteria also could help managers to evaluate the operation and promote it (4). We decided to define related criteria for site selection to develop a GIS based model for site selection of temporary shelters after earthquakes. This project was done with cooperation of Tehran University, Iranian Red Crescent society and Kerman Municipality.

We designed a mixed method study which was done in nine consecutive steps. The study was started with a systematic review of related documents to define proposed criteria for temporary shelter site selection after earthquakes. Definition of related criteria was completed with a semi-structured key informant interview with nine specialists in sheltering. As we were going to develop an appropriated model for temporary site selection; a Delphi method in three rounds was done to select suitable criteria for the model from proposed criteria. Thirty specialists in disaster management from university and Iranian Red Crescent society were participated in this process. All of them had good experiences on the field of disaster and sheltering. Twenty one criteria were selected to be used in related models for temporary shelter site selection. These items were grouped under four categories: land suitability, socio cultural considerations, service availability and disaster risk reduction.

At fourth step, some related geographic layers for selected criteria were defined to be used in the model. Searching geographical layers for selected criteria showed that there are specific geographic layers for eleven criteria. As there are no precise geographic layers for other ten criteria, we need to define some other geographical layers, which could show the means of them indirectly. These layers were defined in a panel of experts with six specialists in sheltering and GIS. 39 related geographical layers were defined for these ten criteria, so we defined totally fifty geographical layers for all selected criteria.

Analytic hierarchy process (AHP) was used to weight selected criteria and layers in the next step. Each selected layer was classified based on fuzzy logic and using available standards for shelter site selection. Related data for geographic layers were classified in the range of 0-1.

Having the criteria, geographic layers, their relationship and weights lead to developing the model. Finally to evaluate the model, selected layers for Kerman city were used in Arc GIS software to show suitable sites for temporary sheltering in Kerman city. A map of suitable sites for temporary shelters was the output of this phase. This map was overlapped with city maps to define available lands, which are located in convenient zones for temporary sheltering. Selected lands in this step were evaluated in a field visit by the research team to propose final proper lands. They checked size, configuration, access and preparation costs. Some of non selected lands also were visited for model evaluation. Their results for all visited sites were analyzed to evaluate the performance of the model for correct temporary sheltering site selection.

Fifteen suitable sites were defined of 18 proposed ones by field visit evaluation. These sites were proposed to the municipality to have related plans in pre-disaster situation and also response phase.

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Co-Designing Disaster Risk Reduction Solutions

16.

Multi-stakeholder Approach in Enhancing Disaster Response in 2009 West Sumatra Earthquake in Indonesia

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Introduction

Indonesia, situated in the Ring of Fire, is well known for its massive geophysical disasters in which earthquake is one of the most common ones. The 7.6 magnitude Richter-scale earthquake hitting West Sumatra Province, Indonesia on 30 September 2009 (1) has caused unexpected damage to infrastructure, livelihoods, and economy of the province. Regardless the limitations in the policy and regulations, the inter-agency collaboration showed positive impact to support rapid needs assessment and relief support. This case evaluates the disaster response and approach, and provides suggestions for future disaster preparedness improvement.

Disaster event and damage

The West Sumatra Earthquake in 2009 was followed by two major aftershocks and landslides. Over 2.5 million people were affected, more than 1,000 deaths and 3,000 injuries were documented after the earthquake. Psychological impact, such as depression (18%), anxiety (51%) and stress (25%) (2), was also reported. The total damage and loss accumulated during West Sumatra earthquake was estimated to reach US$ 2.2 billion (3).

Community disaster training after 2004 Tsunami

Risk communication is of high importance to build and sustain local capacity. Disaster risk reduction programs had been widely promoted after 2004 tsunami in Aceh, Indonesia. A significant number of mock drills, discussions, and simulations on earthquake and tsunami had been conducted in the community. General community and schoolchildren were prepared with mock disaster drills and local motivators were trained to understand the process of natural disasters. Moreover, they were prepared with basic medical and rescue procedures (4).

After earthquake, World Food Programme (WFP) led the emergency telecommunication cluster and deployed WFP Fast Telecoms deployment kit in the early days. WFP, along with United Nations Office for the Coordination of Humanitarian Affairs (OCHA), Telecoms Sans Frontières, and local NGOs, established a communication centre in Padang, managed a VHF radio network in Padang and Pariaman cities, held radio communication training, and developed standard radio operating procedure. Whilst the communication network was established, some local organizations received only communication materials in English instead of Bahasa, and had limited usefulness of the messages (5).

Co-Designing Disaster Risk Reduction Solutions

Multi-stakeholder approach

OCHA was invited as government counterpart in coordinating the humanitarian response from international organisations, while National Disaster Management Agency, Indonesia (BNPB) managed the activities organised by government and local NGOs (6). Ten humanitarian clusters were activated within 48 hours, involving local and international actors. At the same time, various local and international NGOs (e.g. OCHA, WFP, United Nations Children's Fund, etc.) sent their team to conduct joint needs assessment (7). The health cluster was led by the WHO and the Ministry of Health. Fifty-three organisations participated in sub-cluster areas: immunisation, psychosocial and mental health, mobile clinic, injury surveillance and rehabilitation, nutrition, maternal and child health, health facility support, and environmental health (8).

Lesson Identified

Several lessons were identified from the West Sumatra Earthquake case study. In pre-event stage, improvement was needed for legislature in building codes, disaster preparedness policy for primary health centre and early warning system. Government should enforce the regulation for structural preparation, engineering, and designs according to earthquake resistant design standard, in the meantime providing training for craftsmen and education for community.

Control and command, inter-agency collaboration, openness of data reporting as well as communication are essential post event. The government has shown its leadership and quick response in welcoming international assistance, especially by establishing the cluster system in a relatively short time. However, there is still room for improvement. A common reporting structure of health data and information is needed, particularly in the hospitals and primary health centres. Collaboration with media is required to help disseminate disaster information and provide education on building proper structures.

Conclusion

The West Sumatra Earthquake affected over 2.5 million people and damaged more than 200,000 buildings. Government immediately responded and the Cluster approach was adopted to provide humanitarian assistance. Regardless of the well-coordinated response among different organisations, several sectors on disaster preparedness and policy legislation need to be improved to enhance community empowerment and better coordination.

Acknowledgement

This case study was funded by ZeShan Foundation. The study has significant contribution by Chi Shing Wong, Emily Y.Y. Chan, Christy Chan and Kevin Hung.

More information

More information about the case study of West Sumatra Earthquake is available at the website of Collaborating Centre for Oxford University and CUHK for Disaster and Medical Humanitarian Response (CCOUC), http://ccouc.org/disaster-case-studies.

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17.

An Earthquake Early Warning System for Water and Waste Water System of Tehran, Iran

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Many population centers in Iran have experienced some devastating earthquakes in the past, or being in the vicinity of major faults, expect one in the future. Tehran, the political and commercial capital of Iran, and surrounded by many active faults is a notable example. While implementation of seismic building codes is the long term measure to reduce damages and fatality in hazard prone areas, seismic early warning systems can be a short term solution as well as a complementary part of the long term approach to sustainable development.

Seismic records of Iran indicate the occurrence of many devastating seismic events, some of which were in densely populated areas in the vicinity of major faults. Tehran, as an example, with a population of more than 10,000,000, is surrounded by many active faults. Therefore, an earthquake early warning can be a useful short term solution to reduce damages and potential casualties of a large earthquake. As of seismic instrumentation, three major seismic networks are operating in Iran, which need further development and integrity: (1) Iran Strong Motion Network (ISMN), using over 1000 digital accelerographs, of which only 50 stations use GPS timing; (2) Iranian National Seismic Network (INSN), including 30 real-time broadband stations; and (3) the Iranian Seismic Telemetry Network, with 70 3-component seismographs (mostly short-period and occasionally broadband) with real-time connection.

Due to low network density and lack of absolute timing in many stations, the available seismic records are sometimes of poor quality. Furthermore, some important seismic events are not recorded. We chose a method to make the best use of the available data. A combination of Tau-c Pd and Elarms which are capable of using both single-station and multi-station data were used to minimize the exclusion of poorly covered events. The method also has the advantage of being capable of using more accurate events. The results, not only are the theoretical base for a future warning system, but also can be used to optimize and modify the existing seismic networks.

There are these scientific centers to be involved not only in view point of expertise but also in view point of sharing their technology and their instruments: BHRC as the main strong motion data observer and provider in Iran, IIEES, the main comprehensive academic center for research on earthquakes in Iran, the TDMMO, the center for disaster mitigation and management of the municipality of Tehran.

The method of rapid magnitude determination for early warning system, presented by Kanamori (2005) is applied to some important events in Alborz and the preliminary results are presented. An important approach in earthquake early warning is based on using the P wave to estimate the overall size of an earthquake. The waveform of P wave reflects how the slip on the fault plane is occurring.

More precisely, the effective period of the waveform increases with Mw up to Mw = 6.5 (Kanamoori 2005). Most methods attempt to define a measure of the effective period and use it as an indicator of magnitude. Many studies use displacement and velocity time series to calculate. However, the present work tries to develop a relationship between acceleration and mainly because the most densely distributed seismic network in Iran is the Iran Strong Motion Network (ISMN) with over 1000 digital accelerographs, and an indicator which needs fewer calculations would be more favorable.

Expectedly, regression results are different from that of previous works. This could be described by the high frequency nature of acceleration in comparison to velocity and displacement. Furthermore, the limited number of records for some of the events is expected to affect the regression coefficient adversely.

Future works should address a larger number of events, and also provide a basis to combine analog records without decreasing data integrity.

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18.

INARISK: A Tool to Measure Level of Disaster Risk

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An understanding of disaster risk is the basis for every local government to formulate a disaster plan in their region. Therefore, disaster risk assessment becomes an important tool to conduct risk identification, analysis and evaluation of risk to be taken. National Disaster Management Agency (BNPB) has started this initiative since 2008, so has produced a series of publications on Disaster Risk Index in 2009, 2011 and 2013. In each publication has been improved the methods and data collection were used, resulting in 2016 has issued disaster risk assessments for a more interactive form of software-based computer named InaRISK (Indonesia Disaster Risk).

InaRISK is a disaster risk assessment portal using GIS server as data service to illustrate coverage area of hazards, threatened population, physical, economical and environmental exposed, integrated with the capacity of disaster risk management. InaRISK can also be used as: (a) dissemination tools of disaster risk assessment results to the Government, local government, and other stakeholders as a basis for disaster risk reduction planning program; (b) to support Government, Local Government, and the parties to build a strategy for implementation of programs, policies, and activities to reduce disaster risk at the national and regional levels; and (c) assist the Government in monitoring the achievement of reducing disaster risk index in Indonesia.

Description regarding the participatory co-design process

InaRISK is designed by National Agency for Disaster Management (BNPB) with the support by National Development Planning Board (BAPPENAS). As the risk assessment is a basis in formulating some, plan such as national/regional development plan, and also national/regional spatial plan.

Some ministries and institutions were involved in the formulation of the Disaster Risk Index. They provide data and information, reports and methods in preparing hazard map, vulnerability map and risk map, such as: Center for Volcanology and Geological Hazards (for geological hazards), Meteorological, Climatological and Geophysics (for earthquake, tsunami, storm, and extreme weather), Ministry of Public Works (for flood and flash flood), Ministry of Health (for epidemic), Ministry of Forestry and Environment (for forest fire and land degradation), Ministry of Agriculture (for pest and plant diseases), Center Statistical Agency (for demography and social economic data).

Details about contribution of science technology

Disaster risk index determination is done by calculating the index value of hazards, vulnerabilities and capacities. This process is performed by using spatial calculations, so it can produce a risk map and the value of the grid that can be used in the explanation of risk maps.

There are 10 major hazards assesed in the risk index: earthquake, tsunami, volcano eruption, flood, landslides, drought, bush and forest fire, extreem weather, extreem wave and abrasion, and flash flood. As for the vulnerability studied are physical vulnerability (houses, public facility and critical facility), social vulnerability (population density and vulnerable group), economical vulnerability (domestic income and productive land) and environmental vulnerability (land cover and its utilization).

Proposed methods to disseminate

- Results of disaster risk assessments on InaRISK still using a scale of 1: 250,000 and is in the process of adding data of 156 districts / cities with a scale of 1: 50,000 and 1: 25,000.
- Data from disaster risk assessments are dynamic data that is always evolving in accordance with field dynamics.

19.

Food Security in Iran: Shifting Strategies for Reducing Risks and Obtaining Higher Resiliency

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Historically, Iran has been an agrarian-based society until the early twentieth century, after which agriculture changed slowly until the 1960s. Since then and especially after the Islamic Revolution (1979), agriculture has become a key element for Iran's post-revolutionary policy-makers, with 'food self-sufficiency' prioritised and the country has been largely self-sufficient in many strategic crops.

This case study explores how agricultural and food policies of Iran have changed in response to external and internal risk factors with particular reference to the last forty years. In a dry land country such as Iran where harsh climatic situations (e.g. inadequate precipitation and frequent drought cycles) are regarded as normal, the proper agricultural policies have shown to be capable of supporting food security, perhaps indefinitely.

The situation in Iran has broader international relevance, especially across the Arab region as a whole, as all countries in the Region, irrespective of their social, political and economical differences, which face climate change and water shortages. Thus, successes and lessons learned from agricultural policies in one country will assist similar countries to develop more resilient agricultural systems.

Since the 1980s, the subsequent periods have been hugely challenging; the country has experienced the eight-year Iran-Iraq war in addition to issues such as population rise, social change, international sanctions, lack of infrastructure, and harsh climatic conditions (including the worst drought for 30 years in 1999-2000 which caused the agricultural losses). After the Iran-Iraq war, the government gradually initiated wide-ranging developmental activities and prepared the first Five-Year Development Plans (FYDPs). In each consecutive FYDP, special Chapter and budget has been allocated to agriculture sector.

During the 1990s (the so-called 'nation-building' period), great national efforts were made to reconstruct or develop new rural infrastructure including water systems, electricity lines, educational and health centres. Farms were given priority for reclamation and essential inputs, including seeds, seedlings and manures, were heavily subsidised. Water dams, water channels, silos, power plants, and food-processing plants were constructed: e.g. the number of silos increased five times during this period.

Since 2011, the situation has been changed in terms of national subsidization policy and thus the period is regarded as a distinct break from past policies. The Government took the bold step of removing subsidies from the food and energy sectors. The essence of this national plan was to liberate consumer prices gradually while injecting monthly cash payments to low-income and deprived people as compensation. The preliminary aim was to enhance productivity, social justice and equality, cash management, and investment at national level.

The government has also encouraged the young graduates and entrepreneurs through offering low-interest and long-term loans to establish small-scale agri-businesses and greenhouses. It has also set up rules for incentives such as 'guaranteed purchase' of strategic crops, annual crop insurance, annual farmer insurance to support farmers by ensuring a constant flow of cash. This, in turn, can guarantee a relatively continuing and stable agricultural production in the country. There are hopes that high capital investment in expansion of pressurized irrigation and water management structures, developing modified crop varieties, providing low-interest loans for local glasshouse plantations and employing modern machineries and high skill manpower provide better atmosphere for adaptation to climate change in the long-term.

Recent policies such as new subsidization policy and entrepreneurship efforts as well as research activities at national level have shown to be successful. The agricultural sector now provides a platform for food security and jobs. Agricultural products and carpets constitute the major non-oil export commodities from Iran employing 23.5% of the workforce and contributing 14% of the country's GDP. However, challenges such as climate change, low water usage productivity, destruction of farms and so on may threaten this situation.

This case study assessed recent 40-year timeframe in which the Government, local communities and scientific bodies have worked together to achieve a high proportion rate of food self-sufficiency at national level, comparable to many developed countries. In particular, the establishment of linkage between young agricultural graduates and farmers on the ground has been crucial in employing new cultivation and pest management methods.

Such participatory co-design process for achieving food security has ensured the involvement of stakeholders from a wide range of spectrum while guaranteed the sustainability of the Programme at larger temporal and spatial scales.

Such national plan has been accompanied by an unprecedented surge in the number of graduates in agricultural and natural sciences at national level. The role of science and technology has been substantial and undeniable in achieving goals both in terms of quality and quantity of agricultural products towards sustained food security.

Agricultural research in Iran increased during the 1990s, in line with an increase in the number of agricultural university students. It was oriented mostly towards the effects of agriculture on the environment, the optimization of agricultural practices, the economic viability of agricultural enterprises, and the assessment of agricultural machinery, absorbing nearly a quarter of total public research funds in the country (23% in 2004).

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20. An Institutional Mechanism to Implement Science-based and Co-designed Disaster Risk Management in Taiwan

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Challenges

On average, 3.5 typhoons could directly impact Taiwan every year and bring wind damages, floods, landslides and debris flows. Within last two decades, two major earthquakes, in 1999 and 2016, caused deadly casualties and costly economy losses respectively. Therefore, several reports highlight Taiwan's exposure to natural hazards is extremely high around the world. Besides physical vulnerability, rapid urbanization, super-high population density, aging society are also attributes of social vulnerability.

Initiation of large-scale projects on Disaster Research Program (LPDRP), 1982-1996

As requirements by the public to enhance safety against natural hazards, the National Science Council (NSC, restructured to the MOST in 2014) launched three 5-year programs (LPDRP) investing on basic researches to meet demands of dynamic changes of natural hazards and societal developments. Meanwhile, other ministries also announced projects on improving capacity of disaster management. However, because of lacking good intra-government-agency coordination on selecting research topics, "to reduce duplications" is a learned lesson for designing future projects. The major achievements are:

1. To promote integrated projects with multi-disciplinary engagements, instead of individual projects;
2. To extend research scope from engineering factors to disaster management system and social economics;
3. To emphasize on inclusive study on practical implementation and characteristics of locality;
4. To encourage long-term devotion and continuous investment.

The National Science and Technology Program for Hazard Mitigation (NAPHM), 1999-2006

To follow experiences and continue outcomes achieved by previous work, the Advisory Committee Meeting of the NSC formally passed a resolution to further promote integrations and collaborations between research community and governmental agencies by implementing "the National Science and Technology Program for Hazard Mitigation (NAPHM)." NAPHM underscored "co-design" by joint efforts to carry target-oriented researches for application and implementation. There were two phases to execute the NAPHM, 1999-2001 and 2002-2006. In total, 21 agencies under 11 ministries had actively joined the NAPHM. The budget allocations for the two-phase NAPHM are USD 24.3 million and USD 85.7 million respectively. All projects under the NHPHA had high priorities of budget allocations. It is a policy, endorsed by the Cabinet meeting, to secure sufficient funds for supporting the NAPHA. That showed how policy makers emphasized the importance of the NAPHM.

Establishment of the National Sceince and Technology Center for Disaster Reduction, 2004

Through the implementing process of the NAPHM, a consensus had been formulated to set up an institution in charge of coordination, focal issue selection, outcomes integration, technology transfer and practical implementation. Therefore, the National Sceince and Technology Center for Disaster Reduction (NCDR) was established in 2003 to keep progressive momentum and assist in

integrated actions. NCDR's operations focus on long-term devotion, knowledge accumulation and routine updates to database. Later in 2014, NCDR has been restructured to a non-departmental public body under supervision of the MOST. Now NCDR is fully engaged in the system of disaster risk management, including mitigation, preparedness, response and recovery. And it is a role model of how the scientific community partners with decision makers, governmental officials, emergency responders, researchers, practitioners and volunteers on jointly designing missions with partnership.

More scientific-and-intra governmental investments on disaster risk reduction after 2006

The continuous commitments by the MOST, a series of projects have been executed after the NAPHM to sustain learnings and improve findings. The Program for Enhancing Innovation and Implementation of Disaster Reduction (PEIIDR, 2007-2010); and the Program on Applying Science and Technology for Disaster Reduction (ASTDR, Phase1: 2011-2014, Phase 2015-2017) are showing a strong partnership among central-and-local governments, research field and even communities to follow principles of co-designing, co-working and co-implanting.

Conclusions

Taiwan is situated in a highly disaster-prone region of the Asia-Pacific and how to mitigate disaster risk is an essential issue catching attention of both government and the general public. However, due to extreme weather events and potential large-scale earthquakes, risk exposure of natural hazards to land and population increases and becomes more diverse than ever. In last three decades, Ministry of Science and Technology has been investing resources on fundamental science researches related to natural hazards and disaster management that helps to establish the base developing disaster risk reduction and emergency preparedness in Taiwan. The figure 1 shows the consecutive investments on science and technology to enhance basic studies, data base, decision supports, building codes, management system, risk communication, education and etc. Nowadays, modern technology speeds up development of telecommunications and shorten time to transfer data and deliver messages. At information age, it demands for more creative and innovative approaches to make a better use of big data and open data not just facilitate researches, but also benefit disaster management. This is an on-going trend to virtually and digitally engage the whole society for better disaster risk reduction.

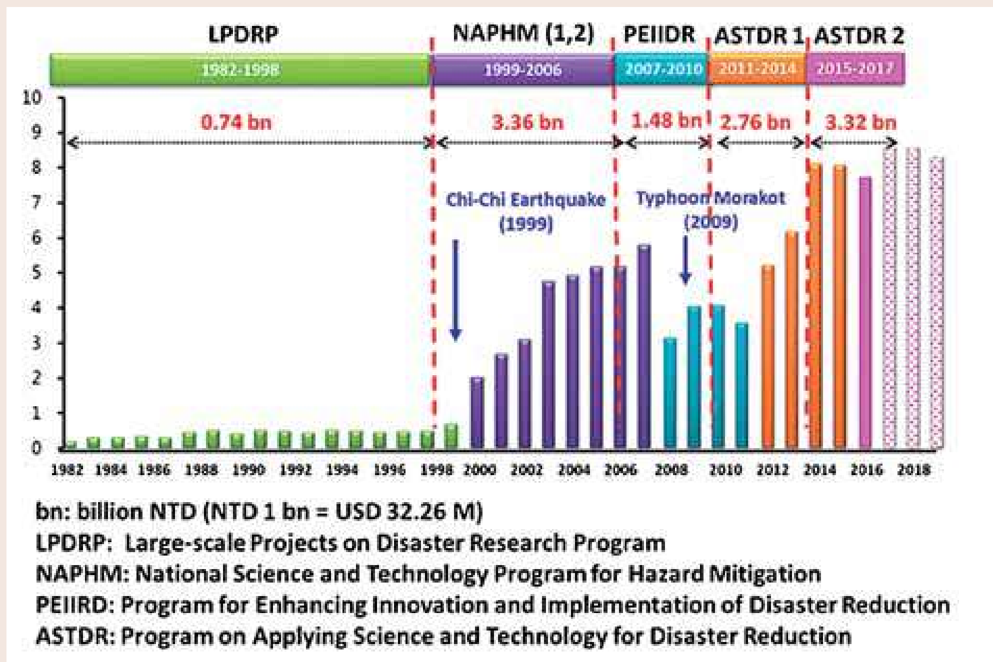

Figure 1: Historical and planned investments on science and technology for disaster risk management (Dr. Ching-Yen Tasy, "From Academic Research to Policy Making - A Case of Taiwan Effort in Disaster Reduction")

Co-Designing Disaster Risk Reduction Solutions

21.

Analyzing the Effectiveness of Moving Peg Method for Landslide Monitoring and its Potentiality for Replication in the Nepal Himalaya

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Nepal is a mountainous country with about two third of its total area covered by hills and mountains. The landform of Nepal in the hilly area consists of unstable slope. A steep slope has high risk of premature damage due to the high combination of adverse climate and geological condition. It is frequently suffering from the water induced disasters such as floods, landslides, debris flows, inundation, bank undercutting etc. During heavy rainfall, huge amount of debris produced in the hills and mountain, flow down and cause heavy loss to the human lives, livestock and infrastructures. Among various water-induced disasters, landslide has always been a major disaster to damage human lives and their properties in Nepal. Nepal possesses very young mountains where geological process is very active.

Landslides monitoring is an essential part to establish an early warning system. Timely predicted data can save people's life and property. Therefore, scientists, engineers and environmentalists have recognized that most recurrent landslides could be predicted through a timely systematic program of detailed engineering, geological, geotechnical, hydro-geological and hydro-meteorological investigation, instrumentation, modeling and real time monitoring. It has been seen that some of the countries of South Asia have developed early warning systems for landslides in specific local areas through a combination of instrumentation and community-based interventions. But in Nepal, very little has been done to establish a community-based landslide early warning system.

In this context, experts from Masters' Program in Disaster Risk Management, Pulchowk Campus, Institute of Engineering, Tribhuvan University took the responsibility with the help of MercyCorps Nepal to study and pilot monitoring system for community-based landslide early warning system in Far-West of Nepal to establish an early warning system (EWS) in Baitadi, Dadeldhura and Kailali districts of Far-western Nepal applying expert knowledge, landslide monitoring, detailed investigation of landslide with their causes and triggering factors. Field investigation of landslide by the expert team with students clearly indicated that the main triggering factor is rainfall. Most of the landslides were occurred in first week of Ashoj, 2065 where more than 180mm/24hr rainfall was recorded. Steep slope, degree of saturation of soil, friction angle and cohesive force, discontinuity and weathering, surface run off and plane of curvature are the main causes for the landslide.

Massey landslide was selected for the establishment of landslide monitoring system. The landslide is located on the right bank of the Tada Khola and uphill side of the Massey Village at 0171442 easting and 3217655 northing with 1125 m amsl. This landslide started with heavy rainfall in 2065 (2008). The scarp and the bending of trees clearly show that this is rotational slide. The landslide is 120m long and 50 m in width. There are eight houses near the toe which are in danger. There are some canals in the landslide body for dewatering.

Wooden posts were longitudinally installed in two series at the interval of 10 meters from crown to the toe along the slope of Massey landslide, the end of which were connected to the reference point on the stable area. A member of EWS Task Force which is a sub-committee under Community Disaster Management Committee was delegated to take regular measurements of distance between two pegs so as to find out temporal displacement of the slope. Distance between two nails is measured using measuring tape at regular interval which gives the displacement between two points. In addition, some stable reference points beyond the boundary of the moving landslide were also recorded. The wooden posts should be deep enough into the solid material so that other factors, such as wind and rain, should not displace them.

The daily rainfall patterns were analyzed during the period of monitoring. Rainfall data of five stations namely Tikapur (207), Sandepani (208), Atariya (209), Sitapur (212) and Godavari (215) are analyzed from January 2014 to December 2014. The data of Nigali station are analyzed from August 2014 to July 2015. The rainfall data of the other time is not available of these stations. The maximum rainfall is observed during the month of June, July and August. The maximum rainfall (144.8 mm) was measured in 14 August 2014 and other stations are also measured large amount of rainfall. Therefore, it is clear that the rainfall threshold value for this landslide is more than 144.8 mm/24 hours. The amount and duration of rainfall did not cross the threshold level (Nepalese standard) because of no displacement. However, the displacement and movement of the landslide does not depend only in rainfall but also depends on rock type, slope, weathering and vegetation etc.

This moving peg method is very cost-effective and easy to handle by community. However, the training program should be conducted about how to measure the displacement prior to the program. This measurement from the Massey village clearly shows that the effectiveness of this method because just one hour training to the local was enough for monitoring. Moreover, the community measures the displacement and instantly they know the condition of the landslide which automatically raised the awareness to them.

Landslide monitoring is a complex process where technical skill and communication skill should amalgamate together. Here are some recommendations to replicate the same type of program in another part of the Nepal Himalaya.

- Technical aspects such as geological survey, site selection should be carried out before the installation for the development of low-cost technology.
- Installation, operation and maintenance should be carried out very sound technical knowledge.
- Social mapping, public awareness and public consultation should be done in the community during the investigation and monitoring phase.

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22.

Assessment of Community Disaster Resilience in Tehran, Iran: A Multidisciplinary Approach

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In recent years community disaster resilience (CDR) has been one of the most common approaches to disaster risk management (1,2). Despite conceptually focus on these issue, the methods and plans for operationalization of CDR are still in preliminary phases (2,3). In order to understanding disaster risk for improving risk governance in local level, there was a great need to develop a quantitative, conceptual-oriented, culture-bounded, comprehensive, local based, and weighted assessment tool which evaluate the level of CDR in the community (4).

While CDR assessment and planning is a multidimensional, multidisciplinary and multi-sectoral action, through purposeful sampling, 21 participants (with adequate knowledge and at least five year experience in disaster management) from different disciplines were selected to participate in all phases of the program. A participatory CDR assessment tool was developed in four phases as follows:

- A systematic review study was conducted to investigate CDR assessment tools, and to find the domains, indicators, and indices that have been considered in these tools. In general, three main CDR assessment tools were found (4).
- A qualitative research using content analysis was conducted to explain conceptual and working definitions of CDR. Furthermore, domains, subdomains and indicators of CDR in Iranian context were explored by this study (5).
- A psychometric process was conducted for developing an assessment tool. Using item generation and item reduction, a primary tool was developed. Validity and reliability of the developed tool were evaluated by face and content validity, factor analysis process, Cronbach's α coefficient (equal to 0.89), and Inter Class Correlation (ICC= 0.83). Thereafter, using Analytical Hierarchy Process (AHP), the validated tool was weighted and normalized in all its domains, subdomains, and indicators.
- The information of different stakeholders was integrated in a unified data bank and then the level of CDR was assessed in six domains (institutional, social, economic, cultural, physical, and environmental), 16 subdomains, and 66 indicators.

The results were classified in five categories including very low, low, medium, high, and very high. Each level respectively was shown with red, orange, yellow, green, and blue. For better contribution of the results, using tables as well as Arc GIS software, different geographical maps for different neighborhoods, and different domains, subdomains and indicators were provided. Figures1 and 2 are some samples of provided tables and maps.

	تاب‌آوری						
	حیطه نهادی	حیطه اقتصادی	حیطه فرهنگی	حیطه اجتماعی	حیطه فیزیکی	حیطه زیست‌محیطی	تاب‌آوری
کاشانک	0/75	0/46	0/40	0/45	0/75	0/50	0/56
پردیسان	0/76	0/60	0/58	0/51	0/75	0/67	0/65
دروس	0/66	0/76	0/59	0/51	0/73	0/55	0/65
کاظم آباد	0/55	0/50	0/50	0/49	0/73	0/56	0/54
جنت آباد شمالی	0/56	0/65	0/53	0/50	0/74	0/50	0/58
دانشگاه تهران	0/61	0/46	0/65	0/52	0/81	0/53	0/58
نظام آباد	0/72	0/60	0/42	0/48	0/71	0/59	0/59
مدائن	0/63	0/53	0/50	0/52	0/75	0/58	0/58
امامزاده عبدالله	0/46	0/55	0/40	0/48	0/69	0/52	0/49
سرسبیل جنوبی	0/72	0/59	0/45	0/51	0/65	0/55	0/59
هلال احمر	0/56	0/56	0/38	0/46	0/75	0/57	0/53
شهید هرندی	0/58	0/20	0/32	0/45	0/84	0/55	0/45
شورا	0/60	0/58	0/48	0/51	0/73	0/60	0/57
شکوفه	0/60	0/61	0/45	0/51	0/70	0/58	0/57
شوش	0/59	0/52	0/35	0/48	0/67	0/57	0/52
جوادیه ۱۶	0/62	0/53	0/39	0/51	0/73	0/53	0/54
باغ خزانه	0/69	0/21	0/41	0/49	0/70	0/54	0/50
بهداشت	0/53	0/58	0/41	0/49	0/70	0/50	0/52
خانی آباد شمالی	0/85	0/64	0/41	0/50	0/75	0/52	0/64
قدسیه	0/71	0/59	0/41	0/49	0/73	0/60	0/59
شهرک شهرداری	0/57	0/64	0/43	0/52	0/70	0/40	0/55
گلستان شرقی	0/67	0/61	0/49	0/48	0/70	0/47	0/56

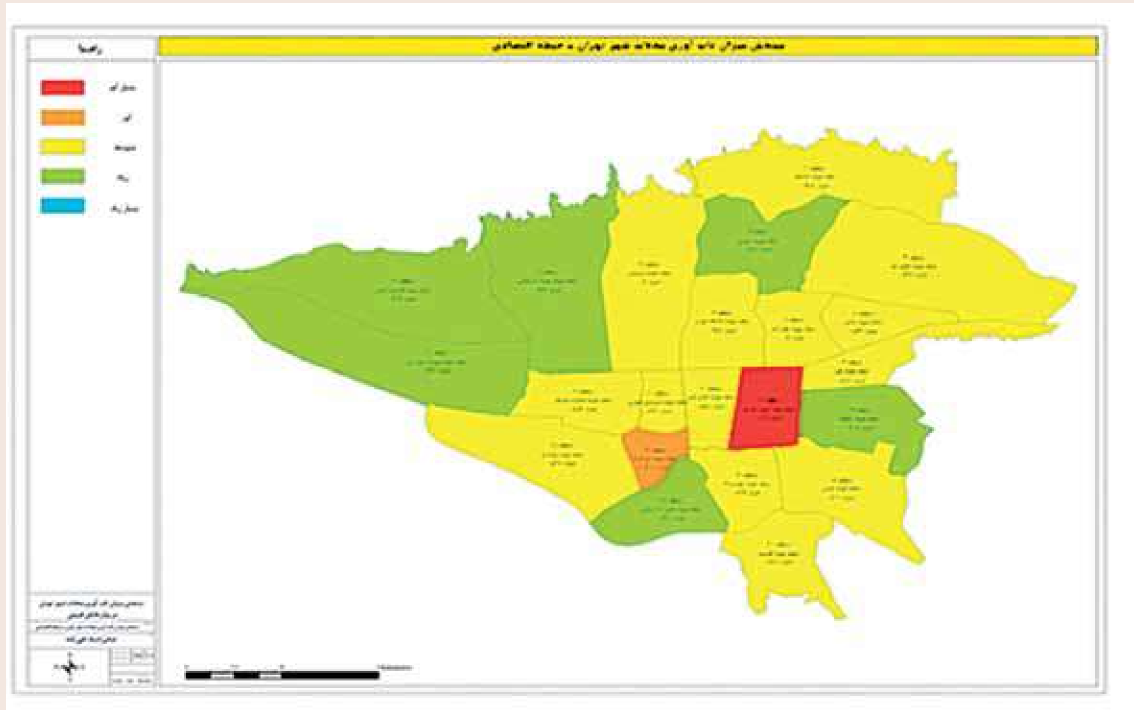

Figure 1 and 2: Samples of tables and maps of community disaster resilience assessment in Tehran.

Currently a dynamic and on-line disaster resilience monitoring system has been lunched in Tehran's municipality portal (figure 3) which shows the level of disaster resilience in all 375 Tehran's neighborhoods. Using this system all local authorities and policy makers are able to see the results, develop neighborhood-dedicated disaster resilience action plans, implement the plans and monitor the changes which might happen in each indicator, subdomain or domain of disaster resilience during the time.

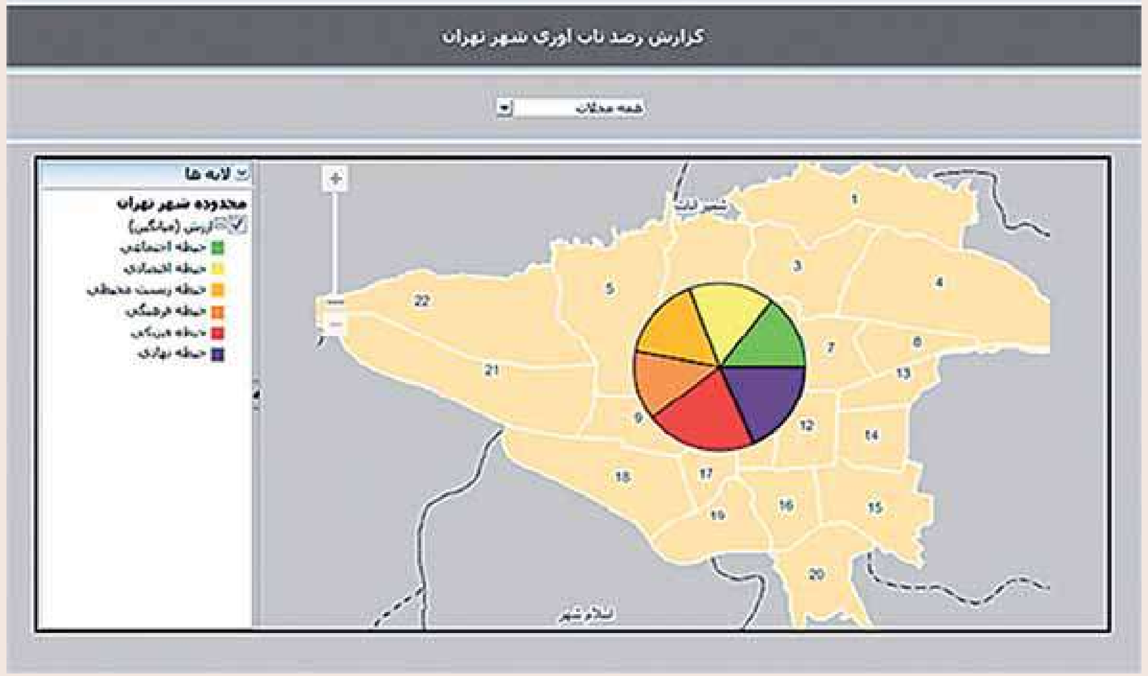

Figure 3: A view of on-line disaster resilience monitoring system

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23.

Community Awareness and Response in 2010 Bumthang Great Fire, Bhutan

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Introduction

Bhutan is a landlocked and developing country that is vulnerable to various natural disasters such as earthquake and floods. Because of the heavy reliance on wood for fuel, infrastructure and building houses, fire is also a frequent occurrence in Bhutan. In 2010, a fire occurred in Bumthang, Bhutan and burnt down closely-positioned buildings in a matter of hour. This case study highlights the key lessons learnt in an urban fire disaster, hence identifying the disaster response in developing countries like Bhutan.

Disaster event and damage

On 26 October 2010, a fire disaster occurred in Bumthang, Bhutan. It started in a mobile phone shop and lasted for 3 hours (1). Due to the community practice of chaining up rooms of the hostel at night at this internal migrant transitioning town, the tragic fire disaster took away two lives and 267 residents were rendered homeless. Psychological problems were found in the affected population, reporting having experience of mood swings and sleeplessness, as well as even anxiety when seeing fire, especially children. Fifty-nine shops including hotels were destroyed in the fire, and which also caused property loss to the shop keepers.

Figure 1: Map of Bhutan, with Bumthang district outlined by red line

Figure 2: Premise destroyed by fire

Multi-disciplinary approach in disaster risk reduction

Different levels, national, district, sub district, municipality and community levels had their own responsibilities in both the pre-disaster phase as well as the post-disaster phase (2). The Department of Disaster Management under the Ministry of Home and Cultural Affairs was the nodal agency coordinating national disaster risk mitigation, response, relief, and rescue operations. After the fire disaster, the Bhutanese government mobilized different resources from within and externally to help the affected people, by providing free services and reconstruction for the survivors. More than 300 army personals were deployed and the King and his ministers visited the victims and provided shelter, food, clothing and blankets, and free medical care in regular intervals. Overall the work adopted the national plan in its response by using a multi-sectorial approach institutionalizing a sustainable and decentralized disaster management mechanism at National, District, Block and Municipality level.

Community awareness

Disaster risk management issues had been incorporated in the school, college and technical curricula to facilitate creation of a generation sensitive to disaster risk and as an investment for mitigating and managing future risks. Cross-sectoral partnership and concerted efforts at disseminating the agenda of disaster management through school curricula and preparedness drills at regular intervals may inculcate a culture of disaster safety and risk management among people at large in the long run. In addition, community awareness was enhanced by developing posters on preparedness and safety measures for fire. Reports were issued to monitor, document and report lessons learnt after disasters. Training classes were conducted on fire safety and evacuation (3).

Lesson identified

Lessons learnt to manage health risk in this disaster include the importance to enhance public awareness and mitigate the hazards, vulnerabilities and disaster risks of fire. Even though government responses were swift, the lack of community awareness of high risk behaviours contributed to this tragic incident. Although the causes of fire were never publicly reported, with the imminent fire risk of wooden-based infrastructure, fire hazard reduction, evacuation drills and fire response capacity should be enhanced.

Conclusion

Strong and dedicated leadership in Bhutan and resilience in Bhutanese people were the key factors towards successful response and recovery of the fire disaster. Bhutan made efforts in restructuring policies and the government divisions after this disaster, as shown through the Disaster Management Bill and disaster education and awareness activities. However, more evaluation and information needs to be made available on the impact of individual disasters and effectiveness of measures carried out subsequently.

Acknowledgement

This case study was funded by ZeShan Foundation. The study has significant contribution by Chi Shing Wong, Sergio Koo and Eliza Cheung. Special thanks to the facilitation by the Department of Disaster Management, Ministry of Home and Cultural Affairs of the Royal Government of Bhutan.

More information

More information about the case study of in 2010 Bumthang Great Fire is available at the website of Collaborating Centre for Oxford University and CUHK for Disaster and Medical Humanitarian Response (CCOUC), http://ccouc.org/disaster-case-studies.

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Co-Designing Disaster Risk Reduction Solutions

24.

Mobile GIS for Surveillance of Health Services and Disaster Management

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The Environmental and Occupational Health Center (EOHC) of the Ministry of Health and Medical Education of Iran and the Tehran Disaster Mitigation and Management Organization (TDMMO) of Tehran Municipality have supported two projects for developing mobile GIS surveillance systems. Classical pen-and-paper surveillance systems of disaster and health field recording and reporting is very limited and inefficient. Using online mobile GIS making it easier, feasible, economic, and faster for coordinated data analysis for disaster mitigation and health care services. Mobile GIS by providing data, methodology and software needed for patio-temporal analysis of disaster and health system is becoming a very useful tool for decision making and planning. Two pilot MGIS systems have been installed in EOHC and TDMMO for hotels health and safety regular surveillance and occasional reporting in bridges failures, respectively.

Mobile GIS (MGIS) providing the abilities of GIS for field data capturing, online storage and updating, spatial –temporal analyze, and displaying results. It is integrating mobile, GIS, GPS, wireless telecommunication, the internet and internet-based spatial services like Google Earth and Map. Pen and Paper (PaP) methods for inspection, surveillance, and monitoring of health and disasters is a classical and simple with different procedures for different organizations. This kind of data collection always facing limitations like: human errors, data inconsistency, lack of coordination information, insufficiency of data storage infrastructures, limited statistical and spatial-temporal analysis, and lack of DBMS and dashboard management system. As an alternative, MGIS enables organizations to add real-time information to their database, speeding up analysis, display, and decision making by using up-to-date, more accurate spatial data for users like, firefighters, police officers, engineering crews, surveyors, utility workers, soldiers, census workers, field biologists, and others, use mobile GIS to complete the following tasks: field mapping, asset inventories, asset maintenance, inspections, incident reporting, and GIS analysis and decision making. For more information readers are referred to below references (www.esri.com/mobilegis). In these development researches two MGIS data collection and surveillance systems designing and implemented in EOHC and TDMMO for hotels health and safety regular surveillance and occasional reporting in bridges failures, respectively. Consequently, PaP methods are almost replaced with MGIS and several benefits have been obtained for mentioned organizations.

In these projects, the necessity of MoGIS and the ways for implementing is clearly documented. In Table 1 the PaP and MoGIS procedures are listed. Based on the level of technology development, needs of organizations and the available budget three versions MoGIS is suggested (Table 2).

Table 1. Inspection procedures of two systems

Pen-and-paper (PaP)	Mobile GIS (MoGIS)
• Inspectors referring to place by address • Filling multicopy paper questionnaire • Archiving filled paper questionnaire • Paper questionnaires delivering to official centers • Entering information into excel-MS files in daily, weekly and monthly bases	• Inspectors referring to place by GPS • Filling digital questionnaire • Obtaining coordination information • Online information sending to database by SMS and internet • Online GIS information creation and updating current Geodatabase • Online spatial-temporal analysis is avaiable • Dashboard and online statistical information is created • Online overlaying data on GoogleEarth, and etc is available • Database archiving is done

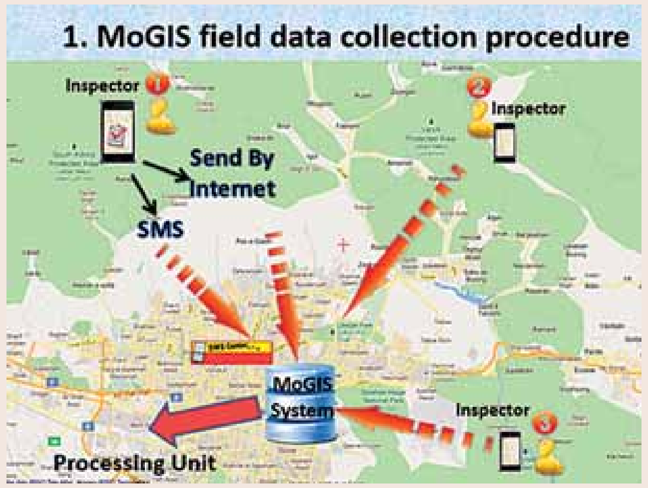
Co-Designing Disaster Risk Reduction Solutions

Table 2. Characteristics of two systems

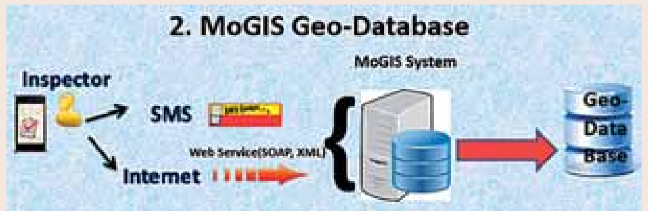
PaP	• Need to carry paper forms • No statistical reporting • Illegible questionnaires • Unable to control the accuracy and precision of the filled forms • Possible Human induced errors • Possible loss of forms without having backup • Impossible spatial-temporal and statistical analysis • Unavailability of coordination information • No access to online data
MoGIS	MoGIS version 1: • Updating available Geodatabase • Online statistical reporting • Guild-based Questionnaires • Archiving data and information
	MoGIS version 2: • Updating available Geodatabase • Dashboard • Online statistical reporting • Guild-based Questionnaires • Archiving data and information • Connections to all kinds of DBs • Bilateral connections between filed and office personals • Send and storages of film and photos • Syncing with personal and organizational website
	MoGIS version 3: • Updating available Geodatabase • Dashboard • Online statistical reporting • Guild-based Questionnaires • Archiving data and information • Connections to all kinds of DBs • Bilateral connections between filed personals and office mangers • Send and storages of film and photos • Syncing with personal and organizational website • Dynamic and online questionnaire banks • Possible Centralized and decentralized management systems • Compatibility with all mobile operators and Internet service providers

Here, as an example the MGIS procedure of data simultaneous capturing for 3 hotels by 3 inspectors are shown in Figure 1a. The obtained Geodatabase which is updated and created using this system (Figure 1b) and data statistical and spatial temporal analysis for decision making and planning is shown in Figure 1c. The spatial accuracy is also important for updating current GIS and creating new GIS features. Here, we the coordination accuracy is less than 3 meters by using A-GPS technology.

(a)



(b)



(c)

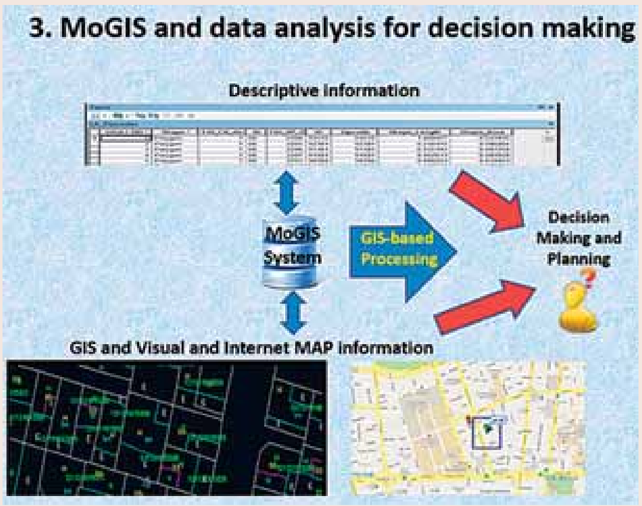


Figure 1: (a) MOGIS data collection, (b) Geodatabase updating and creation, and (c) data analysis for decision making

Co-Designing Disaster Risk Reduction Solutions

As the main results of these development researches, the surveillance and inspection procedures is improved. The GIS database is created and updated, the human based errors is minimized, and speed of data capturing is increased. Conclusion remarks showing that MGIS technology is offering valuable help in health surveillance and disaster mitigation by providing facilities for online GIS data capturing, analyzing and managing. Finally, limited mobile network coverage, shortage of mobile batteries, limitations in cellphones GoogleEarth maps are the main challenges of these projects.

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25.

Translating Information from Evidence to Practice: The Case of Clenbuterol and Food Safety in China since late 1990s

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Introduction

Food safety is a key health protection maintaining agenda globally. Many countries combat this challenge by enacting food laws and regulations, and establishing official institutions for food control. However, sometimes having evidence and implementing policies against a hazardous food substance is not enough. This case examines the example of the battle against clenbuterol (CLB) in China. Despite the Department of Agriculture having banned this substance in 1997 (1), clenbuterol remains largely in the pork industry and caused toxin cases regularly throughout the following decade. This paper discusses the challenges of translating information from evidence to practice, and identifies lessons learned.

Clenbuterol use and health threat

Clenbuterol was first discovered to have the function to enhance lean meat growth in the 1980s, and was used in America and Europe as feed additive for livestock. As America and the EU banned CLB in the early 1990s due to side effects, the use of CLB was introduced in China without mentioning the adverse effects. When mixed into animal feed, a CLB-fed pig would not only have leaner meat, but also grow in half the time, reaching 75~80 kg in 2-3 months, instead of 6, and enable Chinese producers to earn a net profit up to 275% greater than original (2). However, as CLB is not destroyed by cooking, consumption of CLB-contaminated meat leads to acute poisoning and symptoms of nausea, headache, muscle tremors, palpitation, and arrhythmia (2).

Government food safety system, policy and actions

After the initial CLB ban in 1997, various Chinese governmental departments strengthened the regulation with subsequent statements, regulations and inspection procedures between 1998 and 2003 (1) and found the CLB usage rate to have decreased. A year after the ban, however, the first poisoning outbreak occurred in Hong Kong among 17 people who ingested CLB-contaminated food. In the subsequent decade, at least 17 CLB poisoning outbreaks, each which affected a range of 13 to over 500 people, occurred in major cities like Beijing and Shanghai as well as provinces of Guangdong and Zhejiang (2).

China's food safety system underwent adjustments to face these modern challenges. Led by State Food and Drug Administration, China's food safety system originally contained overlapping duties among eight departments. In 2005, responsibilities were redefined over the supply chain process, from Plant and Husbandry, to Processing, and Consumption (3). Food Safety Law, which comprises of areas such as food safety assessment, standardization, inspection, and emergency management (4), was implemented in 2009. In March 2011, national media reported the crackdown of CLB-contaminated pork used in China's largest meat producer, with over 1,000 people taken into custody and 30 enterprises under investigation.

Challenges in practice

Many circumstances in the pork industry complicate the practice of banning CLB use. Unlike other countries where the pork industry is controlled by large enterprises, pig husbandry in China relies on small home-based farms (5). Inspections of these pig farms require lots of quarantine officers and testing equipment, which most provinces lack the financial capacity for. Additionally, CLB-fed pigs can still escape detection by suspending the CLB feeding several weeks before the inspection (5). Attempts at quality control at the slaughterhouses are easily thwarted since inspection-related certifications can be bought at ¥2 per pig. Competitions between slaughterhouses for business also limit the quality control since sellers would switch to another slaughterhouse if one was too strict on the quality.

The resources allocated to inspections in China are limited. The national inspection budget is around 0.1 billion per year which only allows unannounced spot-checks or intrusive inspections. For instance, in 2009, China inspected only 70,000 animal samples and 20,000 aquatic samples, compared to the 793,000 and 1,391,000 needed to match the EU sampling standard. The normal CLB test costs more than ¥2000 per box and ¥100-150 million for the inspection machine. This averages out to ¥100 per urine sample. It additionally takes 4-5 hours to inspect the urine, while one day is required to inspect pig organs.

Lessons identified

The food safety system must address quality issues and actual practice of proper pig husbandry in China's small home-based farms. A unified inspection, certification and accreditation system needs to be implemented. Barriers to inspection, such as the financial limitations and time requirements, should be reduced, and standardisation of qualifications and inspection methods between different departments should be revised.

Conclusion

The development of the food safety regulation in China is becoming more comprehensive with lessons learnt from challenges such as this clenbuterol example, yet increased attentiveness to the local barriers and loopholes are needed in China's food safety system. After more than a decade of its ban, CLB remains to be a food safety concern in China. Despite efforts in hazard management and regulation implementation, the use of CLB continues to slip through the cracks of quality control and reveal its existence through recurrent poisoning cases.

Acknowledgement

This case study was funded by ZeShan Foundation. The study has significant contribution by Crystal Yingjia Zhu, Chi Shing Wong and Tong Yung.

More information

More information about the case study of Clenbuterol and Food Safety in China is available at the website of Collaborating Centre for Oxford University and CUHK for Disaster and Medical Humanitarian Response (CCOUC), http://ccouc.org/disaster-case-studies.

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26.

Rainwater Harvesting as a Weapon to Overcome Safe Drinking Water Scarcity in Southwestern Coastal Bangladesh

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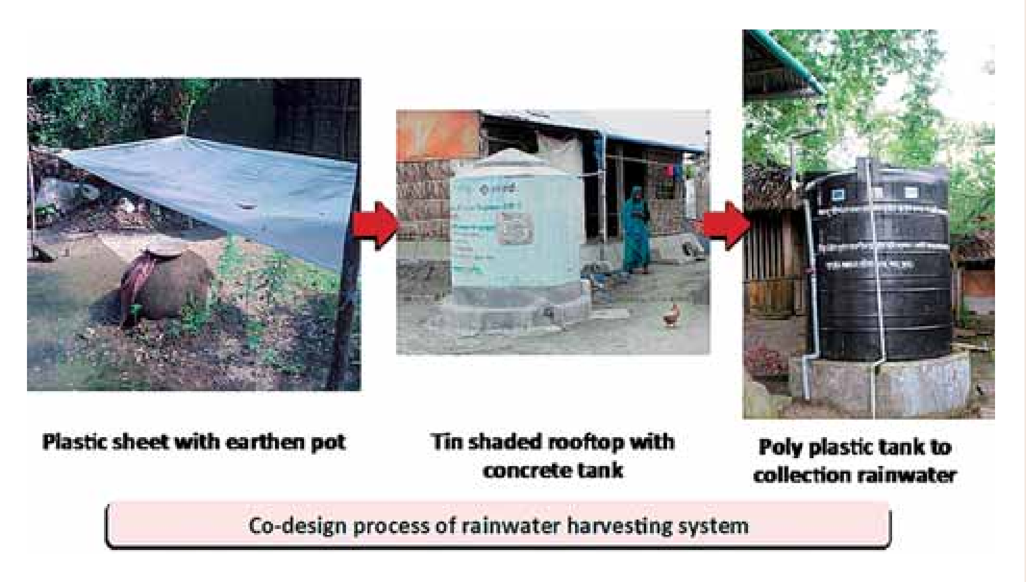
Details about the initiatives key issues addressed

In context of Bangladesh, the management of water resources has become a crucial prerequisite because of growing demand for water and increasing conflict over its alternative uses. As population increases and makes various uses of water, its growing scarcity becomes a serious issue in Bangladesh. Before Sidr and Aila, most of the coastal people used protected ponds water for drinking and cooking and prevents saline intrusion due to raised embankment. Particularly, the southwest coast suffers from a severe safe drinking water crisis due to sea level rise, temperature and extreme events including more intense floods, droughts and storms. Along with these, saline water intrusion is another pressing cause to enhance safe drinking water scarcity for the local people. On the other hand, conflict arises during the collection of water between the households and within the household. As a result, it has impact on the social connectedness and responsibilities of the community people. Rainwater harvesting is a promising alternative source to meet drinking water demand for coastal community. Furthermore, rainwater harvesting is an accepted freshwater augmentation technology. The quality of rainwater collected from rooftop catchment systems, equipped with storage tanks having good covers and taps, is generally suitable for drinking purpose. Hence, rainwater harvesting plays an important contribution to resolving water shortages in the future.

Description regarding the participatory co-design process

At the very early stages, rainwater water was collected in earthen pots by using plastic or polythene sheet and after that people collected rainwater in concrete reservoir. But harvested rainwater could not be stored for longer period. Now, poly plastic tank is used collect and store rainwater for longer period. It is very costly to install poly plastic tank for local community people and now this process is running good by the involvement of private organizations (e.g. Gazi) in association with local NGOs and community people. The private organizations supply poly plastic tanks and the local people install them with the help of trained NGO workers. Then, the local people repay the cost of poly plastic tank in monthly installment. Tin shaded rooftop is used to collect rainwater during rainy season and stored in the poly plastic tank for further use round the year. By using solar energy system, the harvested rainwater is distributed through pipes as per requirements.



Contribution of science and technology and academic community

The innovation of science and technology, people used tin shade rooftop as catchment and concrete made pot to preserve water for longer period of time. Currently, modern technology based poly plastic tank is used to preserve rainwater for longer period of time. This tank has long durability with better quality water preservation capacity and tried to expand by private and NGOs partnership in this region. The community people accomplish the process as they want to get safe water for their livelihood. It is imperative that without cooperation and intervention of community people the sustainability of this process is not achieved in the long run. Adoption of science and technology for implementing RWH system to get safe water can sustain for longer period of time and community gets much more benefits on it. For example, by using solar energy system, harvested rain water could be distributed in different sections and thus the carrying problem of drinking water will be minimized.

Proposed methods and dissemination of results

Rainwater harvesting is one of the feasible options of fresh water sources in the coastal areas of Bangladesh and recently a lot of initiatives were undertaken to promote and install rainwater harvesting systems in the coastal affected areas in Bangladesh. Although the problem of safe drinking water scarcity become much more during and after disaster period of time, however, with the advancement of science and technology community people tries to cope with this problem using innovative approaches like rainwater harvesting. The roof top rainwater harvesting system seems suitable for developing both household and institutional based RWH systems to get safe drinking water. Harvested rainwater can satisfy household monthly drinking water demand from March to October. The excess rainwater stored in September and October is sufficient to meet the demand in the dry months (November to February) provided there is adequate storage facility. At national scale, rainwater conservation plans and policies can be formulated to handle water crisis in coastal areas of Bangladesh. For implementation, private organizations can be engaged with projects to promote, educate, and involve communities for rainwater harvesting practice (this will also relieve the government from taking risk with public funds). Then with the help of these organizations, local government can develop cooperative system to maintain, monitor and ensure the aimed benefit of rain water harvesting. Rainwater harvesting is found technically feasible on the basis of rainfall, roof size and roofing material.

Contact

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27.

Prevention of GLOF in South Lhonak, Lake: A Case of Mainstreaming DRR and CCA in North Sikkim (INDIA)

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Sikkim is a very small Himalayan state of India. North Sikkim is having a number of glacial lakes. Each lake is behaving differently in the Himalayas. Some of the lakes are receding whereas some are increasing in size and become dangerous for Glacial Lake Outburst Flood (GLOF). In the past there were few cases of such GLOF disaster in India (Uttarakhand 2012). South Lhonak glacial lake is such lake located at North West Sikkim along 27^o 054' 969" North Latitude and 88^o 12' 463" East Longitude and at an altitude of 5200m (17000 ft) above mean Sea Level (AMSL). The scientific studies revealed that the size of the lake water increased considerably over the years. The size of the lake during 1997 was 17.71 hectors (ha), in 1990 it was 43.28 ha, 70.02 ha in 2000 and 118.88 ha in the year 2011 as per the scientific reports. The outlet drainage of the lake is considerably small and retained by artificial glacial moraine deposit. With the stress created by the accumulated volume of water and the threat of snow/rock avalanche, Cloud burst, high magnitude seismic events, scouring of the end moraines by water spread and floating ice during ablation may cause breaching of the artificial dam and could cause GLOF disaster. In this scenario the establishments along downstream of Goma Khola and Tista basin will have very high damaging impact. Department of Science & Technology (DST) Government of Sikkim in collaboration with Department of Science & Technology, Government of India took up the issue and made first expedition to the lake during April 2012. They physically accessed the situation and reported that the size of the lake had increased considerably and thought of installation of sensors to monitor the increase of the lake size and for Early Warning System in case of GLOF. It was also observed that the lake water could reach the nearest establishment downstream in four hours time in situation like GLOF and the warning System could alarm the concerned for their safety.

In August 2014 another expedition was organized by Department of Science Technology, Govt. of Sikkim with team members from SSDMA, Land Revenue & Disaster Management Department, Centre for Development of Advance Computing (C-DAC), Ministry of Electronics and Information Technology, Snow & Avalanche Study Establishment (SASE), Ministry of Defence, Government of India participated. During this expedition Electrical Resistivity Survey, and related Technical Studies were carried out with initiation of the establishment of sensors for Early Warning System (EWS).

The lake as being monitored constantly showed the increased volume and it was felt the need to discharge some water out of the lake to decrease the stress to the moraine dam. The department of Land Revenue & Disaster Management Department designed a lake siphoning project for reducing risk of GLOF and sent a team of 18 members led by Dr. Sonam Wangchuk, a Scientist from Ladakh who had experience in siphoning of water and creation of artificial glacier in Ladakh to be used for irrigation during lean months (March – June). The coordination of expedition was done by Indo Tibetan Bordered Police (ITBP). The ITBP personnel were highly useful in laying the siphoning pipes. The concerned departmental experts studied the area and lake in particular. Geologists undertook the geological /geo-technical mapping of the area, and Science & Technology and Climate Change department installed the monitoring sensors in the lake area (Figure 1). Finally, the work of initiation of mitigation measures for the discharge of water from the lake begun. The team installed three pipelines of eight inches diameter each of 140mts long from the lake to Siphon water (Figure 2).

Figure 1: Monitoring sensors in the lake area

Figure 2: Pipelines to siphon water

The three pipes discharged 150 liters /second or 13 million liters of water per day from the lake which is expected to lower at least 1.15 meters of the volume of water from the two kilometer long lake by the end of coming winter. After observing the situation, the second initiation to install more pipes is proposed to be taken up to discharge more water from the lake along with some other mitigation programmes possibly during June, 2017. The installation of siphoning pipes during the second phase is believed to decrease the water level of the lake by five meters, which would drain roughly 25% of the floodable water content of the lake and will drastically reduce the risk of Glacial Lake Outburst Flood (GLOF). The monitoring of the instruments and the pipes is being done by ITBP and is constantly reporting at their headquarters at Gangtok and then to Sikkim State Disaster Management Authority (SSDMA). This project is the first of its kind in Asia and can be replicated in similar conditions in any part of the world.

Acknowledgement

I acknowledge Department of Science and Technology (Govt. of Sikkim and Govt. of India); Sikkim State Disaster Management Authority, Department of Land Revenue and Disaster Management, Govt. of Sikkim and Mr. G.C. Khanal for sharing the reports of various expeditions. Thanks to Dr. Sonam Wangchuk for designing and conducting this unique experiment for CCA and DRR in Asia. I am grateful to Dr. Anshu Sharma for his useful comments and suggestions.

28.

'DREAM': Empowering Communities to Cope with Disaster Risk

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Disasters pose a major threat to life, environment, and property impacting the well-being of large number of people. From preparing for the events to coping in the aftermath are both equally challenging in case of any kind of disasters. Disaster management is the creation of plans through which communities reduce vulnerability to hazards and cope with disaster risks. Lack of resources and information prevents people from making better everyday choices, protect biodiversity and address disaster issues together. China has a long history of disaster occurrences and has suffered from many disasters in the past. Whether a disaster is major or minor, of national or local proportion it is the people at the community who suffers its adverse effects. A map can be one medium for bringing communities together to chart practical solutions and address urgent environmental issues at the same time.

As a response to one of such community based initiative our project 'DREAM' was started. DREAM is an acronym for 'Disaster Reduction Ecological Artistic Map', which focuses on disaster response. It combines disaster reduction information, presenting it in the form of art. Immediately after the disaster events there may not be enough time to act, thus this map is created as a baseline to plan relief logistics and emergency evacuation. The main purpose of creating DREAM is to build a safe, ecological and sustainable place for the benefit of humanity and environment. The main objective behind DREAM is to create an aesthetic map that involves disaster reduction information, which is also easier for general public to understand. The map is locally produced surveys of environmental risks and resources within a community distributed to the people for promoting disaster and environmental awareness and sustainability. The map can act as a tool easing search for more eco-friendly and sustainable life.

The leadership of DREAM is taken by the Institute for Disaster Management and Reconstruction (IDMR) and the map was first created for Jiangan Campus with the immense help and active involvement from student clubs, artists and social community members. DREAM aims to create a service learning mode which enables students to participate actively in it. At the present context, based on the principles of cartography DREAM has plotted location of the campus's human history, nature-ecology and disaster risk reduction information. As the project started in the University, several students were arranged in groups for different subject fields where they had discussion and collected information required for the project. It was started from one campus in the Sichuan University but slowly it is making its area broader. These maps and the process of making them gives better understanding of the ongoing conditions and community resources so as to voice the identified important terms for future as well. Inside the University DREAM has provided new ways for students to join in service learning as they are very important for the creation of a disaster resilient community/country. The main purpose of creating maps is to bring communities together to chart practical solutions and address urgent environmental issues. If communities can receive training and develop their own preparedness strategies to integrate Disaster Risk Management into development, it can surely progress towards development and disaster mitigation side by side.

Disasters can eradicate years of local development in a few minutes or hours, thus Disaster Risk Reduction has to be seen as an integral part of the development efforts. Lack of resources and information prevents people from making better everyday choices, protecting bio diversity and addressing disaster issues together. It is hoped this kind of initiative with map will bring people of all ages together to discuss share and care for their communities directly. The icons and symbols designed for the maps makes it easier to describe the sites and easy to understand areas there. With DREAM a service learning idea aiming to popularize the disaster reduction knowledge and dissemination of safe, ecological and sustainable campus as well as community ideas to the students and general public was started. It has the characteristics of comprehensive, local, scientific, practical and participatory making it an advanced innovative product in the present trend of disaster reduction and security maps over the world. DREAM has four parts; disaster information, the cultural and ecological information, the artistic expression and the icons. Four steps were adopted for bringing this project in the present state; Understanding the context with literature review and case studies, field research/survey, data analysis and mapping. It is organized and led by local people such as community residents, nature conservationist, environmentalist, people working in local cultural heritage, students, teacher and others.

One of the main characteristics of a safe and resilient community is; it is knowledgeable and healthy having the ability to assess, manage and monitor its risks. This is one of such initiative for a disaster resilient community. DREAM is not only a culture map, but also a scientific product as in depth research is done before giving it a final form. Geographic Information System (GIS) software is used for its creation after the data is collected and analyzed for the mapping. Then the series of icons are developed so as to make the map more comprehensive. It is a combination of digital map, artistic map and special icons arranged together for the creation of a better living space.

The concept such as DREAM will help to positively influence community knowledge and awareness regarding disasters. Proper planning in community will implement an all hazard approach so that plans can be reused for multiple events that can exist in future. Our dream is to apply the concept of DREAM in many at risk communities in China and other parts of the world. Its establishment is also an initiation towards the service learning so that students can learn and implement the knowledge for the creation of a better world. It has also a wider prospective for the application in other universities as well.

Acknowledgment

This research was funded by Sichuan University (skyb201603 and 2016SCU11062).

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29.

Documentation of Post-Disaster Reconstruction Projects over the Last Sixty Years in Iran

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With an extensive wealth of knowledge and experiences gained from numerous recovery projects in war and disaster stricken areas of the country, the Department of Post-Disaster Reconstruction is the only and most advanced center, not only in the country, but in the Middle-East. The aim of the centre is to provide a robust professional and practical basis for planning and design development at both local and regional levels. In addition, a number of research works offered within the centre intend to facilitate systematic study into various natural disaster prevention methods – involving all stages of the process, from planning to design, implementation and overall management. The interdisciplinary nature of the program and its objectives also offers great opportunities in fostering future best practices projects.

One of the recent and unique research activities is to document the last six decades post-earthquake reconstruction projects in the country, in order to draw local best practices in the context of active householder's participation in the process of shelter provision and also to explore the roots of sustainability of houses provided. As a matter of fact, lack of appropriate data, information, documentation and critical review of the past sixty years Iranian post-disaster reconstruction in the field of architecture and urban planning, is one of the challenges in disaster reconstruction studies.

It appears that documentation of those projects would pave the way of not only better understanding the causes of sustainable reconstructions, but also learned lessons for the future operations in similar locations. In this respect, the impacts and procedures of a number of reconstruction projects have been documented including earthquakes of 1960 Lar, 1962 Doosaj, 1962 Roudak, 1968 Ferdous, 1974 Gir-Karzin, 1979 Tabas, 1989 South Khorasan. The research benefits from a combination of qualitative and quantitative methods using an exploratory approach and content analysis. The appropriate tools for data collections are literature review, in-depth interviews with those elderly survivors who witnessed the disaster and local authorities and also drawing sketches and marking the physical modifications to the reconstructed units over the decades accomplished with careful observations.

The findings are amazing since a considerable amount of reconstructed units and facilities are still occupied over a number of decades. Some reasons for such success include understanding and using an appropriate combination of traditional and modern construction technology, mutual trust between local people and authorities and people participation. It is worth mentioning that the Department of Post-Disaster Reconstruction within the Shahid Beheshti University is the pioneer centre to study globally and acting locally, concentrating on building local knowledge as an interdisciplinary approach on various aspects of sheltering, such as health, environment, sociology, psychology, architectural planning, management and design.

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Co-Designing Disaster Risk Reduction Solutions

30.

Bringing Science, Society and Institutions Together for Strengthening Emergency Preparedness and Disaster Risk Reduction (DRR) in Myanmar

Chrisitan Aid, Myanmar

This note presents insights into an ongoing initiative being led by Christian Aid on Strengthening Emergency Preparedness Systems (SEPS) in Myanmar following a participatory consortium based approach bringing together diverse stakeholders- science, society and institutions with varied strengths and capacities.

Background

The catastrophic effects of global climate change resulting in extreme weather events have a direct impact on the lives and livelihoods of people in Myanmar. This region witnesses recurring disasters every year causing enormous loss of lives, damage to crops and disruption of livelihoods among poor and vulnerable sections of the community with weak coping capacity, fragile institutional mechanisms and inadequate preparedness measures including early warning mechanisms critical for saving lives. The effects of climate change in targeted areas in south east areas in Myanmar could be observed as sudden Heavy Rainfall, changes in the course of water way, chronic floods, decline of ecosystems due to species loss which threatens the wellbeing of people living at the frontlines. This becomes more complex when the ongoing conflict situation interacts with the natural hazard.

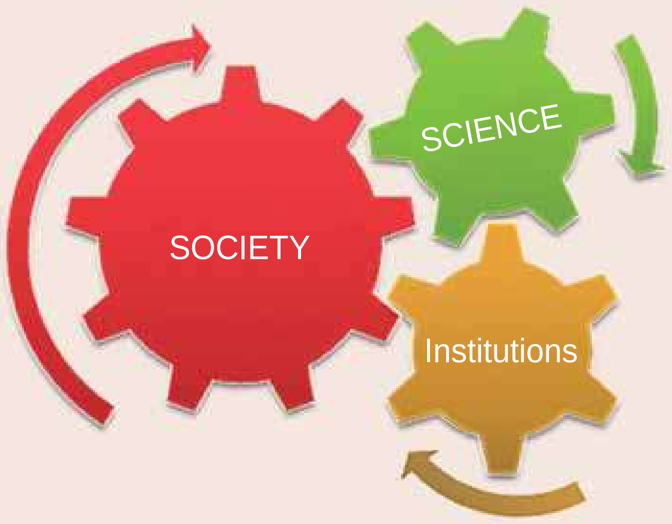
The initiative

To address some of these concerns, the initiative used participatory processes and technical inputs from RIMES working closely with government departments and communities at-risk. Some of the tools used were 1) Participatory, Vulnerability and Capacity Assessment (PVCA) 2) Conflict Sensitivity Tools 3) Early Warning Audits 4) Analysis on technical aspects of operationalizing early warning . These processes cover both government control and non-government control areas and provided greater insights on power imbalance, ensuring meaningful participation, following no harm and accountability practices in targeted communities.

Role of Participatory planning in emergency preparedness and DRR in a complex environment: Use of participatory tools combined with the involvement of local partner organizations and community groups and members is being organized to facilitate a process for reliable information collection leading the way for robust analysis on various aspects of project design such as community based end to end early warning systems, conflict sensitivity and natural hazard specific planning. Perceptions of communities involved in the action on local drivers of risk and issues allow communities, practitioners and policy makers, to directly address community impacts, through the process of participatory vulnerability capacity assessments (PVCA) using a combination of qualitative and quantitative methods to understand how emergency preparedness & early warning systems respond to climate change. The insights from the frontlines are directly feeding into the technology or science of early warning systems being led by RIMES under the initiative.

This created an informed understanding on the local situation and issues that communities are facing, as well as helped in identifying solutions based on local priorities and knowledge using methods such as, transect walks, focus group discussion, and seasonal calendar (trends). As a part of the Early

Warning Audit (EWA) process, the no regret approach was adopted which focuses on maximizing positive and minimizing negative aspects of nature based adaptation strategies and options in both the short and medium terms. For enhancing people's participation and involvement in the areas affected by conflict, some of the tools on conflict sensitivity were carried out as the follow up process of promoting people participation in resilience work and compliment the natural hazard led participatory processes in the villages where both conflict and natural hazard is experienced.



Connecting science, institutions, and societies for end-to-end early warning

Recognizing the critical importance of local knowledge

Rural communities are knowledgeable about the critical issues affecting them, including many of the solutions to address such as challenges. However they feel left out in decision making as most projects are designed and activities pre-determined without their prior engagement. It is very important to recognize the value of local knowledge and use it to make decisions. The PVCA assessment helped in identifying hot spots and interventions and it also helped the project to strengthen the early warning system setup and emergency preparedness aspects from both natural and manmade disasters. This confirmed the wealth of knowledge and skills within the community, and the need to take advantage of these skills.

Validation and dissemination

These approaches were used throughout site selection, planning, design, validation, implementation of activities and delivering the results on the ground. This is a key factor in designing a bottom-up project that empower and enhance the ownership and involvement of local communities in the project. Specialised inputs on capacity development on PVCA, EWA and Conflict Sensitivity were provided at different levels to ensure that tools such as Power Analysis, Conflict Analysis and Communication Flows Analysis and criteria for early warning for emergency is developed with desired quality ensuring a multidisciplinary team comprised of local stakeholders, researchers (external organization of consortium members), community representatives and technical experts.

The initiative also creates wider engagement and learning by creating opportunities through various multi stakeholder platforms/events such as 'Monsoon Forums' where various stakeholders such as government, non-government agencies, UN, subject matter specialists come together and linkages with the wider processes at the national and sub national is strengthened. As a result, there has been sustained engagement, with a high rate of adoptions and scaling up in all the SEPS sites in Kayin and Southern Shan States in South-East Myanmar.

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31.

Emergency Flood Response 2015 in Bangladesh

Zobaer Ahmed, Friendship (NGO)

Bangladesh is the part of world's most dynamic hydrological and the biggest active delta system. The topography, location and outfall of the three great rivers shapes the annual hydrological cycle of the land. Too much and too little water in a hydrological cycle is the annual phenomenon. Regular monsoon event is the flood, the depth and duration of inundation are the deciding factors whether it affecting beneficially or adversely. Monsoon inflow along with rainfall historically shapes the civilization, development, environment, ecology and the economy of the country. Extreme events of flood adversely affect the development, economy, food security, poverty and almost every sector.

Since August 13th, heavy rains in the main river basins and upstream catchments of India, along with continuous rainfall in the north-west and north-east Bangladesh have triggered flooding in low-lying, vulnerable and densely populated areas. Considering the total area of inundation during the flood 2015 may considered as average one. The flood duration was short in places of south east and moderate in the north, north east and central part. No flash flood experienced during pre-monsoon (up to mid May). The Brahmaputra and Meghna Basin experienced the monsoon flood from the second week of August 2015, indicated that flooding was a worst in various parts of the country and particularly in a significant number of districts clustered around the north-west (Kurigram, Rangpur, Gaibandha, Bogra, Sirajganj and Jamalpur) that are known to have many char/ island area and include populations that are classified as day labor and extreme level of poor.

Friendship, with funding from the Friendship Luxembourg (FLux) implemented the project titled 'Emergency Flood response 2015 in Bangladesh'. This project was implemented from mid- September 2015 to early October 2015. The project aimed to address immediate needs of flood-affected populations by distributing food and medical care. Finally food package approximately for 3-5 days distributed among 9,650 flood affected households. From the beginning of flash flood, Friendship Health Sector continued routine health activities in the intervention areas. Apart from routine activities, emergency medical teams were formed and offered services in the affected areas from 06 September 2015 in the project areas at Gaibandha and Kurigram district. Apart from these two districts, recently Friendship installed offices in the new project expansion areas at Sariakandi – Bogra, Kazipur – Sirajganj and Madarganj – Jamalpur. Total 14,806 flood affected people of Kurigram and Gaibandha district has been served through emergency medical camps amongst 2419 patients were referred to LFH by Outreach FCM.

An evaluation was conducted applying rapid appraisal approach which involved interviews with beneficiaries, and observations (transect walk, households visits etc.). The emergency relief team had jointly leaded by sector heads with the support of finance, procurement and administration team. Almost 45 locations covered by the project were visited by the Head office team and along with the large number of staff members from different sectors took part in relief operation.

However, many of structural damages has associated due to inundation and pressure of flood water those have save shelter and protect cultivable land specially in Char (Island) area. So, the report have recommended two things, one is to implement long term Disaster Risk Reduction related project and as well as allocate budget for relief support immediately that has to be another provision for livelihood activities, if not happen any disaster in certain time.

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32. Flood Hazard Mapping in Kajang, Malaysia

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Introduction

Kajang is a bustling old town located at the eastern part of Selangor, Peninsular Malaysia. The township is located along the Jeluk River, which drains into the Langat River before discharging into the Strait of Melaka. Economic activities commenced with tin mining in the 1840s, followed by coffee and rubber plantations in the 1890s. The population of Kajang has grown rapidly in the past few years at a rate of 9% per annum (Population Census, 2010). Its development has been quite compact but not properly planned resulting in traffic congestion, pollution and flash floods (Bahrum & Malek, 2016; Shafie et. al, 2016).

Flooding has been a major problem since the 1970s. Flash floods are common, often receding after one to four hours (Image 1). Water levels have been reported to submerge houses along the river up to the roof level. Kajang experienced 'great floods' in 1971, 1987 and 2011 with flash floods occurring in other times. The event in December 2011 caused damages estimated about RM2.4 million. At least 3 incidences were reported in 2014 causing losses estimated about RM 150,000 per event. The majority of settlements, economic and development activities in Kajang are focused along the Jeluk River (Muhamad, 2016).

Image 1: Flooded areas in Kajang town

Delineation of flood zones

Flood hazard mapping was conducted at the local level scale with support from the local authority i.e. the Kajang Municipal Council (MPKj). The original terrain of the town is an alluvial plain. A large proportion of settlements are in flat alluvial zones or areas with low elevation (Muhamad 2016). Kajang is susceptible to flood due to its geomorphology. The situation is exacerbated by excessive development upstream of the Jeluk River where multiple residential development projects have increased the water runoff during heavy rains. This is the primary cause of flooding in Kajang (Bahrum & Malek, 2016). Intense development has also increased the percentage of impervious surfaces, overwhelming the drainage system and resulting in a large amount of surface runoff (Lee & Pradhan, 2007; Muhamad et al., 2015). The vulnerability of the community has increased due to intense development upstream of Kajang. The hilly areas upstream with increased surface runoff have overwhelmed the narrow river of the town and created a bottleneck resulting in flash floods. Extreme increase in precipitation due to climate change is expected to exacerbate the situation (Pereira et al. 2010). The identification of susceptible zones will enable identification of future flood zones so that appropriate measures can be taken to reduce the risk of flooding.

Reducing risk of floods

The MPKj and several related agencies have made numerous efforts to address the issue of floods over the years. Measures have been taken to reduce the impact of floods via upgrading of drainage and riverbank, river widening and building of floodwalls. Gross Pollutant Traps have been installed to trap solid rubbish draining into the river and retention ponds have been upgraded in the upper watershed. An early warning alarm has also been set up by the Department of Irrigation and Drainage to alert citizens of potential danger when a high volume of water is accumulated upstream of the town. The local community's preparedness and resilience has increased. They are more alert to take action and some residents have built their own flood and custom-made barricade structure to prevent flood water from entering their premises (Image 2).

Image 2: Infrastructure to reduce the impact of flood

These efforts seem to be effective as revealed by the reduction in inundated area in 2014 compared to 1999 (Figure 1). However, it is not known whether these measures will remain effective in the event of extremely high precipitation that could overwhelm the existing drainage system. A local level pilot study is being co-designed based on this preliminary case-study, involving SEADPRI-UKM, the local authority as well as state and federal agencies to determine such a scenario for the Kajang town.

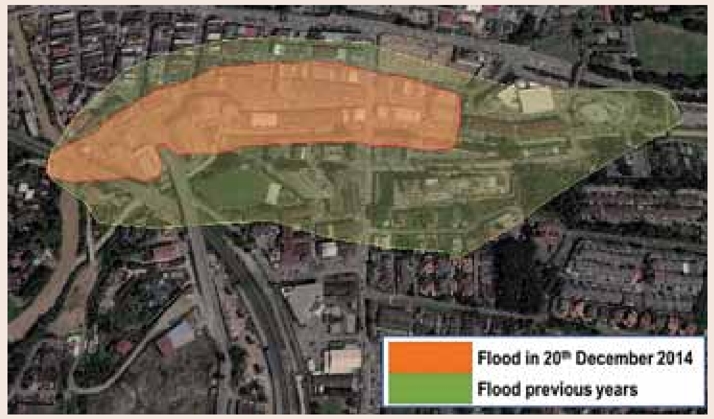

Figure 1: Coverage of flooded area in 2014 compared to previous years (Source: Muhamad et al. 2015)

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Co-Designing Disaster Risk Reduction Solutions

33. Groundwater Arsenic Contamination in Bangladesh; Surface Water Based River Sand Filter (RSF) is the Best Solution

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Richard Wilson, Department of Physics, Harvard University, Cambridge, USA

Groundwater arsenic contamination in Bangladesh is reported to be the biggest arsenic calamity in the world in terms of the affected population. According to survey data from 2000 to 2010, an estimated 70 to 80 million people in the country have been chronically exposed to arsenic in their drinking water in what has been described as the largest mass poisoning in history. In rural areas, 97% of the population relies on tube wells installed by the aid agencies such as UNICEF, WHO and others to spend a substantial amount of funds on sinking tube-wells in Bangladesh with the aim of providing safe drinking water for the country since the 1970s. Unfortunately, this has resulted in a population highly exposed to arsenic but with limited means or incentives for seeking safe water alternatives. Between 2000 and 2003, 4.94 million tube wells throughout Bangladesh were tested for arsenic and marked as safe or unsafe. Bangladesh are at risk of being exposed to arsenic concentrations that are greater than the national standard of 50 µg/litre and the WHO guideline value of 10 µg/litre respectively. The current recommended limit of arsenic in drinking-water is 10 µg/litre.

The success of the UNICEF-sponsored tube-well sinking policy has become a matter of anxiety because of the manifestation of chronic arsenictoxicity among the population resulting from prolonged consumption of arsenic contaminated groundwater and has emerged as a serious threat to public health in the country. The statistics available for the arsenic contamination in ground water indicate that 59 districts (around 85% of the total area of Bangladesh) and about 75 million people are at risk (Ali et al, 2003).The arsenic contamination is not only a health hazard for the people, it also affects the environment and creates social problems. The data collected by the governmental bodies, NGOs and private organizations reveal that a large number of populations in Bangladesh are suffering from melanosis, leuco-melanosis, keratosis, hyperkeratosis, dorsum, non-petting oedema, gangrene and skin cancer.

DCH Trust is the pioneer organization in the field of Arsenic in Bangladesh. It really deserves the sole credit for detecting the serious health hazards caused by arsenic contamination in ground water. DCH Trust found first arsenicosis patient at the health camp at Pakshi on 03 July 1996. Then through their continuous efforts, DCH Trust established this issue as a public health problem in Bangladesh. DCH Trust has undertaking research on arsenic with national and international research organization like –Harvard School of Public Health (HSPH), Harvard University (USA), Oregon State University (USA), South Australia University, Asia Pacific Alliance for Disaster Management (A-PAD), Mercy Malaysia and Jadevpur University (India).

DCH Trust implemented Community Based Arsenic Mitigation project and already installed several safe water options to the affected areas. Total number of population having arsenic free safe water, more than 100,000 People. A River Sand Filter (RSF) is one of them.

A River Sand Filter (RSF) is a simple effective system for treatment of river water. Its performance is dependent on proper operation and maintenance. Continuous availability of DCH ensured that proper maintenance and operation of RSF where installed. The large river having running water is suitable for RSF system where the water contamination usually low. The river water must be supplied after treating for microbes and bacterial levels must be reduced to safe standard to prevent diseases. The objectives of the study is to share with policy makers, researchers and investors who are at present interested in providing arsenic-free drinking water and lessons learned from the DCH River Sand Filters and to spread awareness of RSFs as an effective alternative water source in the arsenic-affected areas. DCH installed RSF is the main principal of Slow Sand Filter (SSF). Since the surface water is arsenic-free, the use of surface water immediately addresses the threat of ingesting high levels of contaminants (bacterial and microbes).The Bangladesh permissible level of faecal coliform is less than 10 per 100ml of water as bacteria grow rapidly in the surface water. The WHO and US permissible levels are zero faecal coliform per 100ml of water.

Materials & methods

Before designing the RSF installation, we (DCH researcher) studied several literatures at the http://www.who.int/water_sanitation_health/publications/ssf9241540370.pdf. We (DCH) first selected six villages in Sirajdikhan, 1 village in Bera and 1 village in Muradnagar where the arsenic concentration of ground water is very high. Then we selected the areas where the RSF is to be installed. For selecting the areas we consider that the villages located on the bank of the river, where the water is available throughout the year, the villagers probably had a high arsenic exposure. DCH encouraged participation for maintenance of the system which the villagers accept and share to maintain the system. We collected demographic and social economic data where the RSFs were installed. For maintenance of records, we collected and measured surface & supply water quality and standard. DCH formed a management committee for the maintenance of RSFs and provided a custodian responsible for supervision and maintenance of the system. The DCH custodian would be available for supervision, advice and maintenance of water quality at regular intervals.

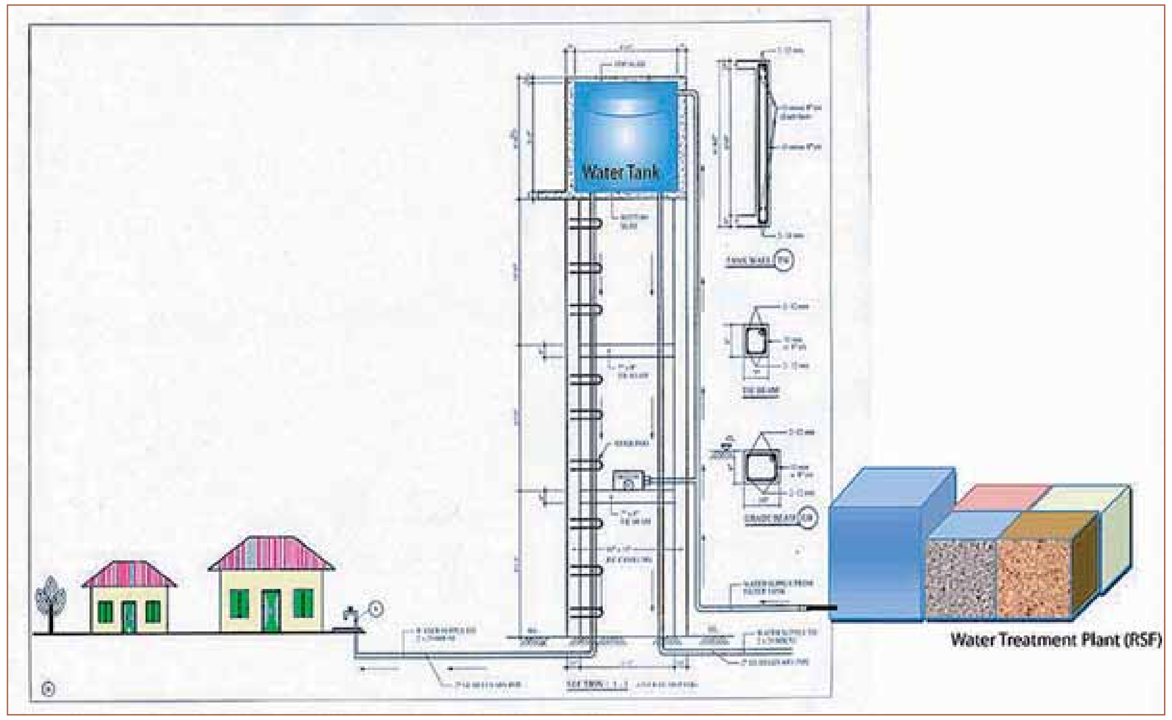

Figure: Design of the RSF System

Co-Designing Disaster Risk Reduction Solutions

After a year of installation the RSF would become the property of the villagers. Later with the experience of Sirajdikhan RSFs system, DCH also installed 2 more RSF in Homna and Muradnagar upazilas. There are two facts of the RSF designed by DCH which are unique and may account for its success. The core of the system is the use of four filters in series. Water from the river is collected first, and after passing gross filtering, is allowed to fall into a series of filter tanks in succession. This filter series is located below the final storage tank. Each of the filter tanks is filled with gravel or sand with steadily finer granularity to filter out the fine bacteria. Then, the water is pumped into a storage tank on top of a tower, which is another feature of the DCH design. Finally, the water is fed by gravity using PVC pipe by 30-60 taps to supply water in the villages. This obviates the often stated criticism that such a filter can only remove 95% of the bacteria If diarrhoea occurs among the users and water becomes turbid cleaning and chlorination of the filters is done by adding Clotech-NaOCl (Sodium Hypochlorite 5.25%) to the water in the overhead tank (0.3ml Clotech/litre). This is 0.0015 mg or 15 ppb of chlorine per 100 gms. The custodian keeps records of incidence of diarrhoea among the beneficiaries of RSF.

Conclusion

With our experience and from the River Sand Filters operating at Sirajdikhan, Bangladesh River Sand Filters could be an excellent source of safe water supply for the rural community of Bangladesh. The RSF is a very simple technology with very high efficiency and low turbidity bacterial removal procedure. It has received acceptance as a substitute water supply option in the arsenic affected areas of Sirajdikhan. We recommend these filters to the policy makers, researchers, donors, and investors who are now engaged in providing arsenic-free drinking water to the millions of people affected in Bangladesh.

34.

Investing in Strengthening Disaster Preparedness Capacity on Campus

Takako Izumi, Tohoku University, Japan

Initiatives and key issues addressed

Priority 2 of the Sendai Framework for Disaster Risk Reduction (SFDRR) is "Strengthening disaster risk governance to manage disaster risk" and encourages each stakeholder at the national, regional and global levels should initiate disaster risk governance for prevention, mitigation, preparedness, response, recovery, and rehabilitation.

Association of Pacific Rim Universities (APRU) jointly the International Research Institute of Disaster Science (IRIDeS), Tohoku University in Japan launched the Multi-Hazards (MH) Program in April 2013. It aims to harness the collective capacities of APRU universities for cutting-edge research on disaster risk reduction (DRR) and to contribute to international policy-making discussions to steadily improve DRR. One of the major activities of the MH program is the Campus Safety Program which supports universities to have sufficient disaster preparedness capacity. Universities have a responsibility to protect the lives of students, faculty, and staff in an emergency. To that end, they are required to invest and allocate funds for disaster preparedness. Universities need to retrofit older campus buildings, construct new buildings with anti-seismic structures, and ensure that they are equipped with tools and facilities such as satellite phones generators, emergency communication systems, and emergency stockpiles.

A survey on campus safety was conducted by APRU and IRIDeS among the APRU member universities and the result showed more attention is required especially to the area of risk assessment and early warning and alert systems as well as support for foreign students. In addition, it was found out that many universities had financial constraints, human resource challenges, difficulties in understanding the risks and safety issues, and a lack of faculty and staff participation.

In order to improve the above problems, it is recommended for universities to invest in the followings: 1. Commitment from university leadership and inclusion of any legal authorities governing emergency management; 2. Adequate funding to develop plans, purchase emergency equipment, and hire dedicated staff; 3. A dedicated emergency operations center staffed with appropriate staff who have been trained; 4. Training exercises with staff and leadership; and 5: Mutual aid partnership with local entities outside of the university.

Description regarding the participatory co-design process

The APRU MH Program established a working group for the campus safety program that consists of the representatives of the following universities: Chulalongkorn University, Florida International University, National University of Singapore, Osaka University, Tohoku University, the University of Sydney, and University of Philippines. In addition, the campus safety program put a focus on collaboration with local organizations and communities as the preparedness capacity of universities has a huge impact on the safety and security of human lives and property, even on communities and universities. Universities are tasked ultimately to contribute broadly to society; therefore, it is important for universities to work together with local organizations and communities in case of emergencies as a part of the community. It is recommended to have discussions in advance on their possible partnership for disaster management, integrate a university emergency management plan with local and regional plans, as well as conduct joint response/recovery activities providing volunteers and technical experts.

Details about the contribution of academic community

A whole community approach to emergency management has been strongly advocated by the Federal Emergency Management Agency (FEMA) to understand and assess the needs of respective communities and determine the best ways to organize and strengthen their assets, capacities, and interests. It requires all members of the community to be a part of the emergency management team, which should include diverse community members, faith-based and disability groups, academia, professional associations, and the private and nonprofit sectors while including government agencies. As a part of the community, the initial responsibility of universities should ensure safety on campus to protect the lives of students, staff, and faculty as well as various institutional assets and to provide necessary support to local governments and communities in case of emergencies. The Campus Safety Program assists in achieving the goal of a whole community approach.

Proposed methods to disseminate results

APRU is a university network of 45 universities in 17 countries in the Pacific Rim (www.apru.org). The APRU and its MH program intend to play a key role in promoting and advocating for necessary initiatives for disaster management at the university level. At the same time, the MH program has been working on highlighting the importance of disaster preparedness on campus in international and regional policy documents to raise the awareness on the issue. For instance, its importance was included in the conference outcome documents of the first Asian Science and Technology Conference for DRR held in Bangkok on 23-24 August 2016. It is recommended under Priority 2 "to develop inter-disciplinary national science and technology plans to support implementation of the SFDRR. This includes actions by academia/universities to develop their own disaster risk management plans".

Contact

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35.

Revival of Himalayan Springs as a Climate Change Adaptation Initiative in Sikkim

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Climate change has an accelerated impact on the fragile Himalayan ecosystem. Sikkim is one of the smallest, highest and steepest states located in the northeastern part of India. It is also the first organic and environment friendly state of the country. With impacts of climate change on precipitation patterns such as rise in rainfall intensity, reduction in its temporal spread, and a marked decline in winter rain, coupled with other anthropogenic causes, the problem of water scarcity is being increasingly felt across this Himalayan region. While the rivers and glaciers play a vital role in ensuring water security in the densely populated lowlands, the mountain people mostly depend on the vast network of rain and snow-fed springs and streams. However, traditionally, the glaciers and rivers have received widespread attention, while the springs and streams are largely unstudied. The hydrological significance of the mountains has largely been assessed from the lowland perspective. The mountain people residing in remote, rural areas are marginalized and face the threat of declining discharge of these springs and streams.

The natural groundwater recharge in mountains depends on various factors such as rainfall pattern, vegetation cover, soil status and degree of slope. The average recharge is typically 10-15 percent, while the rest flows down as surface runoff and causes soil erosion, landslides and flash floods. With reduced natural recharge, the springs are drying up rapidly in post monsoon months, with the lean period discharge declining alarmingly. This drying up of springs caused water scarcity and drought like situation in many villages in the lower belt of south and west districts of Sikkim. Women were affected the most as they had to travel longer distances to fetch water uphill, which increased their workload and compromised their ability to perform other essential and livelihood functions (Image 1).

In order to address this growing threat, the Rural Management and Development Department, Government of Sikkim conceptualized and piloted the Dhara Vikas initiative in the year 2010 with an objective to revive critical springs and streams with funding support from MGNREGA national flagship programme. Using a science based and people centric approach, activities related to enhancing the ground water recharge contribution of spring shed and hill top forests was undertaken. This initiative also partnered with other line departments, NGOs (PSI, WWF, ACWADAM etc) and other national (BARC, Department of Space) and international agencies (GIZ and UNDP). The project was geographically targeted based on a fine scale, vulnerability assessment study. Initially few village panchayats were selected from Kaluk, Rhenock, Sumbuk, Jorthang and Namthang blocks. The project attempted to reduce runoff, increase infiltration and enhance the ground water recharge. A landscape level approach was adopted to recharge the common aquifer which fed several springs. Using geohydrology approaches, the recharge area is identified and trenches and ponds were dug covering 637 ha of sloping land (Image 2). The impacts of this initiative to revive 51 springs and 4 lakes in 20 drought prone Gram Panchayats is showing promising results (Image 3). The night flow from these springs is being stored in hundreds of household and community level water storage tanks which have been specially constructed for this purpose (Image 4).

Co-Designing Disaster Risk Reduction Solutions

Teams from WWF Nepal, Bhutan Government, and other mountain and northeastern states have visited Sikkim on exposure visits to learn more about this spring revival initiative and implement similar programs in their respective states. Hence, this initiative has helped in impacting national policy and the sharing of the learnings has benefitted other mountain regions as well. It has the potential to be upscaled and mainstreamed in ongoing watershed, water supply, afforestation and climate change adaptation programs in the Himalayan region.

Image 1: Due to drying up of springs, women are most affected and have to travel long distances to fetch water uphill

Image 2: Digging of ponds and lakes in the recharge areas helps to trap the surface runoff and supplement the natural ground water recharge

Image 3: Revival of lakes which also feed the downstream springs

Image 4: The night flow from these springs is stored in household tanks

Acknowledgement

Due acknowledgement to the Department of Rural Management and Development, Govt. of Sikkim for providing us all reports and pictures. The state Government got several award for this project and it is well documented by the RM&DD. Details of 700 springs are available on www.sikkimsprings.org.

36.

Mainstreaming Disaster Risk Reduction into the Construction Sector in Bangladesh

Zobaer Ahmed, Friendship (NGO)

Disasters have an enormous impact on development. With every disaster, there is a significant impact on various sectors of development like agriculture, construction, health, education and infrastructure. This results in a serious social and economic setback to the development of the developing countries, and poses a threat for achieving the Millennium Development Goals (MDGs). On the other hand, the process of development, and the kind of development choices made in many countries, sometimes creates disaster risks. A close analysis of the development process with its six aspects namely policy, strategy, programming, project/program cycle management, external relations and institutional capacity; clearly argues for the need of systematic and more conscious ways of integrating disaster risk reduction (DRR) into construction sector in Bangladesh.

Construction sector in Bangladesh

The construction decision-making process requires an in-depth integrated understanding of how to avoid and mitigate the effects of emergencies and disasters (Hamelin &Hauke 2005; Bosher et al 2006). In order to be effective, such resilience needs to be systematically 'built-in' to the planning and design processes and not simply added on as an afterthought. However, it is unclear whether this is being achieved in Bangladesh.

Some advances have been made in recent years to incorporate the roles of construction professionals into debates regarding topics such as climate change and sustainability. However, the integration of construction professions with processes associated with Disaster Risk Management (DRM) has largely been ignored (Spence and Kelman 2004). Thus, although many disasters are not entirely unexpected and can be mitigated for, it is reasonable to hypothesise that at present, the construction sector in the Bangladesh does not play a sufficiently integrated role in DRM.

Disaster Management Bureau (DMB) under the Ministry of Food and Disaster Management, Government of Bangladesh which is a member of the RCC, had expressed interest in initiating mainstreaming DRR into Construction sector in partnership with all concern Ministry. Accordingly in the second half of 2008, the Priority Implementation Partnership (PIP) was initiated by DMB with technical support from Asian Disaster Preparedness Centre (ADPC) and with financial support from Australian agency for International Development (AusAID).

Construction sector is poised to emerge as a new growth engine in Bangladesh, which now thrives on the US$ 20 billion garment sector and $ 14 billion annual inflow of remittances from millions of expatriate workers, said the Economist Intelligence Unit (EIU) of The Economist.

Despite infrastructural development in villages and persuasion against migration to cities from rural areas, thousands of people are moving to the capital Dhaka regularly. Besides rapid population growth and quick urbanization there are several other reasons behind the boosting of the construction sector of the country, which has now become one of the 40 largest cement markets in the world, according to the EIU.

Co-Designing Disaster Risk Reduction Solutions

Due to the rapid increase in the construction sector among the Bangladesh, many natural events threaten this sector every time. The Government of Bangladesh is now trying to mitigate disaster by adopting new strategies. The importance of reducing the impact of these hazards on the construction sector is increasingly being recognized by the Government of Bangladesh and accordingly the National Physical Plan calls for adoption of non-structural and structural mitigation measures in the planning and implementation of development activities and the Draft National Disaster Management Plan highlights the importance of hazard resilient construction and revision of building codes for reducing disaster risk.

Priority Implementation Partnership (PIP) - mainstreaming DRR

Similar to other countries, the construction sector in the Bangladesh functions in the close collaboration of various agencies such as Ministry of Housing, Ministry of Public Administration & Home Affairs, Ministry of Local Government and specific Departments within various Ministries such as Coast Conservation Department (CCD), National Planning Department (NPD), National Physical Planning Department (NPPD), authorities such as National Housing Development Authority (NHDA), Central Environmental Authority, Urban Development Authority (UDA) and Bangladesh Association of Construction Industry (BACI). Each of these agencies has a specific role in the process of planning, designing and approval of housing units. For example, while the approval for construction of individual housing units in urban and non-urban areas are under the jurisdiction of Municipal councils, Urban councils or local authorities, relevant prior approval is required from the Urban Development Authority (if the site is located in urban declared areas), Coast Conservation Department (if the site is located within the coastal zone).

In addition, though the implementation of the large scale public sector construction programmes are based on annual work plans of individual Ministries with funding available from the treasury of external agencies, during the feasibility stage of these large scale projects, Environmental Impact Assessment needs to be undertaken. Thus in order to mainstream DRR in the process of planning, design and approval of construction sector, DRR needs to be integrated in the task of each of these agencies.

Major risk identified in construction sector

- Lack of clear planning authority
- Unenforced building codes
- Low professional standards
- Poor land use

Understanding the development process in Bangladesh this activity mapped out the various stages in the development of a housing program, identified the stakeholders involved in each of the stage, and listed their roles and responsibilities, scope of tasks undertaken and issues and challenges in the integration of DRR in their respective work area.

Thus, with the advancement in building construction technology and fastest growing numbers of construction sites, need for proper attention with regard to safety aspects is becoming an important issue. In this connection, appropriate national policy steps are needed to improve the safety conditions in building construction sector so that the loss of limbs and life sufferings resulting from faulty construction practices can be prevented. In other words, improvement in safety measures in sites and strict implementation of the safe detailed design as per BNBC can provide a better environment for building construction and increase higher productivity.

Contact

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37.

The Reduction of Disaster Risk Emergency Preparedness & Safety Aspects

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Disaster risk reduction on child-centered

1. Mostly affected age group from disaster is 10-14years of children.
2. Children are vulnerable parts of society thus need to be focused and saved.
3. Strong children are the key of strong nation in future.
4. Schools are the second home for children. So, the school safety is also very much necessary.
5. Selection of the safe site should be pre planned so that whenever disaster takes place the school children can be protected.
6. Government should have proper plans for child protection like sexual abuse, malnutrition etc because whenever disaster occur these problems comes into picture at a rapid rate.

Emergency preparedness & safety practices

1. Safety Park should be developed and designed as an area designated for reinforcement of safety knowledge of our work force through visual display of safety related aspects.
2. The requirement was for creating model based safety Knowledge Park depicting various hazards present in the refinery in working safety and providing model based safety training to employee & contract workmen with goal of zero incidents.
3. Safety culture improvement project named 'seed' – safety in each & every deed' which contains following programs in it Safety observations visits(SOV), Safety actions meetings(SAM), Process safety managements(PSM), Contractor safety managements(CSM) and Incidents investigations(II).

Risk reduction & safety aspects

1. Safety at all levels should be our first & foremost concern and is top driven at all our units/ installations. All safety systems & procedures are reviewed & updated from time to time and compliances are ensured.
2. Up-gradation of safety technology is a continual process.
3. Job Safety Analysis for critical jobs and also the Strengthening supervision of contractor jobs.
4. Adherence to safety systems and procedures. Deviations, necessary, if any, are approved by competent authority and documented.
5. Near miss incidents are being reported.
6. Use of PPEs by all personnel is being ensured.
7. Safety training including live fire training is imparted to all personnel.

Industrial disaster management

1. Awareness of the people regarding the industrial hazards.
2. Preparedness of the people regarding industrial hazards in the area.
3. Government and other stakeholders' efforts in risk mitigation and preparedness.
4. Difference in caste, native place, and duration of stay, membership in social and informal groups, and status of education, condition of health, source of income, self-confidence and confidence in the community do influence the interest in industrial hazards.
5. People with higher educational qualifications like graduates and above have shown greater interest in industrial disaster management.
6. The status of health of the respondents does play a major role in interest for industrial disaster management.
7. Salaried people have shown greater levels of preparedness and awareness on industrial disasters, there is great scope for more local people to be employed in the industrial activities.
8. Educational level of the respondents positively affected awareness and preparedness of the people. Hence there is scope for interventions in this sector.

Emergency response on disaster management plan certification

1. Typical failure modes in line with Risk Analysis Report to be incorporated.
2. Other possible emergencies like incident causing shutdown of operations on account of fire/ explosion/leakage, incident leading to reportable injuries & fatalities within plant/location premises, various minor incidents etc. to be categorized under Level I & II.
3. Response Action plan to be incorporated in ERDMP for each major scenario.
4. Preparation always increases the margin of safety in an emergency.
5. If assignment & responsibility are well define in EAP, and then Response always is fast.
6. If the information & resources are well provided in EAP, then Recovery always is fast.

Drought management

1. Almost forty million children less than five years of age, in the rural areas of the eight states visited are currently under the throes of drought.
2. If the situation is not addressed in time, these children may lead an under-developed life in years to come.
3. School dropout cases have marginally increased while absenteeism has been reported as adult children migrate with their families. However loss of school days due to increased seasonal migration could not be worked out as the schools don't have a system to capture the seasonal absenteeism.
4. Children however seem to be benefitted from attending the school, even during vacations due to the extended mid-day meals and a conductive atmosphere.
5. State Drought Manuals and SOPs integrating empowerment of water regulatory authorities, implementation of groundwater.

Flood management

1. Enumeration and identification of beneficiaries for relief assistance to be initiated as soon as possible through the Government or Government ordered NGOs.
2. System strengthening for mitigating risk and managing causalities/epidemics before, during and after emergency for health facilities and health department.

3. Mapping of flood prone areas in the State.
4. Develop proper Early Warning Systems.
5. Disseminate awareness messages amongst communities on does and don’ts during floods.
6. Plan and develop proper drainage system in flood affected areas.
7. Developing DM Plans with defined SOPs department wise and mock drills.

Certification of disaster management plans

1. To identify sectors in which DMPs to be prescribed.
2. Develop requirements for DMP – international best practice – multi stakeholder committees – subject experts – propose DMI to provide secretariat.
3. Decide on inspection or certification model.
4. Develop inspection/certification process.
5. Requirements for inspection/certification agencies.
6. NABCB ready to take on work of inspection/certification system.
7. Time needed – 6 months to one year depending on complexity of sector.

Risk reduction in hazardous industries

1. Replacing the hazardous chemicals with less hazardous / green chemicals.
2. Safe methods of storage and handling.
3. Reducing the storage quantity of the Hazardous chemicals.
4. Appropriate siting and layout for safe and secure operation.
5. Predictive and Preventive maintenance.
6. Safe Design, adopting latest Detecting and Alarm systems.
7. Developing effective safe / standard operating procedures and training the workers.
8. Well planned emergency / disaster management plans
9. Well trained emergency handling personnel.

Chemical disaster management

1. Manufacturing and formulation installations including during commissioning and process operations; maintenance and disposal

2. Material Handling and storage in manufacturing facilities and isolated storages, ware houses and go downs including tank farms in ports and docks and fuel depots.

3. Transportation-Road, rail, air, water and pipelines.

Chemical disasters may occur due to process deviations concerning the chemistry of the process, pressure, temperature and other identified parameters, with regard to the state of the substance i.e. solid, liquid or gas, proximity to other toxic substances and the probability of a runaway reaction due to incidental mixing of two or more hazardous chemicals with dissimilar properties. It may be due to equipment failure, safety valve failure, foundation failure, material failure and any hard ware failure resulting in large scale spills of toxic substances due to loss of containment or an explosion.

Contact

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38.

Indonesian River Restoration Movement (Gerakan Restorasi Sungai Indonesia)

Agus Maryono and Team, Faculty of Engineering, Gadjah Mada University, Yogyakarta, Indonesia

Detail about the initiative and key issue addressed

The Indonesian River Restoration Movement (IRRM) is a long run community based project (movement or activity) to restore rivers, keeping rivers clean, healthy, productive and conserved. The objective is to develop community and stakeholder responsibility and participation in river restorations. The project is run with network approach involving communities, people, groups, NGOs, universities, private sectors, local & national government and organized through social media. The movement initiated in Yogyakarta in year 2014. Growing steadily from only 6 river communities to more than 22 in 2016, with the most rapid growth experienced within last 2 years. Various activities initiated are mainly in the fields of maintaining the ecological, morphological and hydrological conditions of the river by communities. The results are some rivers in the IRRM branches are relatively clean and protected. This movement project will continue until all rivers in Indonesia are clean and each river has a river community.

The river restoration movement is stressing on the participation of the communities living near the rivers (river community). The river communities learn river restoration from university lecturers, experts, volunteers, media and also internet. They create several activities (clean up the river from garbage regularly, planting the river riparian, cultural events, talk shows, economic activities, etc.). Those activities can develop the community into a sustainable society. The objective and target of this project are: 1) to improve the knowledge and practical skill of the community related river restoration, 2) to increase the participation and responsibility, 3) to improve the number of the field activities for river restoration, social and economic development. 4) Reaching the target in 2016, every province has at least one active River Community and by 2020 river in the cities and villages in Indonesia 75% are relatively clean and health and protected by community.

Description regarding the participatory co-design process

Indonesian River Restoration Movement (IRRM) or “Gerakan Restorasi Sungai Indonesia” is a network organization in which Gadjah Mada University acts as the first secretariat or host of this movement. In 2016, IRRM has 24 network branches: Each network branch has its own organization and some sub branches ranging from 2 to 7 groups. The members of IRRM Network Organization are lecturers, communities, local and national government staffs, professionals, NGO members, etc. The institutional network members of IRRM are universities, ministries, national councils, private sectors, NGOs, etc. Communication and coordination of activities between branches and sub branches are maintained through social media mainly Whatsapp, Email, Facebook, etc.

Co-Designing Disaster Risk Reduction Solutions

Details about contribution of science technology

The IRRM project involves society and community groups with the focus activity to restore rivers and their ecological environment. River is an asset for the region, so the communities can create environmental friendly economic activities such a culinary on river sites, plantation, fisheries, river tourism, rafting, tubing etc. For their role as river keepers, the communities learn about several subjects: *river ecology, hydrology, and morphology*. Since their activities are based on social activities, they will learn about social interaction, regulation, and institution and network development.

Through such activities the members of the river community will get more and more information and experience in relation to river restoration and environmental friendly river utilization. Communication with lecturers and experts assure their knowledge development, which will improve their capacity and ability with time. Therefore, this movement creates a sustainable development: the society and community restores and keep the river clean and healthy, they gain good quality of water, can use the river for environmental friendly economic activities, and increase their knowledge. Successful and significant results of the restoration activities have and will encourage those communities and spread the movement.

Proposed methods to disseminate

The Indonesian River Restoration Movement is an innovative action. This community based movements builds on the spirit of "love and togetherness" with clear goals and numerous innovative activities (including culture and socio-economic) to restore and preserve the river and environment. So that the river can be used as a sustainable asset and environment, and the rivers remain clean, health, productive and conserved by community.

This organization is based on systemic thinking; it covers all environmental elements, stakeholders are actively involved and their roles are appreciated, the interests are accommodated, the weaknesses are understood, the strengths are respected. This is an innovative way of management and results in a harmony between nature and human as a foundation of sustainable development. The network organization implemented for IRRM is an innovative approach. The results are IRRM spreads rapidly, the flexibility and independence of each group in creating innovation is high. Usage of social media as the main means of communication speeds up the movement, support the information exchanged on a real time basis, decrease the use of paper, etc. This not only supports environment sustainability but also promotes the rapid development of the River Restoration Movement in Indonesia.

To develop and expand the River Restoration Movement, we would like to continue by: developing *"River School"* in many places, invite more young people to join river communities, support river community leaders to be trainers and motivators and prepare modules, books, films, etc. The IRRM budget depends on the activities of the communities. Full authority is given to each branch to collaborate with local/national government, private sectors, etc. in raising financial support.

Co-Designing Disaster Risk Reduction Solutions

39.

Disaster Risk Assessment as a Tool to Establish Targeted, Sustainable and Transdisciplinary Multi-Stakeholder Disaster Management Governance Structures

Matt Dorfstaetter, State government Queensland, Australia

Transdisciplinary multi-stakeholder disaster management governance structures can be seen as a foundation for adequately preparing for, responding to and recovering from the negative consequences of disasters. This case study outlines how a typically output-focused risk assessment process can be widened in scope, to foster stakeholder empowerment, create risk expertise and drive stakeholder commitment for sustainable disaster risk reduction solutions.

In 2015, Emergency Management Victoria (the central agency for disaster management in the State of Victoria, Australia) was leading the State through significant shifts in disaster management policy. One particular shift was concerned with moving from a regional, single-hazard disaster management focus (bushfire) to an all-hazard encompassing, risk-based and sustainable disaster risk management focus. This shift needed to be supported by scientific risk expertise, multi-stakeholder collaboration, new governance arrangements and most-importantly, a robust process to lead stakeholders through this change. The key challenge of this initiative was creating a participatory environment, where stakeholders from all sectors (academia, industry, government and business) would be enthusiastic enough, to participate on a voluntary basis, contribute to disaster risk assessments, and take ownership of identified risks, in order to produce sustainable management in future years to come.

The decision was made to utilise a participatory, co-designed, regional disaster risk assessment process (the Process) as a *'tool'* to foster stakeholder collaboration and create regional disaster risk knowledge, as starting point for disaster risk reduction solutions. The Process methodology encompassed multiple stakeholder engagements by conducting surveys, 17 workshops and targeted research. Over 200 participants from more than 50 stakeholder groups were engaged with representation from academia, industries, government and businesses. The Process commenced with a thorough environmental disaster risk scan, identifying key stakeholder groups, gathering regional expertise and preparing information for various engagement activities. During various stages of the Process, stakeholders determined regional focus areas, steering the disaster risk assessment and co-designing the Process on the way. Following on from the determination of regional disaster risk levels and high priority focus areas, key stakeholders formed regional disaster risk management committees, in order to ensure a sustainable approach to manage transdisciplinary multi-stakeholder disaster risk reduction activities.

The following sections, elaborate on some of the key design principles of this initiative.

Driving outcome-focused processes

The Process had to be designed significantly differently from a conventional output-focused disaster risk assessment process. It was designed in a way which ensured that stakeholders were empowered, risk-knowledge was created, accountabilities communicated and disaster risks adequately managed. The common misconception of *"disaster risk assessment being a one-off activity, with the establishment of a risk register as criteria for success"*, had to be replaced by a notion of an *"ongoing commitment to work collaboratively on disaster risk reduction"*. This notion had to be supported by process elements, where stakeholders identified for themselves the beneficiary aspects of working collaboratively towards a shared outcome. This was achieved by clearly understanding and leveraging of organisational drivers for disaster risk reduction. By doing so, various high level outcomes were formulated, which were used throughout the Process, to highlight the importance of individual and organisational contribution.

Reducing complexity in a transdisciplinary multi-stakeholder empowerment

Communicating the value of disaster risk is very complex, as risk itself presents something unreal, by relating to random change and possibility (Cardona, Hurtado & Chardon, 2003). This very nature of disaster risk has to be taken into account when aiming for any collaborative disaster risk reduction effort. A healthy balance of sophistication, proportionate to the stakeholders' appetite for the disaster risk reduction, needed to be found. Stakeholders need to feel comfortable with the Process to ensure that they can contribute and enrich the outcomes of an initiative. It was necessary to reduce the amount of risk information provided to stakeholders as workshop input, if this ensures that the majority of stakeholders remain engaged and are therefore able to follow the conceptual risk assessment framework.

Identifying power dynamics within your stakeholder group

The power dynamics within the stakeholder group need to be clearly recognised in order to manage risk workshops appropriately. All types of power can serve as a resource for collective action (Wilkinson, 1991), hence the identification of power structures, provides a basic understanding for how the collaborative co-design process can be managed effectively. This knowledge can be utilised to embed mechanisms to draw or suppress such dynamics for achieving risk reduction solutions.

Fostering a transdisciplinary multi-stakeholder empowerment

The nature of disaster risk obliges a collaborative effort to manage its risk adequately. Empowered stakeholders need to have the capacity to understand disaster risk and accept responsibility in order to implement initiatives (AIMI, 2013). It is vital that stakeholders join forces, fully recognising the value of their own contribution, that of others and the overall benefit of the risk reduction initiative, for their organisations and the broader community. The interdependency of academia, science, technology, industry, government and community was clearly communicated to every stakeholder involved, by designing disaster risk scenarios emphasising the shared responsibility for disaster risk management, while highlighting clear organisational accountabilities. This allowed stakeholders to see the mutual benefits, which enhances the outcomes of the designed disaster risk solution.

Communicating the 'common ground'

The clear communication of the 'common ground' ensures that stakeholder participation and motivation levels are high. The common ground of disaster risk assessments can be found in focusing on the *'consequences'* of disaster risk, rather than the hazard (as cause of the consequences). In Victoria, disaster management legislation focuses on the management of certain hazards (or aspects of it). During the risk assessment workshops, it can be contra-productive to focus on hazards, as this focus would naturally lead workshop participants to think in organisational responsibilities. The reduction of negative disaster consequences represents a shared interest between organisations which have community safety as a policy priority. A common ground is the basis for people to establish rapport with each other, acknowledging disaster risk management interdependencies.

Concluding remarks

The utilisation of disaster risk assessments as a *'tool'* for co-designing disaster risk reduction solutions at a regional level, proved to be good practice. This case study illustrates that disaster risk assessments can be designed in a flexible manner, encouraging transdisciplinary multi-stakeholder groups, to co-design the assessment process. Providing the highest level of freedom possible to stakeholders, encourages individuals to not only participate, but determine the direction of disaster risk reduction solutions. Those stakeholders that created the disaster risk assessment outcomes are those who have a vested interest in managing disaster risk. They form a community of interest, a combination of non-exclusive groupings, sharing certain cultural beliefs and practices (Gordon, 2004). Viewing disaster risk management stakeholders as a community, emphasises that disaster risk management governance structures need to be flexible, as disaster risk management governance structures are fluid, subjective and conceptual by nature. It is important that a sustainable disaster management governance structure is undergoing a continuous adaptive management process, ensuring that it reflects the actual underlying disaster risk. A disaster risk assessment can serve very well to determine disaster risks, empower stakeholders and set up adequate disaster risk governance arrangements. By focusing on the outcome, rather than the output of the assessment, transdisciplinary multi-stakeholder groups are taken on a journey to continuously collaborate towards embedding disaster risk solutions.

Note and contact

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Co-Designing Disaster Risk Reduction Solutions

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Regional Innovation Forum Asia (RIF-Asia) - Multi-sectoral Collaboration to Solve the 'Unsolved'

Takeshi Komino, Asian Disaster Reduction and Response Network (ADRRN); CWS Japan

Details about the initiative and key issues addressed

The Asia-Pacific region is home to 40 per cent of all natural disasters and 84 per cent of people affected by natural disasters worldwide. With the region facing such a magnitude of humanitarian and development challenges, there is need for innovation and collaboration to 'solve the unsolved'. RIF-Asia is a creative forum for fostering multi-sectoral partnerships to "solve the unsolved" problems that are hindering disaster risk reduction (DRR) and humanitarian efforts in the Asia region. RIF was designed to bring together local practitioners and thought leaders from countries across the region to identify and develop solutions to challenges from the field and showcase some of the region's key innovation practices. RIF-Asia aimed to provide a facilitated space to develop innovative solutions to regional challenges through collaboration between partners from civil society, the private sector, government and academia. The goal was to generate specific innovation projects – and the partnerships that will bring them to reality.

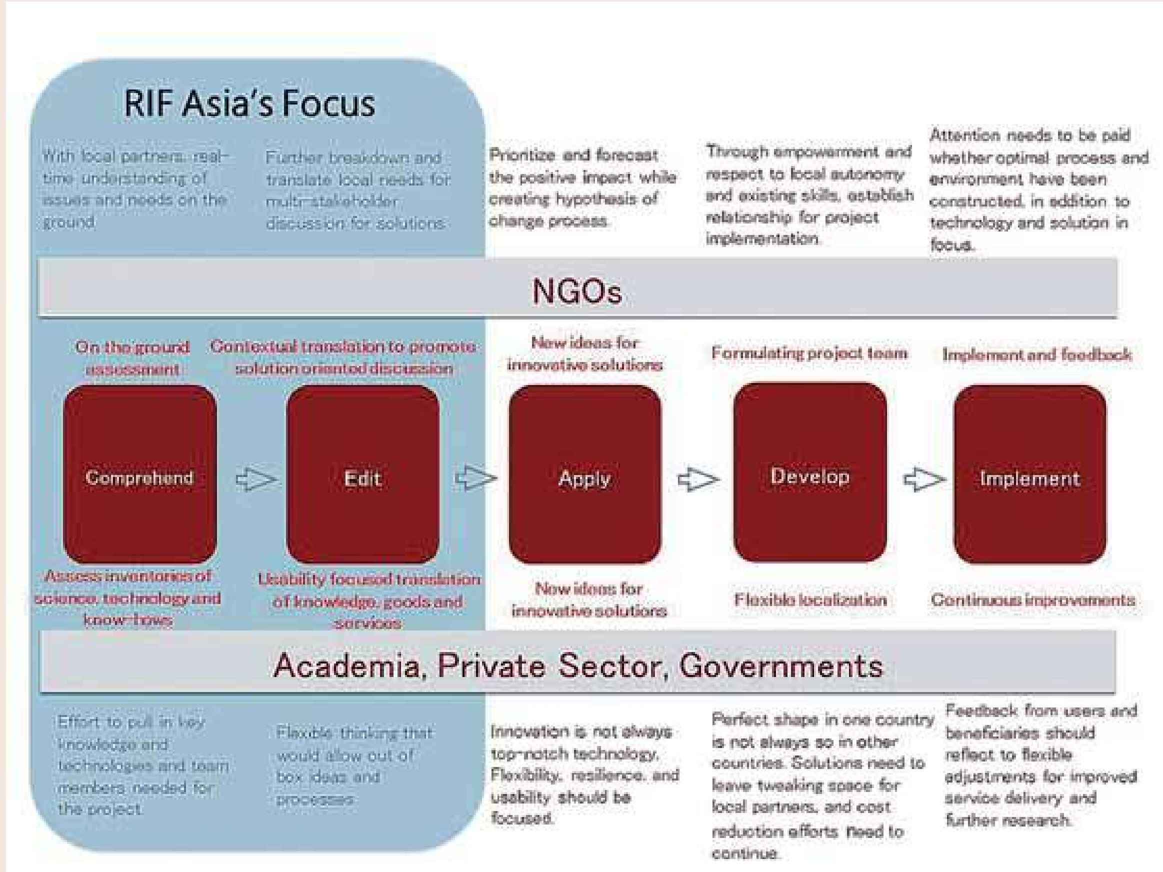

Figure: Bottom-up innovation process and RIF-Asia's area of intervention (ADRRN, More Impact)

Description regarding the participatory co-design process

ADRRN along with UNOCHA (ROAP), IRDR, More Impact and UNDP came together to organize first ever Regional Innovation Forum (RIF) to discuss various issues within humanitarian and developmental sector based on the pre decided themes. Two day facilitated discussion was organized on 6th and 7th December, 2016 in Bangkok with the main objective of identifying key innovative ideas which can be taken up based on the key challenges faced by communities in various countries where ADRRN members are present. ADRRN secretariat team started discussion with various members to share some of the key challenges faced by them for their ongoing work with communities in various countries within region. Based on the details shared by various members and partners we finalized four themes which requires immediate attention for humanitarian sector as well as solving some of the long term developmental issues. Four themes are as given below:

- Theme 1: Localizing disaster risk reduction. How to maximize the ownership for more impact?
- Theme 2: Stay or relocate? Solutions for communities living with high recurrent risks.
- Theme 3: Safe water for all. Is filtering an only option? Addressing root causes.
- Theme 4: Alleviating malnutrition during disasters. Is reducing the need possible?

RIF-Asia was designed as a bottom-up, problem-first innovation discussion forum where stakeholders from different sectors gather to co-create solutions together.

Details about the contribution of the science technology or academic community

Science and technology stakeholders were well represented at RIF-Asia. IRDR presented the current research going on about the innovation from academia as well as why innovation is needed to solve some of the challenges in humanitarian and developmental space. Particular focus was on science innovation and its application: the missing link. Thammasat University also presented innovation case study on urban resilience; a board game which they have developed for Bangkok city based on the current and future risk of the city due to hazards and climate change. Along with various partners they have developed an innovative board game for process innovation for multi-stakeholder engagement and collaboration. Social resilience is key to urban resilience and societies living in urban areas need to have knowledge on “changes”, forecast future risk (under uncertainties), risk dynamic (space & time, assess risk by different scenarios & with holistic view to take decision informed decision based on current and future risks. It is clear that academia plays an important role in such solution-oriented innovation discussion and the process encouraged further partnership between NGO/UN, corporate, and academia.

Proposed methods to disseminate results

RIF-Asia is proposed to be an annual forum where solution oriented innovation discussions take place, and concrete innovation projects stem out from. As a mean to accelerate multi-stakeholder collaboration on DRR and humanitarian innovation, RIF-Asia 2017 will be planned in latter part of 2017.

Contact

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