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ICT FOR DISASTER RISK REDUCTION

UNITED NATIONS APCICT-ESCAP

ICT FOR DISASTER RISK REDUCTION

Asian and Pacific Training Centre for Information
and Communication Technology for Development (APCICT)

ICTD Case Study 2

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ICT for Disaster Risk Reduction

United Nations Asian and Pacific Training Centre for Information
and Communication Technology for Development (UN-APCICT/ESCAP)

Issue 2: ICT for Disaster Risk Reduction

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Acronyms

AADMER	ASEAN Agreement on Disaster Management and Emergency Response
Academy	Academy of ICT Essentials for Government Leaders
AHP	Analytic Hierarchy Process
APCICT	Asian and Pacific Training Centre for Information and Communication Technology for Development
ARC	Alert Retrieval Cache
AREA	Addressable Satellite Radios for Emergency Alerting
ASEAN	Association of Southeast Asian Nations
AVA	APCICT Virtual Academy
BAKORNAS PB	National Coordinating Agency for Disaster Management, Indonesia
BMD	Bangladesh Meteorological Department
BNPB	National Disaster Management Agency, Indonesia
BRR	Aceh-Nias Rehabilitation and Reconstruction Agency
BTCL	Bangladesh Telecommunications Company Ltd.
BTRC	Bangladesh Telecom Regulatory Commission
CAP	Common Alerting Protocol
CB	Cell Broadcasting
CBDRM	Community-based Disaster Risk Management
CBO	Community-based Organization
CDMP	Bangladesh Comprehensive Disaster Management Programme
CFP	Community Focal Point
CNO	Centre for National Operation, Sri Lanka
CO	Country Office, UNDP
CPP	Cyclone Preparedness Programme, Bangladesh
CRED	Centre for Research on Epidemiology of Disasters
CTEC	Community Tsunami Early Warning Centre
DAD	Development Assistance Database
DDPM	Department of Disaster Prevention and Mitigation, Thailand
DEM	Digital Elevation Model
DFID	UK Government's Department for International Development
DMB	Disaster Management Bureau, Bangladesh
DMC	Disaster Management Centre, Sri Lanka
DMIC	Disaster Management Information Centre, Bangladesh
DRR	Directorate of Relief and Rehabilitation, Bangladesh
DRR	Disaster Risk Reduction
ENSO	El Niño-Southern Oscillation
EOC	Emergency Operation Centre
ESCAP	Economic and Social Commission for Asia and the Pacific
ETC	Emergency Telecommunication Cluster
EWS	Early Warning Systems
FOSS	Free and Open Source Software
GDACS	Global Disaster Alert and Coordination System
GDP	Gross Domestic Product
GEO	Group on Earth Observations
GEOSS	Global Earth Observation System of Systems
GIS	Geographic Information Systems
GLIDE	Global Identifier Number
GoB	Government of Bangladesh
GoTN	Government of Tamil Nadu, India
GPS	Global Positioning System
GSMB	Geological Survey and Mines Bureau, Sri Lanka
HFA	Framework for Action
HIH	Hazard Information Hub, Sri Lanka
IARU	International Amateur Radio Union
ICRRP	Inventory of Community Risk Reduction Programme, Bangladesh
ICT	Information and Communication Technology
ICTD	Information and Communication Technology for Development
IDRN	India Disaster Resource Network
IFRC	International Federation of Red Cross and Red Crescent Societies
ITU	International Telecommunication Union
LAN	Local Area Network
M/DM&HR	Ministry responsible for Disaster Management and Human Rights, Sri Lanka
MDG	Millennium Development Goal
MoFDM	Ministry of Food and Disaster Management, Bangladesh
MoU	Memorandum of Understanding
MPND	Ministry of Planning and National Development, Maldives
NCDM	National Council for Disaster Management, Sri Lanka
NCDR	National Committee for Disaster Reduction, China
NDMC	National Disaster Management Centre, Maldives
NEOC	National Emergency Operation Centre
NGO	Non-governmental Organization
NHNL	New Home New Life, Afghanistan
NIC	National Informatics Centre, India
OCHA	United Nations Office for the Coordination of Humanitarian Affairs
PGIS	Participatory Geographic Information Systems
RAD	Remote Alarm Device
RAND	Recovery Aceh-Nias Database
RP	Regional Programme on Capacity Building for Sustainable Recovery and Risk Reduction, UNDP

SAR	Synthetic Aperture Radar
SEA-EAT	South-East Asia Earthquake and Tsunami, Blog
SMS	Short Message Service
SOD	Standing Order on Disasters, Bangladesh
TSF	Télécoms Sans Frontières
UN	United Nations
UNDP	United Nations Development Programme
UN/ISDR	United Nations International Strategy for Disaster Reduction
UNOSAT	United Nations Operational Satellite Applications Programme
Virtual OSOCC	Virtual On-Site Operations Coordination Centre
VIT	Vellore Institute of Technology, India
VSAT	Very Small Aperture Transmission
XML	eXtensible Markup Language
WC	World Changing
WFP	World Food Programme
WHO	World Health Organization
WSIS	World Summit on the Information Society
WWH	World Wide Help

Foreword

Rapid advances in information and communication technology (ICT) have begun to touch - and frequently transform - the lives of people and communities in ways that were virtually inconceivable just a few decades ago. In urban centres, ICT-enabled services are opening up new windows of skilled jobs and opportunity for underserved youth. Farmers are learning about modern agricultural techniques and buying quality inputs online to increase their productivity. Doctors are diagnosing common ailments and recommending treatment to patients in far-away villages via telemedicine networks, while fishermen are accessing advance warnings of impending bad weather conditions before venturing into the sea via mobile phones, thus saving lives. The examples are indeed plentiful.

While the linkages between ICT and development are strong and well acknowledged, there are sharp disparities in access to ICT and its benefits between the developed and developing world which reflects a major digital divide. For instance, according to the International Telecommunication Union, the percentage of internet users is much higher in developed countries than in developing countries where four out of five persons are still not able to avail of the benefits of being online. Such disparities also prevail in the Asia Pacific region with Japan and the Republic of Korea alone accounting for 70% of mobile broadband users.

The task of bridging the digital divide is enormous in its magnitude, and requires concerted and mutually synergistic efforts from all relevant development agencies and institutions. Towards this objective, the Economic and Social Commission for Asia and the Pacific (ESCAP) has been fostering economic and social connectivity through ICT and providing a platform for regional cooperation. It has also accorded due importance to sharing of knowledge, expertise and best practices on ICT for development within the various stakeholders.

To promote a better appreciation of the significance of ICT for socio-economic development, the Asian and Pacific Training Centre for ICT for Development (APCICT), a regional institute of ESCAP, is successfully executing its 'Academy of ICT Essentials for Government Leaders' programme in the region. To complement this effort, APCICT's Case Study Series aims to present a useful resource for compiling and disseminating best practices in ICT for development for the reference of a range of stakeholders including government agencies, international organizations, academia, non-governmental entities and the private sector. This is an important initiative with much potential to promote south-south cooperation for building a digitally inclusive society. I encourage all to take full advantage of it!

Noeleen Heyzer
Under-Secretary-General of the United Nations
and Executive Secretary of ESCAP

Preface

Over the last year, in the Asia Pacific region, we saw Typhoon Ketsana hitting the Philippines; a tsunami affecting Samoa, American Samoa and Tonga; two massive earthquakes striking the Indonesian island of Sumatra; and most recently a devastating earthquake hitting the Qinghai province of China. The series of events served to remind us that development efforts are increasingly at risk.

These disasters left over three thousand dead and millions affected. Properties and infrastructure were destroyed, livelihoods were affected, and access to health and education services was impeded. The social and economic cost of disasters has increased in recent years due to population growth, change in land use patterns, migration, unplanned urbanization and environmental degradation.

Statistics indicate that one person in twenty has been affected by disasters in any given year since 1990. The year 2008 was particularly catastrophic (partly due to Cyclone Nargis and the Sichuan Earthquake) with almost 0.25 million deaths in the region, representing 97 percent of fatalities worldwide.[1] The urgency to reduce disaster risks, therefore, is very rapidly being recognized internationally, especially with climate change threatening to further increase the frequency and severity of natural disasters. Thus, it is more important than ever to Act Now, Act Together and Act Differently.

It is fundamental to act together as disasters often affect multiple countries and sectors. Early warning and the sharing of risk information require close cooperation across countries and sectors. It is also important to act differently - to shift from a reactive mode focused only on relief and response, to a proactive approach of building disaster resilience.

Information and communication technologies (ICTs) have made incredible leaps in utility, applications, and capacity. The revolutionary potential of ICTs lies in their ability to instantaneously connect vast networks of individuals and organizations across great geographic distances, and facilitate fast flows of information, capital, ideas, people and products. With the new ICTs, in particular computers, the Internet and mobile phones, the constraints on the place and time for interaction have eased considerably. They have become essential tools for cooperation and collaboration.

ICTs have also been important tools for developing innovative solutions to development challenges. ICTs have transformed government services through improved efficiency, transparency and accountability in government and by reducing transaction times and removing redundant layers of bureaucracy.

Similarly, ICTs can play a catalytic role in reducing disaster risks now, together and differently. ICTs are important tools for lessening the risks brought on by disasters through early warning, coordinating and tracking relief activities and resources, recording and disseminating knowledge and experiences, and raising awareness. The challenge is gaining commitment to incorporate ICT tools effectively in disaster risk reduction (DRR), and providing favourable political, social and economic conditions for identifying and applying an appropriate mix of ICTs to address vulnerabilities in the different contexts throughout Asia and the Pacific.

Governments need to act swiftly and decisively to ensure that they provide an enabling environment for the use of ICTs in creative ways towards DRR. Unfortunately, many policymakers, including disaster management authorities, have yet to acquire the knowledge and skills needed to leverage opportunities provided by ICT and integrate ICT applications in their daily work. We therefore hope that this publication will contribute to a better understanding of ways in which ICTs can be used for DRR, and in turn, generate opportunities for networking, collaboration and implementation of new solutions.

This publication is the second issue in APCICT's ICT for Development (ICTD) Case Study series that provides analyses and compilations of best practices and case studies on different aspects of ICTD and capacity building in the Asia Pacific region.

The Asian and Pacific Training Centre for Information and Communication Technology for Development (APCICT) was inaugurated on 16 June 2006 as a regional institution of the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) to strengthen the ICT capacity of ESCAP Member States. ESCAP has been mandated by the UN General Assembly in December 2009 to support Member States in DRR efforts, in close coordination with implementing entities of the United Nations system.

ESCAP's overall strategy on DRR is to mainstream this issue in development strategies as well as climate change adaptation efforts to strengthen regional cooperation. The Information Communications Technology and Disaster Risk Reduction Division (IDD) of ESCAP serves as a regional hub for cooperation and technical support for DRR with particular attention to countries with special needs, vulnerable social groups, poverty reduction and gender equality. Moreover, two ESCAP Commissions, namely the Committee on Disaster Risk Reduction and Committee on Information and Communications Technology, are a formal mechanism to discuss policy options and strategies on DRR, regional cooperation, good practices and lessons learnt in DRR as well as ICT applications for DRR. This issue of APCICT's ICTD Case Study series complements the ongoing DRR activities of ESCAP.

Given its commitment to promoting ICT for DRR, APCICT had previously developed a primer on ICT for Disaster Management in partnership with the United Nations Development Programme, and is also in the process of developing a training module on ICT for DRR as part of its "Academy of ICT Essentials for Government Leaders Programme" (Academy). The Academy, presently comprising of eight standalone but interrelated modules that make up a comprehensive ICTD curriculum, is currently running in over a dozen countries throughout Asia and the Pacific, and has been translated into different languages.

The primer, this publication and the upcoming training module add to the limited knowledge resources currently available on ICT for DRR. We extend our deepest appreciation to the authors of these case studies - Shanta Halder, Tasdiq Ahmed, Manzul Hazarika, Dwijendra Das, Lal Samarakoon, Li Jing, Shen Li, Tang Hong, Gasbrielle Iglesias, Novil Wijesekara, Nirmala Fernando, Peter Griffin, Chamindra de Silva, Mark Prustalis, and UNDP - for their valuable cooperation in providing expert insights on the role of ICT in DRR. A special note of recognition is extended to Christine Apikul for the publication's Introductory Chapter and her excellent editorial work. Together, we hope that these resources will contribute to the enhancement of capacities and the forging of partnerships in the effective use of ICT to save lives and achieve development targets, including those set out in the Millennium Declaration.

Xuan Zengpei
Director
IDD-ESCAP

Hyeun-Suk Rhee
Director
UN-APCICT/ESCAP

1. United Nations Economic and Social Commission for Asia and the Pacific Press Release No: G/24/2009, "Asia-Pacific Countries See the Need to Cooperate to Reduce Risk of Disasters," 25 March 2009, http://www.unescap.org/unis/press/2009/mar/g24.asp.

ICT for Disaster Risk Reduction in Asia and the Pacific

An Overview of Trends, Practices and Lessons

Christine Apikul

1. Disaster Trends in Asia and the Pacific

The Asia Pacific region is the most disaster prone region in the world, accounting for 42 percent of the world's natural disasters between 1999 and 2008. A person living in the region is 4 times more likely to be affected by natural disasters than someone living in Africa, and 25 times more likely than someone living in Europe or North America.[2]

Asia and the Pacific are well known for its fast growing economies and rich cultural diversity. But, many parts of the region have seen their economic and social development stalled, or even reversed, by natural disasters.

Table 1 illustrates the intensity of damage in the region. Compared to more developed countries, most disasters in the region have a higher number of casualties and low financial damage in absolute terms, but still quite an important figure as a share of gross domestic product (GDP).[3]

This trend of increasing disaster risks is jeopardizing the significant progress made towards meeting the UN Millennium Development Goals (MDGs). The 2004 Indian Ocean Tsunami, for example raised Aceh's poverty rate from 30 to 50 percent.[4]

Climate change threatens to further magnify the vulnerability of the poor by increasing the frequency and severity of natural disasters. About 40 percent of the world's climate-related disasters occur in Asia and the Pacific.[5]

For some people, these natural disasters are believed to be acts of God and therefore, unavoidable. Based on this belief, some countries focus on providing relief and response as quickly as possible after a disaster, to prevent further loss of life and social, economic and political damage; and this is seen to be the responsibility of relief workers, the fire brigade and the army.

Increasingly though, disasters are being recognized as resulting from unsustainable development practices - encroachment into high-risk areas due to rapid urbanization, construction of unsafe shelters, pollution, loss of biodiversity, land degradation, social discrimination, etc. These factors and processes are believed to increase people's vulnerability to disasters. Taking this perspective, the impact of disasters can be reduced or even avoided by promoting change in development practices. Disaster risk reduction (DRR) has become everybody's responsibility, and requires a wide range of political and professional collaborations and partnerships.

Disaster occurrence	Country	Number of deaths	Estimated financial loss (US$)	Financial loss as percentage of GDP
India Ocean Tsunami, 2004	Sri Lanka	→ 31 000	1.3 billion	6.4
Northern Pakistan earthquake, 2005	Pakistan	73,338	5.2 billion	4.7
Cyclone Sidr, 2007	Bangladesh	4,234	2.3 billion	3.4
Niigata/Chuetsu earthquake, 2004	Japan	40	28 billion	0.6
Wenchuan earthquake, 2008	China	87,476	20 billion	0.6
Cyclone Nargis, 2008	Myanmar	138,366	4.1 billion	21

Table 1. Comparison of damage from natural disasters

DRR can be visualized as a continuous cycle comprised of four phases - Mitigation, Preparedness, Response and Recovery (see Box 1 for their definitions). Although it is at the phases of response and recovery that disaster-related issues receive the most attention, mitigation and preparedness are being recognized as key phases that will save lives and contribute to sustainable social and economic development. Recent studies by the World Bank, the Asian Development Bank and the US Government have shown that every dollar invested in disaster preparedness not only saves lives, but can also save between US$4 and US$7 in humanitarian relief and reconstruction costs after a disaster occurs.[6]

In January 2005, 168 governments affirmed their commitment to DRR through the Hyogo Declaration and Hyogo Framework for Action (HFA) 2005-2015, a global blueprint with guiding principles and priorities for action to significantly reduce disaster losses. The latest review of progress in the implementation of the HFA by the United Nations International Strategy for Disaster Reduction

2. United Nations Economic and Social Commission for Asia and the Pacific Press Release No. G/63/2009, "Natural Disasters in Asia and the Pacific Underscore The Urgency For A Meaningful Climate Change Agreement," 1 October 2009, http://www.unescap.org/unis/press/2009/oct/g63.asp.
3. United Nations Economic and Social Commission for Asia and the Pacific, Implementation of the Hyogo Framework for Action in Asia and the Pacific: Follow-up to the Outcome of the Third Asian Ministerial Conference on Disaster Risk Reduction: From the Regional to the Global Platform, Note by the secretariat presented at the Committee on Disaster Risk Reduction First Session, 25-27 March 2009, Bangkok, Thailand, http://www.unescap.org/idd/events/cdrr-2009/CDR_INF4.pdf.
4. International Federation of Red Cross and Red Crescent Societies, World Disasters Report, Geneva, 2009, http://www.ifrc.org/publicat/wdr2009/index.asp.
5. Ibid.
6. United Nations Economic and Social Commission for Asia and the Pacific Press Release No. G/61/2008, "Asia-Pacific Governments Can Save Lives and Money By Investing in Disaster Preparedness," 2 December 2008, http://www.unescap.org/unis/press/2008/dec/g61.asp.

(UN/ISDR) shows good progress made overall, but compared to disaster damages and spending on relief, recovery and reconstruction, however, such efforts are insufficient.[7]

Box 1. Terminologies[8]

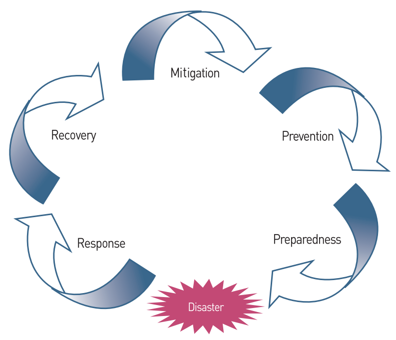


Figure 1. Disaster Risk Reduction Cycle

Disaster Risk Management - The systematic process of using administrative directives, organizations, and operational skills and capacities to implement strategies, policies and improved coping capacities in order to lessen the adverse impacts of hazards and the possibility of disaster.

Disaster Risk Reduction - The concept and practice of reducing disaster risks through systematic efforts to analyse and manage the causal factors of disasters, including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events.

Response - The provision of emergency services and public assistance during or immediately after a disaster in order to save lives, reduce health impacts, ensure public safety and meet the basic subsistence needs of the people affected.

Recovery - The restoration, and improvement where appropriate, of facilities, livelihoods and living conditions of disaster-affected communities, including efforts to reduce disaster risk factors. Recovery programmes, coupled with the heightened public awareness and engagement after a disaster, afford a valuable opportunity to develop and implement DRR measures and to apply the 'build back better' principle.[9]

Mitigation - The lessening or limitation of the adverse impacts of hazards and related disasters. It encompass engineering techniques and hazard-resistant construction as well as improved environmental policies and public awareness.

Prevention - The outright avoidance of adverse impacts of hazards and related disasters. Examples include dams or embankments that eliminate flood risks and land-use regulations that do not permit any settlement in high risk zones. Very often the complete avoidance of losses is not feasible and the task transforms to that of mitigation. Partly for this reason, the terms prevention and mitigation are sometimes used interchangeably in casual use.

Preparedness - The knowledge and capacities developed by governments, professional response and recovery organizations, communities and individuals to effectively anticipate, respond to, and recover from, the impacts of likely, imminent or current hazard events or conditions. It is based on a sound analysis of disaster risks and good linkages with early warning systems.

2. ICT Trends and Applications for DRR in Asia and the Pacific

ICTs have proven to be an accelerator of economic and social progress. ICTs have contributed to economic growth by enhancing access to information and services, and by driving process efficiency and cost-cutting in businesses. Empirical studies on the impact of ICTs have found a positive correlation between the use of ICTs and business performance measured by labour productivity.[10] Innovative use of ICTs in various development sectors have also contributed to more effective delivery of services in agriculture, education, energy, government and health care.

Access to adequate infrastructure is a prerequisite for organizations and individuals to adopt and use ICTs. Over the past decade most countries have put in place some form of ICT infrastructure, and have allowed various ICT tools to become more accessible and affordable for many developing countries. Moreover, the convergence[11] of these technologies is leading to greater possibilities for use by different sectors and stakeholders.

The different digital technologies and their use to reduce disaster risks are briefly highlighted below. This is not meant to be an exhaustive list of ICTs but provide highlights of some key ICTs that have proved indispensable to DRR. They include: mobile technology, the Internet and Web 2.0 tools, space-based technologies such as geographic information systems (GIS), remote sensing and satellite communications, and different types of radios, including amateur radio and satellite radio.

2.1 Mobile Technology

A target set by world leaders at the World Summit on the Information Society (WSIS) that more than half the world's population should have access to ICTs has been reached seven years ahead of schedule thanks to

7. ISDR, Global Assessment Report on Disaster Risk Reduction, Geneva: United Nations, 2009, http://www.preventionweb.net/english/hyogo/gar/report/index.php?id=1130&pid:34&pih:2.
8. UN/ISDR Terminology on Disaster Risk Reduction, http://www.unisdr.org/eng/terminology/terminology-2009-eng.html.
9. United Nations Secretary-General's Special Envoy for Tsunami Recovery, Lessons Learned from Tsunami Recovery: Key Propositions for Building Back Better, December 2006, http://www.preventionweb.net/english/professional/publications/v.php?id=2054.
10. UNCTAD, Information Economy Report 2009: Trends and Outlook in Turbulent Times, New York: United Nations, 2009, http://www.unctad.org/en/docs/ier2009_en.pdf.
11. Convergence brings together, in a seamless manner, the different media including text, audio, graphics, animation and video such that all are delivered on a common platform while also allowing the user to choose any combination of media to interact with. An example is the mobile phone that can be the delivery channel for text, audio, video, e-mail, SMS and Internet browsing (Source: APCICT Academy Module 1 - The Linkage between ICT Applications and Meaningful Development, http://www.unapcict.org/academy).

mobile phones.

Mobile technology is probably the most rapidly expanding technology in terms of the speed of expansion and reach to the unconnected. The technology is mostly based on voice and short message service (SMS). But with the rapid growth in mobile phone usage, more sophisticated mobile services are being introduced, the most widely known being m-banking (allowing people to pay, receive and transfer money using a mobile phone), m-commerce (the buying and selling of goods and services), m-health (for health research and healthcare delivery), and m-learning.

On average 40 per 100 people are mobile phone subscribers in Asia and the Pacific. Figures range from 26 per 100 people in South and South-West Asia to 87 per 100 people in North and Central Asia. Growth rates have been particularly impressive in the Russian Federation from 25 per 100 people in 2003 to 119 per 100 people in 2007, and also in the Maldives from 23 per 100 people to 104 per 100 people.[12]

The ubiquity of mobile phones in some countries has prompted humanitarian organizations to explore their usage for DRR, in particular for early warning. Following the 2004 Indian Ocean Tsunami, the Sri Lanka Disaster Management Centre (DMC) developed an SMS-based tsunami warning system, which was put to the test on 19 September 2007.The DMC sent out a 20-word tsunami alert via SMS following a magnitude 7.9 earthquake off the southern coast of Sumatra: "Tsunami warning for Sri Lanka north, east and south coast. People asked to move away from coast - Disaster Management Center." The message was sent to government officials, media representatives, the military, police officers and village chiefs via SMS. These agencies, in turn, contacted citizens within their district to inform them of the alert via SMS, as well as through radio and television networks. No injuries or casualties were reported and citizens returned home over the course of the next three days. However, mobile networks became jammed after the alert was issued due to the high volume of voice calls. The Sri Lankan telecommunication authority now insists that subscribers only use SMS messaging during national emergencies, so as not to overburden the networks.[13]

Subsequently, DMC Sri Lanka developed a Disaster and Emergency Warning Network in partnership with Dialog Telekom PLC, Dialog University of Moratuwa Mobile Communications Research Laboratory and Microimage Technologies that sends out SMS message crafted by the DMC to pre-identified individuals. This network is 'cell broadcast-enabled'.

2.1.1 Cell Broadcasting

Cell broadcasting (CB) has several advantages over SMS, particularly for early warning, and is being assessed and tested in a number of other countries including Bangladesh and the Maldives. While SMS is a one-to-one and one-to-a-few service, CB is a one-to-many geographically focused messaging service, which means that messages can be tailored to multiple phone subscribers located within a given part of its network coverage area at the time the message is broadcast. CB is also not as affected by traffic load; therefore, it may be used during a disaster when load spikes tend to crash networks. For countries with high mobile penetration, CB is an inexpensive technology that requires no further infrastructure as it uses the existing mobile telecommunication system. Policymakers should also be aware of the limitations. For instance, to receive alerts through CB, the user must have a CB-enabled phone that is switched on and set to receive the CBs; and it is not infallible to hazardous events - disruption of the mobile telecommunication system would hamper optimal functioning of the CB system.

In Bangladesh, the Disaster Management Information Centre is piloting early warning dissemination through CB in two districts - Sirajgonj (for floods) and Cox's Bazaar (for cyclones). Agreements were signed with two mobile operators - Grameenphone and state-owned Teletalk - to send instant messages to their subscribers. Based on the result of the pilot, this technology will be expanded to other high risk areas of Bangladesh through the Comprehensive Disaster Management Programme or CDMP (see case study on the Programme below).

In Maldives, the Telecommunications Authority of the Maldives commissioned LIRNEasia, a regional ICT policy and regulation think tank, to conduct a scoping study on the implementation of CB as part of the national public alert system.[14] The report focuses not only on public warning but also on ways to make CB commercially viable. In higher-income countries like Japan and the Republic of Korea, CB has already been deployed nationwide for public warning for a number of years. In these countries, governments have often borne the cost of equipping the mobile network for broadcasts. Since 2005, the Netherlands has provided 2.5 million Euros to equip the mobile network of three operators for CB, and has required all operators to transmit government text warnings via cell broadcast.

Mobile technology is also being used during relief and response for communication between relief workers and between relief workers and their headquarters. Additionally, mobile technologies have been used to raise funds, and to a lesser extent, in DRR awareness raising and education. Frontline SMS is one of the most popular free and open source software (FOSS) applications[15] for sending out SMS messages to groups of people, which has been used for various development communication initiatives.[16]

2.2 Radio

Radio is another ICT that is relatively extensive in reach in Asia and the Pacific. Different types of radio have been regarded as an effective communication technology throughout all phases of DRR.

12. ESCAP, "Information and communication technology," in Statistical Yearbook for Asia and the Pacific 2008, http://www.unescap.org/stat/data/syb2008/18-ICT.pdf.
13. New Media and Development Communication, http://www.columbia.edu/itc/sipa/nelson/newmediadev/Emergencies.html.
14. Natasha Udu-gama, Mobile Cell Broadcasting for Commercial Use and Public Warning in the Maldives, LIRNEasia, May 2009, http://lirneasia.net/wp-content/uploads/2009/07/CB_Maldives_FINAL_2009_041.pdf.
15. FOSS is software that is liberally licensed to grant the right of users to study, change, and improve its design through the availability of its source code. Source: http://en.wikipedia.org/wiki/FOSS. The availability of FOSS without license fees and its inherent characteristic of being open to modification and adaptation make it an attractive proposition to poorer communities. As a result, many projects that make use of FOSS to empower and help the people have been initiated all over the world especially in poor and developing regions. For further discussions on FOSS, see section 5: Key Lessons Learned.
16. See http://www.frontlinesms.com/who/.

2.2.1 Amateur Radio

In times of crisis, amateur or 'ham' radio is often used as a means of emergency communication when other conventional means of communication become damaged or destroyed. This is because amateur radio is not as dependent on terrestrial systems that can fail.

Amateur radio operators are trained volunteers known worldwide not only for their skills to provide emergency communication facilities but also for their dedication to help save lives. There are several million volunteers across the world that have taken a technical examination and received a radio transmitting license from their national administration, which permits them to operate a personal amateur radio station on authorized bands of frequencies. Amateur radio operators are experienced in improvising antennas and power sources to quickly establish lines of communications. Annual 'Field Days' are held in many countries to practice these emergency improvisational skills.[17]

Most of these individuals are part of National Amateur Radio Societies. Since 1925, there has been a federation of these National Societies known as the International Amateur Radio Union (IARU). IARU has a Memorandum of Understanding with the United Nations Office for the Coordination of Humanitarian Affairs (OCHA), and assists in mobilizing volunteer amateurs to operate radio communication networks in support of relief efforts.[18]

News coverage about amateur radio's role in the 2004 Indian Ocean Tsunami relief effort has been widespread and positive. For example, in the Andaman and Nicobar Islands, amateur radio operators were the critical link between the islands and the Indian mainland and helped in the coordination of rescue and relief operations.

More recently, amateur radio's role in response after the Sichuan earthquake has been well documented. Within three minutes after the tremors from the Sichuan earthquake was felt in Chengdu, the capital of Sichuan, the first local amateur radio emergency network was set up. Seventeen minutes later, over 200 stations around Chengdu city had checked in to the emergency network. Upon receiving news that the local government in Hanwang, a town adjacent to the epicentre of the earthquake, had lost all communication means, a team of radio amateur walked from Chengdu to Hanwang to set up an amateur repeater and distributed some handheld transceivers. This became the major channel for coordinating local response.[19]

2.2.2 Satellite radio

Satellite radio is being pilot tested for use during emergencies. In Asia, countries such as Bangladesh, India, Indonesia, Sri Lanka and Thailand have tested the Worldspace Addressable Satellite Radios for Emergency Alerting (AREA) system that can issue hazard information directly to communities at risk. Global positioning system (GPS) technology incorporated into the radio receiver set, along with the unique code assigned to every receiver, allows for hazard warnings to be issued, in text and audio formats, to sets that are within a vulnerable area or just to radio sets with specific assigned codes.

The cost of an AREA terminal device is under US$80. However, the audio channel is what costs the most. In Sri Lanka, a large national non-governmental organization (NGO) tested the AREA system not only for transmitting alerts but also for conducting distance education on the audio channel. Additionally, communities have been using the audio channel to express their opinions on the ongoing projects in their communities. The result from the pilot test recommended that the NGO devise an appropriate business plan by charging a nominal fee to broadcast news and other programmes of the NGO to communities based on fixed weekly programme.

2.2.3 Broadcast radio

Broadcast radio has been used to disseminate early warning messages, as well as for awareness raising and community education. For example, the well-known Cyclone Preparedness Programme of Bangladesh operates an extensive network of radio communication facilities, in the coastal areas, linked to its communication centre at its head office in Dhaka. Disaster alerts are sent through the network consisting of 130 HF/VHF radio stations, which covers most of the high risk cyclone prone areas.

In Afghanistan, broadcast radio has been used successfully to raise awareness on disaster-related issues through a radio soap opera. New Home New Life (NHNL) has been broadcasted in Dari and Pashto on the BBC World Service since 1994. NHNL communicates educational messages on key developmental themes such as health, gender equity, good governance, and sustainable rural livelihoods. This is complemented by weekly educational programmes to provide additional information on the issues raised in the soap opera. Evaluation results provided clear evidence that listeners of NHNL recall the disaster-related messages from the soap opera, and some of them have even taken specific actions to prepare for disasters.[20]

In the aftermath of the 2004 Indian Ocean Tsunami, UNDP supported a radio programme in Aceh to reduce trauma. The weekly show invited a counselor and psychologist to discuss issues related to family relations, employment and income, housing conditions and community support. And listeners were able to call in or SMS their questions.[21]

2.3 Space-based Technology

Space-based technologies are increasingly being recognized as essential in improving performance during all phases of the DRR cycle, particularly for remote sensing, mapping and communication.

17. Wikipedia, "Amateur radio emergency communications," http://en.wikipedia.org/wiki/Amateur_radio_emergency_communications.
18. The International Amateur Radio Union, http://www.iaru.org.
19. Chinese Radio Sports Association, "A Report on Amateur Radio Emergency Service in Disasters in China," presented at the International Amateur Radio Union Region 3 Fourteenth Regional Conference in Christchurch, New Zealand, on 12-16 October 2009, http://www.iaru-r3.org/14r3c/docs/020.doc.
20. Anurudra Bhanot, Building Disaster Resilient Communities: Evaluating the Impact of the BBC WST's Radio Programme New Home New Life on Disaster Risk Reduction and Related Messages, BBC World Service Trust, http://downloads.bbc.co.uk/worldservice/pdf/wstrust/ECHO_Research_Report.pdf.
21. Aceh and Nias Recovery Stories: UNDP Supports Radio Program to Reduce Tsunami Trauma, July 2006, http://www.undp.or.id/tsunami/view.asp?Cat=st&FileID=20060711-1.

2.3.1 Remote Sensing

Remote sensing refers to the process of recording information from sensors mounted either on satellites or aircrafts. Earth observation satellites, for example, can be used to view the same area over long periods of time and thus, make it possible to monitor environmental change, human impact and natural processes. This helps scientists and planners create models to simulate trends observed, and offer projection for the future.

In China, satellite remote sensing technology, satellite navigation and positioning technology and unmanned remote sensing aeroplane technology have been used for disaster management. China has also launched meteorological, oceanic and land resources satellite systems that are used for disaster management. Yet gaps remain in their comprehensive coverage, timeliness and all-weather observation. As a result, China is developing a dedicated satellite constellation for environment and disaster monitoring.[22] One of the case studies below provides details of China's experience in using space-based technology for DRR.

Constellations of satellites comprise different types of satellites carrying a range of sensors to better capture the characteristics of each disaster type. Two complementary types of satellites are particularly relevant to disaster management. Polar-orbiting satellites fly in a relatively low orbit and are able to provide high spatial resolution. But they can only collect data over the same point once every few days. Geostationary satellites are positioned at a much higher altitude and can provide almost constant surveillance (every 15 minutes), but their spatial resolution is low (providing less clarity and details). Both are required for disaster management to track changes in weather patterns, and to have high spatial resolution data for DRR planning.[23]

Moreover, each satellite in the constellation carries one or more sensors on board that take measurements in different wavelengths. It is recommended that different types of sensors be available to track and monitor multi-hazards. For example, data from optical and near infrared sensors can be used to map land use and assess agricultural droughts. But to track a cyclone's eye, or monitor flooded areas beneath cloud, microwave sensors are needed. For fires or volcanoes, it is thermal imagery that is needed to pick up hotspots.[24]

Some developing countries, such as China and India, have invested heavily in both Earth observation and communication technology, and launched their own satellite - or constellation of satellites - to monitor and respond to disasters. But for many other countries, barriers to using remote sensing for DRR include the cost factor. Countries may also lack the institutional infrastructure or human expertise to analyse and interpret satellite data, package the results into images, maps and explanations that can be easily understood by the targeted user, and quickly disseminate them through appropriate channels.

22. ESCAP, Implementation of the Hyogo Framework for Action in Asia and the Pacific: Case Study - The National Disaster Management system of China and its Response to the Wenchan Earthquake, Note by the secretariat presented at the Committee on Disaster Risk Reduction, First session, 25-27 March 2009, Bangkok, Thailand.
23. Ranganath Navalgund, "Disaster management needs satellite 'constellations'" SciDevNet, 11 November 2009, http://www.scidev.net/en/opinions/disaster-management-needs-satellite-constellations—1.html.
24. Ibid.

There is also a general lack of understanding and political commitment among policymakers on the use of remote sensing for DRR.

Some experts question whether it is necessary at all to invest heavily in space-based technology especially with free satellite data now available from several international organizations.25 Collaborations such as the International Charter on Space and Major Disasters - established in 1999 and now signed by nearly 20 space agencies and organizations - offer governments free satellite data to any country affected by a natural disaster.

Another example is the Operational Satellite Applications Programme (UNOSAT) of the United Nations Institute for Training and Research that supports the humanitarian community (UN and non-UN) with maps and analyses derived from satellite imagery acquired commercially or via the International Charter on Space and Major Disasters. In 2003, UNOSAT created a humanitarian rapid mapping service to help coordinate response and relief efforts.

But the International Charter can only be activated after a disaster, and cannot be exploited to help developing countries acquire data for planning mitigation and preparedness, and the cost of using satellite imageries for long-term monitoring and predicting risk remains high.[26]

Recognizing this constraint, the Group on Earth Observations (GEO) aims to support access to remote sensing data at all stages of the DRR cycle. The Global Earth Observation System of Systems (GEOSS), developed and managed by GEO promotes common technical standards so that data from the thousands of different instruments can be combined into coherent datasets. GEOSS is also responsible for GEONETCast, a global network of communication satellites and alternative web dissemination channels that transmits environmental data to disaster managers (and others). It offers data from various satellites to regional centres in Europe, Africa and Asia via a small receiving station. These centres then disseminate the data to relevant local stakeholders through digital video broadcast.[27]

GEO has also successfully been pushing space agencies to release their data for free. In 2007, it announced that the China-Brazil Earth Resources Satellite would distribute its images gratis. And NASA, following participation in the GEO Ministerial Summit in Cape Town in 2008, announced that it would make the full archive and future data from their Landsat satellites available free of charge. The decision opened up remote sensing data to thousands of users across the world.[28]

ESCAP has signed an agreement with the Japan Aerospace Exploration Agency to scale up assistance to ESCAP's member states in the use of space-based information and services, and the provision of satellite images to disaster-affected areas.

25. See Tatum Anderson, "Launching your own satellite - the pros and cons," SciDevNet, 11 November 2009, http://www.scidev.net/en/new-technologies/remote-sensing-for-natural-disasters-1/features/launching-your-own-satellite-the-pros-and-cons.html.
26. Sian Lewis, "Remote sensing for natural disasters: Facts and figures" SciDevNet, 11 November 2009, http://www.scidev.net/en/agriculture-and-environment/tropical-cyclones-1/features/remote-sensing-for-natural-disasters-facts-and-figures.html.
27. For more information about GEO, see http://www.earthobservations.org.
28. Sian Lewis, op. cit.

Another noteworthy initiative is Sentinel Asia[29] that comprises a team of 51 organizations from 18 countries to deliver remote sensing data via the Internet as easy-to-interpret information for both early warning and flood damage assessment across Asia. Led by the Asia-Pacific Regional Space Agency Forum, the system draws on satellite-derived products and imageries from all available earth observing geostationary, or low-earth orbiting satellites, including meteorological satellites that provide routine data to the region.

2.3.2 Geographic Information Systems

GIS is a vital application for transforming images generated through remote sensing to an information system that can be used to produce interactive maps, conduct spatial analyses, present results in a variety of ways, and manage the data. GIS is essentially the merging of cartography and database technology.[30]

The use of GIS and remote sensing have allowed a more comprehensive mapping of disaster risks to better support decision-making and improve coordination among agencies. For example, when hazards are mapped against the location of houses, schools, critical infrastructure (hospitals, airports), power lines, storage facilities, etc., plans for mitigation, preparedness, response and recovery can be formulated.

For mitigation, GIS can be used to identify high risk areas and prioritize them for mitigation activities. For preparedness, GIS can be used to identify evacuation routes, shelters outside the hazard zone, and resources available (people, equipment, supplies) in the area and its vicinity that can be mobilized in the event of a disaster. For response, GIS is useful in prioritizing areas for search and rescue, and planning the route for evacuation, delivery of relief supplies and medical assistance. In recovery, GIS can be used to plan reconstruction.

In India, for example, community contingency plans have been developed using GIS technology that enable the visual display of critical data by location, for use in the coordination and implementation of relief efforts.

Some of the challenges of using GIS include the lack of trained personnel; difficulties in exchanging data between different systems; and the quality and detail of the data required by GIS analysis. Recognizing the importance of trained personnel in producing GIS maps for DRR, a number of private and non-profit organizations and UN agencies are available to develop and disseminate various GIS maps, especially for use in response and recovery to meet information needs.

In the aftermath of the 2004 Indian Ocean Tsunami, for example, the OCHA-established Humanitarian Information Centre produced 'Who Is Doing What Where' maps and database. The UN Joint Logistics Centre utilized GIS to produce a detailed atlas of the damage to the transportation infrastructure in northern Sumatra, Indonesia. MapAction, a UK-based NGO, mapped the damaged areas in Sri Lanka in support of the Government of Sri Lanka. Private companies such as ESRI, EarthSat, IBM, and Trimble supported many UN agencies, government bodies and humanitarian organization with GIS software; GIS professional services; and data collection, management, and dissemination.[31]

GIS professionals are also increasingly making themselves available to support international development and humanitarian programmes through volunteer organizations. GISCorps, a not-for-profit volunteer organization, matches interested and qualified GIS professionals with programmes in need around the world.

2.3.4 Satellite Communications

Many emergency communication systems use satellite phones and, or satellite radios either as back up or a means for two-way communication during disasters as these technologies will remain functional when terrestrial networks fail. High-speed Internet access can be switched to satellites in the event of a disaster.

Satellite communications have also been used to reach the 'last mile'[32] in remote communities where terrestrial or wireless networks are not available and not considered commercially and technologically viable to set up.

Combining remote sensing satellites with communication satellites can be useful in ensuring that data generated by satellites reach disaster managers and planners. The information presented should be relevant and easy to understand. For example, India combines its Indian Remote Sensing satellite system - designed for land use and ecological monitoring - with the Indian National Satellite System communication satellites.

Being able to integrate satellite data with other geo-spatial datasets and ICTs is also important. To assess landslide risk, for example, it is important to integrate remote sensing data with population maps and other spatial databases. In South Africa, a system has been developed that combines satellite data with mobile phone technology to provide a cost effective alert system. The service is complimentary and anyone can sign up to receive alerts.[33]

2.4 The Internet

Internet use is spreading rapidly in some countries. In the Islamic Republic of Iran and Viet Nam, less than 10 percent of their population used the Internet half a decade ago. In 2008, the number of users has expanded to one third and one quarter of their respective populations. In other countries though, growth has been slower due primarily to high prices, inadequate infrastructure, and lack of content in local languages.[34]

The penetration rate of broadband technology that allows for high-speed, high-capacity transmission of

29. Sentinel Asia, http://dmss.tksc.jaxa.jp/sentinel/index.html.
30. Wikipedia, "Geographic information system," http://en.wikipedia.org/wiki/Geographic_information_system.
31. ESRI, "Assessment and Coordination of a Complex Emergency: GIS Supports Indian Ocean Tsunami Disaster Relief," ArcNews Online, Spring 2005, http://www.esri.com/news/arcnews/spring05articles/gis-supports.html.
32. Last mile is a term that has been adopted by some disaster managers because it expresses the sentiment that warnings and the means to respond to them often do not reach those who need it most ? those within the last mile. They may be people who, for reasons of age, gender, culture or wealth, are not reached by disaster preparedness programmes (Source: IFRC, 2009).
33. See http://www.scidev.net/en/new-technologies/opinions/fires-spotted-from-satellites-warned-by-phone-1.html.
34. ESCAP, 2008, op. cit.

data, voice and video signals is growing, but remains low in the region. In 2007, there were 3.5 broadband subscribers per 100 people in Asia and the Pacific. Most of the recent growth has been in the high-income economies, where almost 90 percent of the increase in the number of Internet users is based on broadband connections. However, for the Asia-Pacific region as a whole, the percentage is less than one-fifth.[35]

Fixed broadband is essential for development because there are many applications that do not run or operate effectively without sufficient bandwidth. In DRR, maps and imageries created using GIS and remote sensing are often made publicly accessible on the Internet for information, research, training, and to aid decision-making. High bandwidth will be required to make the most of these tools.

The Internet has been widely used in the response phase to report casualties and damages, and to coordinate relief. An example is the India Disaster Resource Network (IDRN)[36] initiated by the Ministry of Home Affairs of India in collaboration with the United Nations Development Programme (UNDP). IDRN is a nationwide online inventory of resources for disaster response. The IDRN lists equipment and expertise at the district level that can be rapidly mobilized during emergencies. And a decentralized system has been put in place to update the database every three months. IDRN is accessible only to authorized government officials, district level nodal persons, corporate bodies and units of the public sector.

Aimed at improving early warning and response, the Global Disaster Alert and Coordination System (GDACS)[37] of OCHA provides near real-time alerts about natural disasters around the world and tools to facilitate response coordination, including media monitoring, map catalogues and the Virtual On-Site Operations Coordination Centre (Virtual OSOCC). Information posted on GDACs is available to all with an Internet connection, except for the Virtual OSOCC that is password-protected for disaster managers in government and response organization. The Virtual OSOCC provides users with tools to create disaster alerts by e-mail and SMS that are automatically sent to subscribers. There are also tools for impact estimations, and through this system, the UN Disaster Assessment and Coordination Team can be mobilized. Another online platform is AlertNet that tracks all emergencies and provides essential tools for relief workers and journalists in response operations.

Also a tool for tracking disasters, the Global Public Health Intelligence Network developed by Health Canada in collaboration with the World Health Organization (WHO) is a secure Internet-based multilingual early-warning tool that has been programmed to continuously search global media sources such as news wires and websites to identify information about disease outbreaks and other events of potential international public health concern.

There are also online portals and communities that focus on knowledge sharing for longer-term recovery, preparedness and mitigation processes. Portals, such as PreventionWeb, ProVention Consortium and ReliefWeb, focus on providing a searchable repository of relevant resources, news and events; and communities, such as the UN Solution Exchange for Disaster Management Community and the Duryog Nivaran, emphasizes the building of an online community over time to exchange ideas and experiences and advance the field of disaster management, including the sharing of good practices and lessons learned.

GEO is a coalition of governments and international organizations that links together all existing Earth observation systems, and ensures that Earth observation data and information remain universally accessible as a global public good. Its online portal provides a platform for members to design new projects and coordinate their strategies and investments. The portal is comprised of a clearinghouse of information and services; registries for members to post their standards and components; and a Best Practices Wiki to promote interaction between members.

ICT Application	Advantages	Disadvantages
Cell Broadcasting	· Not affected by traffic load. · Will not add to congestion. · Messages can be differentiated by cells or sets of cells. · Greater authenticity of message.	· Must be literate. · Phone must be switched on. · Phone must be set to receive cell broadcasting.
GIS and Remote Sensing	· Continuous monitoring. · Spatial presentation of data. · Facilitates cooperative effort.	· Require high bandwidth. · Require high-speed networks. · Costly hardware and software · Require skilled professionals. · Difficulty capturing qualitative data.
Internet/Email	· Interactive. · Multiple sources can be checked for accuracy of information.	· Low penetration rate. · Must be literate. · Internet content in local languages may be limited.
Mobile Phone (Text SMS)	· High penetration rate. · Portable. · Relatively low cost.	· Must be literate. · No indication that message is generated by a legitimate authority. · Subject to congestion and thereby delay.
Radio	· One-to-many broadcasting. · Does not require user to be literate. · Portable.	· Less effective at night.
Satellite Communications	· Independent of terrestrial communication network that can be damaged by natural hazards.	· High cost of systems hardware and bandwidth utilization. · Unlikely to work indoors.
Telephone	· Does not require user to be literate.	· Inadequate penetration rates. · Congestion of phone lines during emergencies. · Disasters can damage infrastructure.
Television	· One-to-many broadcasting. · Does not require user to be literate.	· Less effective at night.

Table 2. The Advantages and Disadvantages of Selected ICT Applications

35. ESCAP, 2008, op. cit.
36. http://www.idrn.gov.in.
37. http://www.gdacs.org.

3. Technological convergence and the social media

The convergence of telecommunication, computing, and multimedia applications have further opened up new potential for its use in DRR and other aspects of development. Mobile phones, for example, are not only used for phone calls and messaging, but also used to capture and distribute images and videos, access the radio and television, and download music and news from the Internet.

Digitization has enabled the transmission of all kinds of communication signal, including voice, data, video, graphics and music over a network, and has contributed to the rapid rate of convergence. This has led to the growth and popularity of social media or Web/Mobile 2.0 tools.[38]

Social media provides an unprecedented level of user control and interactivity. Companies like Facebook, Yahoo! and You Tube offer platforms on the Internet for user-generated content. These platforms allow users to share and receive text and audio-visual content from a computer or mobile phone. As a result, social media has broadened access to diverse and previously unavailable data and analysis.

For DRR, avenues for receiving disaster-related information, particularly after a disaster, are increasing. Previously people relied on the mainstream media or government authorities for information, but a number of online social media tools have facilitated an increase in 'citizen journalism' that provides independent reporting and analysis on many areas of public interest, including post-disaster situations.[39] The Internet has become one of the first places that people now go to for the latest news updates. This trend was most evident after the 2004 Indian Ocean Tsunami disaster.

One particularly well-known site that emerged following the Tsunami was the South-East Asia Earthquake and Tsunami (SEA-EAT) Blog, launched within hours of the Tsunami. Initially intended as a site to aggregate news and information, it evolved into an interactive platform with calls for help and offers to assist.[40] See case study below that looks at how volunteers from different parts of the world came together to form and develop SEA-EAT.

38. The term "Web 2.0" (2004?present) is commonly associated with web applications that facilitate interactive information sharing, interoperability, user-centered design and collaboration on the World Wide Web. Examples of Web 2.0 include web-based communities, hosted services, web applications, social-networking sites, video-sharing sites, wikis, blogs, mashups and folksonomies. A Web 2.0 site allows its users to interact with other users or to change website content, in contrast to non-interactive websites where users are limited to the passive viewing of information that is provided to them (Source: http://en.wikipedia.org/wiki/Web_2.0).
39. The idea behind citizen journalism is that people without professional journalism training can use the tools of modern technology and the global distribution of the Internet to create, augment or fact-check media on their own or in collaboration with others (Source: Mark Glaser in http://en.wikipedia.org/wiki/Citizen_journalism).
40. See http://firstmonday.org/htbin/cgiwrap/bin/ojs/index.php/fm/article/view/1325/1245 and http://www.tveap.org/disastercomm/Chapters_in_seperate_PDFs/Chap-2.pdf.

In most disaster events, the very first responders are not the relief workers and search and rescue teams, but regular people who happened to be at the site of the disaster. Accounts of these regular people in the local community getting together quickly to coordinate response are common. With the advancement of ICTs, offers of assistance have been extended to the global community in creating online platforms for information sharing and coordination of activities on site.

Organizations and volunteers are making innovative use of existing tools available on the Internet to save lives, particularly through social media. Some recently used tools for DRR include blogs (e.g. Wordpress), wikis (Wikipedia), web mapping (Google Maps), web-based instant messenger and voice calls over the Internet (in Skype and Yahoo!), image and video sharing sites (Flickr, YouTube), and social networking sites (Facebook, Twitter). Many of these sites are accessible via mobile phones that are connected to the Internet. Microsoft is beta-testing Vine, which is similar to Twitter, and allows users to receive real-time emergency updates from media outlets nationwide.

More recently, in the aftermath of Typhoon Ondoy and Typhoon Pepang in September/October 2009, a group of volunteers set up a site using Google Maps to document flood updates and persons needing rescue. Users will need to complete the online form, which is then sent to the group's main database for posting on the map.[41]

This, however, does not mean that mainstream media no longer plays a key role in disseminating information; they do. In fact, mainstream media agencies such as BBC and CNN have embraced citizen journalism and often provide links to these 'alternative' media from their websites. The examples above demonstrate the collective power of people and their effectiveness in disaster response when they are given the space and tools to collaborate. As shown in Table 2, different ICT tools have different advantages and limitations, but now there are increased choices, and they in most cases complement each other, filling each other's gaps, and thus the information has a higher possibility of reaching more people faster.

Because information through social media is not coming from one central and authoritative source, a common concern regarding reporting from citizens is the accuracy and reliability of the information provided. To counter these concerns, a study by Jeannette Sutton of the Natural Hazards Center in Boulder, Colorado found citizen information remarkably accurate in the aftermath of a number of disasters in the United States. She stated:

> *Many emergency managers I've talked with have expressed concerns about social media as a channel, and that the public at-large is going to be sharing misinformation. They also say there isn't a sense of organization within the online communications. But this isn't an entirely accurate perception of how social media is being used online. It's very organized. It just isn't organized through a central point. And, it's self-correcting. Those who participate on sites like Wikipedia or are invested in a particular conversation have some sort of stake in making sure the information is correct. So they put out information to correct misinformation.*[42]

41. See http://www.google.com/landing/typhoon-ondoy.html.
42. Jeannette Sutton, "The Public Uses Social Networking During Disasters to Verify Facts, Coordinate Information (Analysis, Social Media Package Part 1 of 2)," Emergency Management, 30 July 2009, http://www.emergencymgmt.com/safety/The-Public-Uses-Social-Networking.html.

To improve the credibility of citizen journalists, the Knight Citizen News Network has led the development of principles for citizen journalism focused on accuracy, thoroughness, fairness, transparency and independence.[43]

Apart from broadcasting breaking news and their use during times of crisis, the various social media have also been used in other phases of the DRR cycle - for early warning, recovery coordination, raising funds, generating awareness, campaigning and strengthening capacities. They also provide alternative avenues for psycho-social support to survivors.

When you have been evacuated from your home and community, you don't have the ability to participate onsite or to provide hands-on resources. Communicating with others can help victims cope because it gives them the ability to share information and talk about the event. Community forums where people can dialog with one another provide a very important resource for coping.[44]

Disaster management and development organizations are taking advantage of these social media for DRR. UNDP has made available the ICT for Disaster Management e-primer on Wikibooks,[45] which hosts open educational resources that can be edited and updated by all, and used for capacity building initiatives. And the Caribbean Disaster Emergency Management Agency has used Facebook to attract youths to participate in an essay and poster competition as part of its aim to raise youth awareness on comprehensive disaster management.[46]

As access to the Internet increases and more people in the region are using it, social media can be utilized to monitor people's interpretation of disaster information, including warnings and other risk messages, so that these messages can be fine-tuned based on how people are responding to them, and new information can be pushed out to correct any inaccuracies.

What is still missing, however, are in-depth research studies and systematic impact analyses showing evidence of ICTs as contributing to better, more effective and efficient DRR. Nonetheless, there is a growing awareness of the importance of ICT for DRR, and the next section examines various innovative ICT applications that have been used at different phases of the DRR cycle, in order to draw out some key lessons learned for policymakers to maximize the potential of ICT for DRR.

43. See http://www.kcnn.org/principles.
44. Jeannette Sutton, "Social Media Brings Together Resources, Creates More Resilient Communities (Analysis, Social Media Package Part 2 of 2)," Emergency Management, 31 July 2009,http://www.emergencymgmt.com/safety/Social-Media-Brings-Together-Resources.html.
45. ICT for Disaster Management Wikibook, http://en.wikibooks.org/wiki/ICT_for_Disaster_Management.
46. See http://www.facebook.com/pages/Comprehensive-Disaster-Management-Conference-Essay-and-Poster-Competition/133761107939?v=wall.

4. ICT Applications for DRR

The importance of ICT for DRR is recognized at international arenas such as the World Summit on the Information Society (WSIS). The WSIS Plan of Action specifically mentions the use of ICT for humanitarian assistance during disaster relief, and for forecasting and monitoring the impact of disasters.

The application of ICTs can be divided into two broad usages in disaster management. The first set of usage is associated with knowing the risks, including being aware of them and having access to relevant information on these risks to be able to minimize these risks in a timely manner. ICT applications that are used to enhance information management, forecasting, modeling, monitoring and risk mapping in support of decision-making falls into this category. It also includes ICT applications for teaching and learning, and for raising awareness that are all critical for developing a 'culture' of DRR, as well as building specific skills set required by disaster managers.

The second area of usage focuses on how best to manage risks and disasters by utilizing available ICT tools, including the Internet, phones, television and radio, in alerting communities of impending disasters, in coordinating response and rescue, and in managing mitigation programmes and projects.

Below, the application of ICTs during different phases of the DRR cycle will be discussed, starting with the use of ICT for strengthening early warning systems (EWS), since it has recently received most attention. In line with the latest thinking, this publication sees and discusses EWS as an integral part of DRR that require effective communication, preparedness planning, multi-stakeholder cooperation and the conduct of risk assessments to better under the risks. Therefore, the good practices and lessons learned presented in section 4.1 on EWS appliy to overall DRR as well.

Section 4.2 focuses on the use of ICT for disaster mitigation. The effective use of ICTs in this phase often receives the least attention as it is the time of calm in between disasters. As a result, the author has made significant effort to demonstrate the wide ranging programmes and projects that utilize ICTs as tools to help generate the momentum to reduce disaster risks, build sustained systems and networks, and develop synergies that contribute to wider development goals.

Section 4.3 examines the use of ICTs in the response and recovery phases. In contrast to ICT usage in mitigation, the field of emergency communication is more widely documented. This section highlights key interventions in Asia and the Pacific focused particularly on experiences relating to interoperability between technologies and systems, and the development of open standards and free and open source software to facilitate interoperability.

4.1 Early Warning Systems

Recent major disasters have brought to the fore the importance of EWS and, in response, a number of conferences and analyses examined the elements and processes of EWS. From these efforts, there emerges a consensus that "early warning is not only the production of technically accurate warnings but also a system that requires an understanding of risk and a link between producers and consumers of warning information, with the ultimate goal of triggering action to prevent or mitigate a disaster,"[47] making early warning a key component of DRR.

This analysis has broken EWS into four separate but interlinked elements as follows:

1. Risk knowledge
2. Technical monitoring and warning service
3. Dissemination and communication of warnings
4. Response capability and preparedness to act (by authorities and by those at risk)

Previously, development of an EWS focused largely on the second element in developing systems to monitor and detect hazards, and establish institutional mechanisms for the generation and issuance of warnings. But recent disasters clearly showed that the production of technically sound warnings can be futile without prior assessment of what the risks are or without a clear dissemination strategy and appropriate response capacity.

For example, the devastation caused by Cyclone Nargis in Myanmar in 2008 was not due to a technical failure in the early warning service - warnings were provided by the Myanmar Meteorological Service - but due to a failure in the other elements of the EWS, especially communication and preparedness to act.[48] ICTs can be effective tools in improving both these aspects of the EWS.

4.1.1 Communication

By and large, warnings are transmitted from a national (or sometimes international) technical agency through multiple receivers before they reach the at-risk communities. To avoid delay and distortion in the process, the development of international standards such as the Common Alerting Protocol (CAP) is important.

The CAP provides a general format for exchanging emergency alerts and public warnings between different alerting technologies. It is a set of ordered data that encapsulates all the information for an alert. It includes information such as the area, urgency, severity, certainty, headline, description, event, category, message type, and scope, as well as response type, sender, effective time, and message type.[49]

47. IFRC, World Disasters Report 2009: Early Warning and Early Action, Geneva: IFRC, 2009, p. 17, http://www.ifrc.org.
48. Ibid.
49. To see what a CAP message looks like go to http://www.weather.gov/alerts/ and select the CAP message of any state.

CAP allows a warning message to be consistently disseminated simultaneously over many warning systems to many ICT applications, which thus increases warning effectiveness and reduces costs. The system will also simplify the work of alerting officials by giving them a write-it-once method for issuing warnings over multiple dissemination systems without duplicate effort.[50]

The actual alert message itself needs to be carefully crafted so that it is clear and succinct, with guidance that incorporates the values, concerns and interests of those who will need to take protective action, so that the message is easily understandable and unambiguous. For example, in reference to evacuation, it is less effective to say, "Get to high ground" than to say : "By 'evacuate to high ground', we mean climb the slopes around town until you are higher than the tallest buildings."[51]

Even with well-coordinated structures and well-crafted messages, dissemination to remote areas is still difficult in many places and requires a combination of technological and non-technological solutions. There is no 'one size fits all' solution to last-mile communication - the participation of community members in deciding the appropriate communication tools and processes is essential to ensure that warnings reach them in a timely manner.

LIRNEasia, with funding support from the International Development Research Centre, initiated an action research project (the HazInfo Project) in Sri Lanka during 2006 and 2007 to study which ICT applications and community mobilization methods could work effectively in disseminating information on hazards faced by selected coastal communities.[52]

The project involved Sarvodaya, Sri Lanka's largest NGO whose work encompasses 15,000 villages throughout Sri Lanka. Sarvodaya established a Hazard Information Hub (HIH) to maintain 24/7 links with the government's designated disaster warning agencies as well as with international sources monitoring various hazards in the Indian Ocean region. Thirty-two Tsunami-affected villages that belong to Sarvodya's network of villages were selected for the study, and volunteers from these villages were trained in community-based disaster preparedness, and subsequently undertook a participatory risk mapping exercise, developed an emergency response plan and decided on early warning procedures with members from their respective community. To assess the outcome of the different components, simulated drills were conducted.

Five tools in eight combinations were tested for their reliability and effectiveness in transmitting information from the HIH to the villages. They included:[53]

- Fixed telephones (using wireless CDMA technology)
- Java-enabled mobile phones customized to carry text alerts in English, Sinhala and Tamil

50. The CAP 1.0 specification was approved by the Organization for the Advancement of Structured Information Standards (OASIS) in April 2004 and updated to CAP 1.1 specification in October 2005. In 2007, the International Telecommunication Union adopted the CAP as Recommendation X.1303. For more information, see http://www.oasis-emergency.org/cap, http://www.oasis-open.org/committees/download.php/15135/emergency-CAPv1.1-Corrected_DOM.pdf, http://en.wikipedia.org/wiki/Common_Alerting_Protocol.
51. IFRC, op. cit., p. 47.
52. See Nalaka Gunawardene and Frederick Noronha, ed., Communicating Disasters: An Asia Pacific Resource Book, Sri Lanka: TVEAP and Bangkok: UNDP, December 2007, http://www.apdip.net/news/communicatingdisasters/; and http://lirneasia.net/projects/2006-07/evaluating-last-mile-hazard-information-dissemination-hazinfo/.
53. Gunawardene and Noronha, op. cit., p. 92.

- Very Small Aperture Satellite Terminals
- Addressable Radios for Emergency Alerts (AREA), developed by the WorldSpace Corporation
- A remote alarm device (RAD) developed by Dialog Telekom and University of Moratuwa

The project not only evaluated the ICTs, but also studied the extent to which training and the level of organizational development in a village influenced community responses; and how women participated in these exercises.

Results from the research revealed that AREA combined with fixed or mobile phones were the most effective and reliable in communicating warning. Under normal circumstances, AREA can work as a radio, receiving digital radio transmissions from WorldSpace satellites. In the event of an impending hazard, they can be switched on remotely from a central location, whether or not the user has turned it on at that moment, converting them instantly into a hazard alert system. Each radio has an in-built GPS and a unique code. This enables hazard warnings to be issued to only those units known to be within a vulnerable area, or just to those units with specific assigned codes. Mobile and fixed phones, on their own, were also found to be reliable, although having two communication technologies ensured at least one would work at critical moments. AREA and RAD units also worked well as a combination.

The lack of access to ICT and connectivity is a critical bottleneck in establishing end-to-end EWS. But as indicated at the beginning of the chapter, the ICT access and connectivity is increasing at rapid rates with technological advancements, including space-based technologies. It is therefore important to stress the need for a mix of technology and a combination of technological and non-technological solutions to reach the last mile. For example, the Bangladesh Red Cross uses megaphones and hand sirens, and the Sri Lanka villages from the HazInfo project use runners and loud-speakers and/or temple bells. The appropriate mix of communication channels will need to be determined by the communities themselves through a participatory planning process.

ICTs can be used to enhance global, regional and national cooperation in early warning, where global information networks of the World Meteorological Organization, Food and Agriculture Organization, WHO, UN/ISDR, etc. support national and local EWS. ICTs are also indispensable for regular two-way communication between national and local authorities and the communities, as the role of communities in early warning is increasingly being recognized as important, particularly in their participation in monitoring hazards (e.g. in reading flood markers and rain gauges, and transmitting data in real time over handheld, two-way radios with a city flood-monitoring station). Effective channels of communication are also required in complementing technical warnings with communities' local and indigenous knowledge of early warning signs (e.g. colour of the river water, size and type of debris in river, animal behaviour, etc.); and for communities to provide feedback to the warning providers about how they understood the warnings and how they might be made more actionable or comprehensible.

4.1.2 Preparedness

People's willingness or ability to take appropriate actions when warnings are received can be affected by various factors, many of which can be overcome through preparedness. People are more likely to pay attention to warnings if they have been educated about the risks in advance and know what actions to take. Public education campaigns, including incorporating disaster risk awareness into school curricula, can contribute to a culture of safety. For schools with computers and Internet connectivity, these ICT tools can be incorporated into raising disaster risk awareness, e.g. through 'SchoolNets' - a recognizable national or regional network of teachers, students and communities to learn together, share experiences and support each other. A number of radio programmes such as Afghanistan's New Life Project are used to promote disaster preparedness. Sri Lanka has explored the use of television soap operas to raise public awareness on landslide risks.

But preparedness does not just end with the provision of information. There is a growing recognition that vulnerable communities can and should be engaged in developing their disaster preparedness and response plans, involved in regular drills to test the effectiveness of the early warning dissemination processes and responses, and even participate in the design of EWS and preparedness programmes.

One of the ways to begin engagement with community members is through conduct of risk assessments. The concept of participatory GIS (PGIS) for risk mapping takes advantage of the capabilities of GIS to produce a visual representation of place-specific local knowledge, which can then be disseminated among the community members and to local authorities (see section on Risk Assessment below for more discussions on PGIS).

4.1.3 Risk Assessment

ICTs play a significant role in addressing the first element of the EWS in improving risk knowledge, particularly in the areas of data collection, analysis and dissemination. Remote sensing and GIS capabilities through seismographic networks, deep ocean sensors and satellite-based systems are being used to develop effective EWS. GIS technology, for example, is used to predict what hazards might potentially impact a region or a specific project; assess physical assets to provide more accurate information on how to protect investments; and suggest alternatives available to reduce the direct and indirect impacts.

Maps and GIS technologies are ideal for capturing the physical dimensions, but their use in analysing the vulnerability aspects due to people's social, political and cultural conditions, their perception of risk and their coping capacity proved more challenging. Nonetheless, research and pilot initiatives have been conducted to capture these vulnerability aspects at the community level using maps and GIS.

A research study[54] carried out by the Aon Benfield UCL Hazard Research Centre demonstrated that local community knowledge related to flooding can be systematically structured into spatial and non-spatial information compatible with a GIS, through a practice named 'participatory GIS' - essentially the use of geo-spatial technologies to promote interactive participation of stakeholders in generating, managing, analysing and communicating their knowledge.

54. Graciela Peters, Michael McCall, Cees van Westen, Coping Strategies and Manageability: How Participatory Geographic Information Systems can Transform Local Knowledge into Better Policies for Disaster Risk Management, Aon Benfield UCL Hazard Research Centre, Disaster Studies Working Paper 22, February 2009, http://www.abuhrc.org/Publications/Working%20Paper%2022.pdf.

This practice has made community knowledge, experience, perception and coping capacity more visual and accessible, contributing to a better understanding of risks. At the same time, it has helped initiate dialogue and partnership between the vulnerable communities and other actors in DRR, including government authorities, NGOs, international agencies, academia and the private sector.

PGIS can be a powerful tool for enhancing communities' capacity and building their resilience to disaster risks. It is also extremely helpful in managing preparedness at the local level by providing local authorities with better indicators than just typical GIS information on water depth and flood duration or population characteristics. Additionally, it can help promote learning among different actors by bringing new information and perspectives into decision-making processes.

The UNU-ITC School for Disaster Geo-information Management recognizes the value of local knowledge for DRR and is carrying out research on the integration of local knowledge on frequent hazards, with data from remote sensing images.

The Asian Disaster Preparedness Center (ADPC), an advocate and pioneer in many aspects of community-based disaster management, has initiated pilot projects that demonstrate the benefit of involving communities in the mapping process. Communities often develop maps as part of their community-based risk assessment exercise. The process encourages community-wide participation and discussions on the risks they face. Communities have used their maps to plan evacuation routes, emergency response and small-scale disaster-mitigation projects. In one of ADPC's projects in Dagupan City, Philippines, community maps have been used as input to the city's disaster information management system, resulting in a working end-to-end flood EWS. One of the case studies contributed by ADPC, looks at the use of ICTs in a community-based EWS system in Sri Lanka.

As mentioned at the beginning of this section, the various practices described are relevant to DRR in general. Risks assessments are useful not only for early warning, but also for policy formulation, programme design, and evaluation of interventions, and are carried out at all phases of the DRR cycle, albeit at different levels of detail and emphasis. While the response phase involves the conduct of rapid damage and needs assessment to allow for quick decisions to be made, programmes and projects that are focused on mitigating risks should include in their planning process, an extensive assessment process.

4.2 Mitigation

Mitigation is usually incorporated in mid- to long-term DRR strategies that are focused on minimizing the adverse impacts of hazards and related disasters. The presence of data and information is crucial to helping decision makers understand the root causes of a disaster so that informed decisions can be made in order to, as much as possible, avoid an event from turning into a disaster.[55] Root causes can be related to poverty, inequality, illiteracy and other aspects of vulnerability.

4.2.1 Databases for Policymaking and Planning

Information on different aspects of DRR is expanding rapidly, and access to the information is becoming easier through ICTs. Resources, previously considered the domain of specialists, now reach a wider range of users. The number of interested people, educational institutions, organizations and local community users is growing, as are relevant websites, networks, professional and often multidisciplinary exchanges online and offline.

A number of disaster databases, for example, are now available online to the public. The Centre for Research on Epidemiology of Disasters (CRED) maintains EM-DAT, a global database of natural disasters that contains essential data on the occurrence and effects of more than 17,000 disasters worldwide from the period of 1900 to the present. Reinsurance companies such as Munich Re and Swiss Re also maintain global disaster databases to assess insurance risk. But for these corporate databases, there is a lack of statistics in poor areas where insurance is unaffordable or unavailable.[56]

At the national level, UNDP has been promoting the establishment of nationally-owned disaster loss databases to better analyse the disaster trends and impacts at the sub-national level (see case study by UNDP below).

These databases are extremely useful for policymaking, planning and research. But the development of these databases is not without challenges and constraints. A key constraint is the unavailability of a standardized approach to collecting and defining/classifying different aspects of disaster. Another is the lack of data in many developing countries. Looking at natural disasters over the last decade, data on deaths are missing for around one-tenth of reported disasters, data on people affected are missing for around one-fifth of disasters, and data on economic damages are missing for 67 percent of disasters.[57] CRED deals with these challenges by constantly revisiting, reviewing and verifying the data.

4.2.2 Databases for improving transparency and accountability

Also developed by UNDP, the web-based Development Assistance Database (DAD) is an aid information management tool for tracking the use of aid received for response and recovery after the 2004 Indian Ocean Tsunami. The Governments of Indonesia, Maldives, Sri Lanka and Thailand have established nationally owned systems of DAD. Additionally, a regional information portal has been developed as a resource for coordination at the regional level. It brings together results and resource-allocation information from each country and makes them available online.

While almost US$8 billion of assistance was tracked on DAD, the customized systems were faced with a number of challenges.

> *... as one observer from Maldives put it, "high-tech, but also high-maintenance." A major challenge facing all countries trying to improve accountability was achieving the cooperation of all parties to provide accurate, updated tracking of tsunami assistance online. Moreover, sometimes self-*

55. Disasters occur when a potentially dangerous natural phenomenon impacts vulnerable people (or their houses, organizations or cultures) who then cannot cope with these natural forces and their destructive effects.

56. IFRC, op. cit.
57. IFRC, op. cit.

reporting by development agencies fell short. As a result, in Sri Lanka, for example, despite strong Government efforts to encourage development organizations to report expenditures, the system apparently had not captured between US$500 million and $1 billion as of March 2006, including funds already disbursed. Agencies struggled to break their contributions down by district. To go beyond a database and ensure systems really help lock in improved accountability, according to the Maldives observer, "you need a senior, seasoned person," with a clear vision of how the various pieces of the puzzle fit together.[58]

In the Indonesian province of Aceh, the Aceh-Nias Rehabilitation and Reconstruction Agency (BRR) promoted a number of initiatives to help overcome some of the challenges described above. For instance, to encourage organizations to update the customized DAD database (named the Recovery Aceh-Nias Database or RAND), BRR contacted major donors, key users in BRR, and provincial and district governments, to identify their information needs and the types of format they need the information in. The database was customized accordingly.

In another initiative, BRR encouraged many NGOs that were not yet online to send BRR their data in a CD-ROM, which BRR staff uploaded. Later, an Outreach Team was established that provided a help desk function as well as developed customized reports as requested by donors and other users of RAND. These initiatives helped RAND gain credibility and increased its level of updating from 35 to 98 percent. RAND won the Innovative Government Technology Award in the Information Management category at the 2008 FutureGov Summit.

Data on RAND provided the basis for another innovative ICT application by BRR - the Aceh and Nias Housing Geospatial Database - that was used to monitor housing reconstruction in the effort to promote transparency and minimize corruption. This database allows the process of tracking and monitoring reconstruction to be systematically recorded in the database. The information is first gathered from RAND, then verified by field teams and digitally mapped for GPS coordinates, followed by the building of a text database. In its finest detail, each entry in the database includes a picture of the house, its GPS coordinates, the name of the house's present owner, the building contractor, and the organization that helped build it. The housing geospatial database has been merged with another database covering all other assets - bridges, hospitals, schools, roads - creating a combined information system that is one of the most comprehensive and 'leak-proof' in the recovery phase.[59]

4.2.3 GIS for mitigation

Recognizing the importance of making global disaster risk more visible as a key step towards mobilizing the political and economic commitment needed to reduce it, and in the attempt to bring together reliable data from various credible sources, the PREVIEW Global Risk Data Platform[60] was developed. Initiated by the United Nations Environment Programme in 1999, PREVIEW recently underwent major improvements in application and data to support the analyses for the 2009 Global Assessment Report on Disaster Risk Reduction of UN/ISDR.

PREVIEW uses GIS technology, which as explained above, has been widely used for the presentation and analysis of hazards, vulnerabilities and risks. Developed by a large, interdisciplinary group of researchers from around the world, PREVIEW shares spatial data information on risks related to tropical cyclones and related storm surges, drought, earthquakes, biomass fires, floods, landslides, tsunamis and volcanic eruptions. Users can zoom in on a particular area, choose layers to display, such as population distribution, GDP per capita, elevation or land cover against the natural hazards, to show the risk areas. Users can choose to visualize, download or use the data live in a GIS software.

Other examples of platforms and systems using GIS technology to present, analyse and share geospatial information include the Typhoon Committee's[61] forthcoming web-based disaster information system that aims to facilitate timely access to typhoon-related disaster information through the Internet. It will also serve as a platform for members to share disaster data, knowledge, experiences, good practices and other information related to typhoon disaster risk reduction. The Pacific Disaster Center's Asia Pacific Natural Hazards and Vulnerabilities Atlases, an online GIS tool that combines baseline geographic and infrastructure data layers with historical as well as near-real time data on multi-hazard events, is another example. Hits on this tool rose by 300 percent during the aftermath of the 2004 Indian Ocean Tsunami.[62]

4.2.4 Knowledge, innovation and education

Information by itself is not knowledge. Just being aware of a danger does not automatically lead to a reduction of the risks. It is therefore imperative to train and promote continuous learning in vulnerable communities towards enhancing their capacity in finding appropriate risk reduction solutions and techniques. It is also important to promote risk education among decision makers, highlighting the way a 'development' decisions can impact risks. This is because many decisions affecting vulnerable communities are driven by external decision makers, including national and local governments and private companies. In some cases, these decisions are even taken in another country (particularly in the case of trans-boundary river management that can lead to flooding in the lower part of the watershed).

The 2009 UN/ISDR Global Assessment Report on Disaster Risk Reduction reports that the average global progress is weak across most areas of HFA Priority for Action 3 - using knowledge, innovation and education to build a culture of safety and resilience at all levels. As ICTs become ubiquitous across the globe and within the region, it is ever more important to take advantage of the potential of ICTs to share knowledge, and promote awareness, education and innovations to reduce disaster risks.

A number of online portals with disaster-related resources are accessible through the Internet, the most popular being PreventionWeb and ReliefWeb. They not only provide an aggregation of news on

58. Tsunami Global Lessons Learned Project, The Tsunami Legacy: Innovation, Breakthroughs and Change, 2009.
59. Ibid.
60. See http://www.grid.unep.ch/activities/earlywarning/preview/index.php.

61. The Typhoon Committee is an intergovernmental body officially established in December 1968 under the auspices of ESCAP and the World Meteorological Organization to promote and coordinate the planning and implementation of measures required to minimize the loss of life and material damage caused by typhoons. The Typhoon Committee is composed of 14 members from the Asia Pacific region.
62. See http://www.pdc.org/atlas/ and http://demo.pdc.org/pdf/factsheets/Atlas2.pdf.

disaster events, but also include training materials, maps, videos, research studies and other resources that can be used to raise awareness and advocate for DRR. Furthermore, the Web 2.0 phenomenon has added a collaborative dimension to many of these portals and networks. PreventionWeb, for instance, provides the opportunity for individual to contribute resources, events and organization contacts. It also offers to provide free tools and advice to anyone interested in setting up a network or online community on DRR-related issues.

Nonetheless, the use of ICT devices and systems is still limited in many countries and alternative models are needed to provide connectivity in low and no-bandwidth environments. For example, one of the case studies below looks at the role of the Community Tsunami Early-warning Centre (CTEC), established in Peraliya, Sri Lanka after the 2004 Indian Ocean Tsunami, which is equipped with some ICT tools such as radios, telephones, a satellite television, computers and Internet access. One of its activities includes the involvement of community volunteers in monitoring seismic activity and other natural disasters on the Internet. Any relevant information online is then translated and posted on notice boards. CTEC also holds public awareness events on DRR. One of the activities involved showing videos of community-based disaster risk management activities in other countries to prompt discussions among the community.

The Red Cross Red Crescent Climate Centre in partnership with Red Cross and Red Crescent Societies also uses video tools in their community projects that are aimed at raising awareness on extreme weather events and climate change, and working with communities to identify coping strategies. A methodology called 'participatory video' has been used in which a group or community is involved in producing a video from developing the storyboard, to interviewing people and operating the camera. The rationale for investing in participatory video is based on its huge potential to change human behaviour - the key element of reducing disaster risks and adapting to climate change. Videos' audiovisual ability can portray the human-side of technically complex issues, and effectively capture people's experiences and emotions in ways that can inspire and motivate change.

> *After a workshop on flooding and climate change with Mozambican farmers, participants watched a four-minute video from a similar workshop held in a flood-prone Argentinean shanty town. After seeing the short film on a laptop screen, one of the women farmers said to the workshop facilitator: "I had followed your explanations of global warming, but didn't fully believe you... We've had the 2000 floods that killed so many people and since then two dry spells, and like everybody else I thought it was God punishing us, or that the ancestors were angry... and we can't do much about it. But now in the film I see that white women in the other end of the world have the same problem we have! So maybe it is true that the global rainfall is changing, and so if I can do something about it, I will." The video had touched this farmer in a way that motivated her to consider changing crops to adapt to different climatic conditions.*[63]

Media agencies for television and newspaper can also play key roles in raising public awareness. Although media coverage is still largely focused on major disaster events and the immediate dramatic aftermath, there is a growing recognition of the need to include media representatives and journalists in mitigation programmes and targeted as a group for training to encourage reporting on DRR before a disaster occurs. For example, Inter-Press Service Asia-Pacific had a special series on the 2004 Indian Ocean Tsunami that invited applications from journalists residing in Tsunami-affected countries to report on another Tsunami-hit nation, to produce stories linking the two and learning from each other's DRR experiences. The challenge is in sustaining public interest, and keeping important stakeholders actively interested and engaged in the efforts, in times of calm. But it is the time between disasters when DRR capacities must be strengthened if future losses are to be avoided.

The potential of e-learning, distance education, open learning or online learning tools that make use of the Internet and multimedia technologies (combining video, sound, animation, text and graphics) to impart DRR knowledge should also be tapped. The National Institute of Disaster Management in India has collaborated with the World Bank Institute in offering a series of online training courses on DRR.[64] APCICT is in the process of developing an ICT for DRR training module as part of its Academy of ICT Essentials for Government Leaders Programme (Academy) that comprises a comprehensive ICT for development curriculum with a number of standalone but interlinked modules. The ICT for DRR module, like the other modules of the Academy, will be repackaged into a self-paced online course and made available on a learning management system - the APCICT Virtual Academy (AVA). The system offers: video lecture synchronized with presentation; self-assessment and review quiz; learning resources downloading; and learner's tracking and progress monitoring system. There is the option for users from countries with limited connectivity to choose a bandwidth matching their situation (300k, 100k, 52k or audio only). For users with no or limited Internet connection, the DVD version of AVA provides an almost identical technology platform and a comparable learning experience. AVA has been developed as part of APCICT's strategy to diversify its delivery channel, extend outreach in a cost effective manner, attract a broader user base, and encourage continuous and self-learning.

4.2.5 Enhancement of internal organizational effectiveness

To improve the internal efficiency and effectiveness of DRR organizations, particularly for international or regional organizations with country offices, many have made use of online applications to manage information, share knowledge and coordinate activities. The International Federation of Red Cross and Red Crescent Societies (IFRC), comprising of about 60 regional and country delegations around the world and 185 member Red Cross and Red Crescent Societies, has established FedNet, an extranet - a private web site for National Societies, staff at Headquarters and field delegations. Through this online platform, IFRC employees and volunteers worldwide are able to access key resources required in their day-to-day operations. It also provides an interactive forum for knowledge sharing and online collaboration. FedNet runs on a web content management system[65] called Synkron.web. This system was chosen because of its ability to integrate with other information systems which were already in

63. IFRC, op. cit., p. 108-109.

64. See http://www.nidm.net/WBI_09.pdf.

65. A content management system is a software program that allows non-technical users to edit, update, maintain, and create a website using built-in templates.

existence in the Federation.

UNDP established a Solutions Network of Asia-Pacific or the SNAP Platform, built on the Microsoft Solution Sharing Network program, and used for knowledge sharing and collaboration to improve the effectiveness of UNDP programmes and projects. SNAP is the virtual 'home' for the DRM-Asia community of practice established by UNDP in 2006 to share knowledge among the disaster risk management community in Asia and the Pacific. Initially an internal community of UNDP practitioners only, it has now expanded its membership beyond UNDP.

4.3 Response and Recovery

When a disaster strikes, there are a handful of organizations that are ready to provide assistance. In providing emergency communication, the International Telecommunication Union (ITU), for instance, deploys mobile satellite terminals and various other communications equipment to help restore vital communication links for the coordination of relief operations. This is part of the ITU Framework for Cooperation in Emergencies that has benefited from the contribution of funds and equipment from its partners - FedEx, ICO Global Communications, Inmarsat, Iridium, TerreStar Global, Thuraya and Vizada.[66]

Another key player in emergency communication is Telecoms Sans Frontiéres (TSF) that is involved in the provision of communications to UN agencies and humanitarian organizations to coordinate emergency relief, and in providing those affected by the disaster a free phone call. Recently, TSF has also been working with various countries in strengthening their capacities to respond to disasters through training and by expanding the ICT infrastructure.[67]

Most data needed in a disaster are geospatial. The first questions typically asked are related to the location of the disaster event: "Where is it? What is in the area? How do I get there?" Collaborations such as the International Charter on Space and Major Disasters and other organizations are ready to provide satellite images and GIS analyses to aid response and recovery, as discussed in the section on GIS above.

More recently, with the growing popularity of Web 2.0 tools, they have been used as a mechanism for the coordination of response and recovery initiatives. Hundreds of blogs emerged in the first few days following the 2004 Indian Ocean Tsunami. These were used for providing instantaneous situation reports, information sharing, locating missing persons and fund raising. One of the case studies below provides a personal account of a blogger who led the development of an online initiative that started out as TsunamiHelp, and became the widely recognized South-East Asia Earthquake and Tsunami Blog, known also as the SEA-EAT blog.

This trend was also evident following Typhoon Ondoy in the Philippines in September 2009 when volunteers from the Philippines and across the world came together to provide, organize and disseminate information online through sites such as Facebook, Multiply, Plurk and Twitter. People turned to these sites for up-to-the minute reports regarding what was affected, what was needed, what resources were available, and as aid began arriving spontaneously, what was coming and when. Affected organizations and individuals used the site to post requests for assistance, while volunteers and other individuals and organizations responded with the goods or human resources needed. This was possible because although the storm cut power, telephone and water supply in many areas, Internet connections were generally not affected.[68]

Also in the Philippines, what started as an initiative by a local Web developer who volunteered his time to set up a Google Maps page to document flood updates and persons needing rescue was quickly supported by major organizations such as GMA and ABS-CBN news networks, who embedded the map in their respective news sites; and by Google who helped make the page more visible by putting the link to it below the keyword search box at the Google Philippines home page. Google software engineers, staff from the two news networks and willing Filipinos pitched in by improving the capabilities and interface of the map facility. By then, the site had become a central hub of information regarding the latest developments with the relief efforts.[69] Other noteworthy initiatives that have emerged from the typhoon are Rescue InfoHub Central[70] using Google spreadsheet and Bayanihan Online that aggregated relevant 'tweets' from Twitter.[71] This Philippine case has also shown successful examples of online fundraising. PhilippineAid.com and Txtpower.org have raised significant funds for the Philippines National Red Cross.

A study found that being able to participate in social media is a great benefit to those who are directly affected by disaster because it gives them something to do. It allows those who have been evacuated from their home to participate in an online 'community' and provide the latest updates and information. Communicating with others can help survivors cope because it gives them the ability to share information and talk about the event.[72]

Indonesia effectively used radio to help reduce the trauma of survivors after the 2004 Indian Ocean Tsunami. A weekly one-hour programme assisted by UNDP was launched for the 13,000 internally displaced in Meulaboh, Aceh. The radio programme covered topics derived from interactions with the community, such as how to control emotions, family relations, employment and income, housing conditions and establishing a community support network. A counselor and a psychologist provided advice on how to cope with various forms of stress. To promote two-way communication, listeners could send in an SMS to ask questions.[73]

66. See http://www.developingtelecoms.com/itu-restores-telecoms-links-vital-for-sichuans-rehabilitation-effort.html.
67. Diane Coyle and Patrick Meier, New Technologies in Emergencies and Conflicts: The Role of Information and Social Networks, Washington, D.C. and London, UK: UN Foundation-Vodafone Foundation Partnership, 2009, http://www.unfoundation.org/press-center/publications/new-technologies-emergencies-conflicts.html.
68. John Mark V. Tuazon, "Disaster Management 2.0," Computerworld Philippines, 6 October 2009, http://computerworld.com.ph/disaster-management-20/. See also http://newsinfo.inquirer.net/inquirerheadlines/nation/view/20090928-227233/Netizens-help-victims-via-social-network-sites.
69. See http://sites.google.com/site/ondoymanila/, http://www.google.com/landing/typhoon-ondoy.html, http://www.abs-cbnnews.com/nation/09/27/09/ondoy-situation-map-metro-manila-google-maps#Map, http://maps.google.com/maps/ms?ie=UTF8&hl=en&t=p&source=embed&msa=0&msid=100693175203414818292.00047501c97fd73a79b85&ll=15.315976,122.124023&spn=7.412133,9.338379&z=6.
70. See http://spreadsheets.google.com/ccc?key=0Ai4KmPHsK-wPdG9odTlrdGh0VTZhbmxmMjFMb3cw0Gc&hl=en.
71. See http://bayanihanonline.wordpress.com.
72. Jeannette Sutton, 31 July 2009, op. cit.
73. UNDP, "Aceh and Nias Recovery: UNDP Supports Radio Program to Reduce Tsunami Trauma," July 2006, http://www.undp.or.id/tsunami/view.asp?Cat=st&FileID=20060711-1.

4.3.1 Emergency Response Planning

For effective response, emergency response planning before disaster strikes is absolutely critical. As part of this emergency planning process, many countries have established Emergency Operation Centres (EOCs). An EOC is a central command and control facility responsible for carrying out disaster management functions at a strategic level in an emergency situation, and ensuring the continuity of operation of a key government entity.

A critical component of an EOC is its communication system to receive information in a timely manner and disseminate appropriate messages to alert relevant officials and to communicate with the response teams on site. Since the regular telecommunication infrastructure of public wired and wireless telephones is usually destroyed or damaged by the disaster, it is essential to set up robust and reliable systems that will continue to function during disasters. For instance, EOCs can employ both terrestrial and satellite-based communication technologies with redundancies to establish a based network. Interoperability between these technologies must be considered for seamless communication between the primary and back-up platforms.[74] In providing rapid back-up in an emergency, wireless and mobile satellite based units that can be transported to the disaster site can be procured in advance.

There are a number of information systems and communication solutions for response and recovery being developed and continually improved upon. Examples of systems developed in Asia include DUMBO, OpenCARE and Sahana. DUMBO is a project initiated by the Asian Institute of Technology Internet Education and Research Laboratory.[75] It is a set of network technologies deployed post-disaster to provide multimedia communication responders on site and with a distant command headquarter, when a fixed network infrastructure is not available or has been destroyed. OpenCARE[76] is an information middleware that enables incompatible systems to work together. At the same time, it is also an information/alert dissemination system. Its development is being led by Trin Tantsetthi, former president and CEO of Internet Thailand.

Sahana was developed by a group of IT volunteers from Sri Lanka, headed by the Lanka Software Foundation, after the 2004 Indian Ocean Tsunami. Sahana is a web-based disaster management application for tracking missing people and coordinating relief and recovery efforts of different agencies, including the matching of pledges of aid to requests from the field and the management of camps. Sahana was authorized and used by the Centre for National Operation (CNO) as a part of their official portal in 2005. Sahana is a FOSS application, which means all users can use, copy, distribute and modify the software without having to seek permission for a license. This is critical because it enables systems to be modified to specific circumstances or specific disasters quickly, making the system re-usable for the future and open for further development by IT professionals from around the world. Since its first

74. ESCAP, Enhancing Regional Cooperation on Disaster Risk Reduction in Asia and the Pacific: Information Communications and Space Technologies for Disaster Risk Reduction, Note by the secretariat presented at the First Session of the Committee on Disaster Risk Reduction, 25-27 March 2009, Bangkok, Thailand, http://www.unescap.org/idd/events/cdrr-2009/CDR_5E.pdf.
75. See http://www.interlab.ait.ac.th/dumbo/.
76. See http://opencare.inet.co.th/twiki/bin/view/Main/WebHome, http://nationmultimedia.com/option/print.php?newsid=30086500, http://www.bangkokpost.com/221008_Database/22Oct2008_data71.php.

deployment by the CNO in Sri Lanka, Sahana has been further developed by a global community of over 200 volunteers comprised of emergency management practitioners, humanitarian consultants, academics and software developers. Additional features have been added to Sahana to not only assist in relief operations but also to help countries prepare for different type of disasters. New applications include a volunteer coordination system, mobile messaging and situation mapping. Sahana has been deployed in over a dozen other countries, and has gained a tremendous amount of recognition for the project and for the concepts it promotes. It has also received numerous awards. (see case study on Sahana below)

Following Cyclone Nargis in Myanmar, a local NGO, Myanmar Egress, and the Myanmar Computer Professionals Association started a DUMBO-Sahana Project.[77] The project includes training, and the set up and customization of DUMBO, wireless ad-hoc mesh networks, GPS mapping, Sahana and OpenStreetMap to enhance the communication and coordination aspects of Myanmar's emergency response system. A number of recent systems and solutions for response and recovery, including DUMBO and Sahana, are briefly discussed in an article by Nadia Nouali, et al.[78]

When disasters strike, private companies play a significant role in relief efforts, and in rebuilding the economy. Companies in the communications industry in particular, have been known to donate communications equipment, repair the communications infrastructure or provide alternative communications systems in case the infrastructure is damaged. Ericsson implements an Ericsson Response Programme that not only provides communication solutions at times of disasters, but is involved in research and raising awareness. Ericsson also contributed to the development of IFRC's Disaster Management Information System.

The Alcatel-Lucent Foundation, the company's philanthropic arm was actively involved after the Sichuan earthquake. Other companies such as Motorola and Qualcomm have partnered with governments and NGOs in providing emergency communication devices such as satellite phones, and various networking solutions. Engaging in partnerships with private sector at the emergency response planning stage is essential in order to ensure better coordinated response operations during emergencies. Partnerships with private sector to support longer-term mitigation and preparedness activities should also be explored.

The World Food Programme (WFP), rather than rely on borrowing equipment from large corporations, developed its own system to allow relief workers to communicate with field offices and headquarters. WFP is also the service provider for the Emergency Telecommunication Cluster (ETC). The cluster approach aims to strengthen the effectiveness of humanitarian response through building partnerships. It promotes predictability and accountability in international responses to humanitarian emergencies, by clarifying the division of labour among organizations, and better defining their roles and responsibilities within the different sectors of the response.[79] ETC is one of the nine clusters established. It aims to

77. Myanmar Egress and MCPA, DUMBO & Sahana Project Implementation Plan, 23 June 2008, http://www.nargisaction.org/images/pdf/reinvent/dumbo__sahana_project_implementation_plan.pdf.
78. Nadia Nouali, et al., "Information Technology for Enhancing Disaster Management," 22 June 2009, http://www.scribd.com/doc/16654082/Using-Information-Technology-for-Enhancing-Disaster-Management.
79. For more information on the cluster approach, see http://ocha.unog.ch/humanitarianreform/Default.aspx?tabid=70.

ensure timely, predictable and effective provision of inter-agency telecommunication services in support of humanitarian operations from the onset of the emergency. WFP has partnered with Vodafone Foundation and United Nations Foundation to set up an ICT Humanitarian Emergency Platform to increase the efficiency and coordination of emergency communication by optimizing and standardizing ICT solutions in emergencies, organizing training programmes on the use of ICTs in disaster preparedness and response to expand the pool of trained ICT experts, establishing a network of stand-by partners ready for deployment, and enabling immediate dispatch of ICT emergency responders.[80]

Evident from the numerous examples given above, ICT applications and solutions are available for almost any situation. But humanitarian organizations can face regulatory barriers that make it extremely difficult to import and rapidly deploy telecommunication equipment for emergency without prior consent of the local authorities. A notable policy breakthrough in emergency communication is the Tampere Convention on the Provision of Telecommunication Resources for Disaster Mitigation and Relief Operations that came into force on 8 January 2005, following ratification by 31 countries.[81]

The Tampere Convention calls on States to facilitate the provision of prompt telecommunication assistance to mitigate the impact of a disaster, and covers both the installation and operation of reliable, flexible telecommunication services. Regulatory barriers that impede the use of telecommunication resources for disasters are waived. These barriers include the licensing requirements to use allocated frequencies, restrictions on the import of telecommunication equipment, as well as limitations on the movement of humanitarian teams.[82]

5. About the Case Studies

Following this introductory chapter, there will be five national case studies from Bangladesh, China, Sri Lanka, and Haiti, and two regional ones that provide in-depth accounts of the processes, challenges, solutions and good practices from their programmes. Focused on different phases of the DRR cycle and the use of a variety of ICT applications, the case studies draw attention to a rich array of lessons learned and recommendations that are summarized in section 6. Before that, a brief overview of the case studies presented in this publication is given below.

i The Bangladesh Comprehensive Disaster Management Programme (CDMP) is a long-term multi-partner programme designed to institutionalize DRR, not only in the Ministry of Food and Disaster Management, but more broadly across various sector ministries. The programme focuses primarily on strengthening institutional and professional capacities to reduce disaster risks. The case study explores its ICT for DRR initiatives, as well as ways in which ICTs have been used to enhance CDMP's effectiveness.

ii. Another case study on Bangladesh contributed by the Asian Institute of Technology assesses the state of the national emergency communication networks, and proposes an integrated and comprehensive information and communication system to address the gaps and weaknesses of the existing system. The development of the integrated information and communication system is based on the principles of reliability, interoperability, energy efficiency and scalability to meet diverse needs in emergency response.

iii. China, being one of the leaders in the research and use of space-based technologies for DRR in Asia and the Pacific, has shared a case study that discusses the application of space-based technologies to reduce flood risks at different phases of the DRR cycle in China. It also provides an overview of China's disaster management system.

iv. The case study from Sri Lanka looks at some of the bottom-up approaches to ICT for DRR. This study on the establishment of CTEC in Peraliya after the 2004 Indian Ocean Tsunami and their strategies and interventions in bridging the 'last mile' of the EWS is contributed by the Asian Disaster Preparedness Center. The case study also shares some insights into factors that have contributed to CTEC's success and sustainability.

v. The case study from Haiti, highlights the deployment of Sahana applications in the aftermath of the devastating January, 2010, earthquake. Tracing the origins of this Humanitarian Foss system from the 2004 Indian Ocean Tsunami, this study examines how Sahana has since developed and how it is being applied to assist relief and recovery agencies in Haiti.

vi. The UNDP case study is based on a regional programme that supports the establishment of national disaster loss databases in the Tsunami-affected countries. It demonstrates the key factors to the successful implementation and institutionalization of the national disaster loss databases, and at the same time identifies the challenges faced during their implementation.

vii. The final case study gives a detailed insider's account of the evolution of the SEA-EAT blog that was launched within hours of the Tsunami. The case study captured the dynamics of how a group of volunteers from across the globe converged on an online platform, and collaborated in meeting needs for information and coordination during the response phase. This blog site pioneered a model for successful online collaboration for DRR and demonstrated the power of the Internet in saving lives.

80. See http://ictemergency.wfp.org/home and http://www.wfp.org/emergencies/ict.
81. The Tampere Convention was ratified by Pakistan on 1 March, 2009, bringing a total of 40 parties on board. For the full list of signatories, see http://www.itu.int/ITU-D/emergencytelecoms/List%20of%20Tampere%20signatories.doc.
82. http://www.itu.int/ITU-D/emergencytelecoms/tampere.html. For the Tampere Convention, see http://www.itu.int/ITU-D/emergencytelecoms/doc/tampere/S-CONF-ICET-2001-PDF-M07.pdf.

No.	Case Study	Location	Hazard Type	Disaster Management Phase	Type of ICT Application
1	Use of ICT in the Comprehensive Disaster Management Programme in Bangladesh	Bangladesh	Multi-Hazard	Mitigation and Preparedness	Various
2	Integrated Information and Communication System for Disaster Management in Bangladesh	Bangladesh	Multi-Hazard	Preparedness (Emergency Communication)	Various
3	Use of Space-based Technology in China	China	Flood	All Phases	Space-based Technology (GIS and Remote Sensing)
4	Community-Based Early Warning System in Sri Lanka	Sri Lanka	Tsunami and other hazards	Preparedness (Early Warning)	Various
5	The Sahana Free and Open Source Disaster Management System in Haiti	Haiti, Sri Lanka	Multi-Hazard	Response and Recovery	Various
6	Establishment of Disaster Loss Database in Tsunami Affected Countries	India (Tamil Nadu), Indonesia, Maldives, Sri Lanka and Thailand	Multi-hazard	Mitigation	Web-based Disaster Loss Database Application (DesInventar)
7	South-East Asia Earthquake and Tsunami Blog	Regional	Tsunami	Response and Recovery	Various social media

Table 3. Summary of case studies

6. Key Lessons Learned

The case studies and the analysis of ICT for DRR applications and projects in general, reveal a number of key lessons learned that are presented and discussed below.

i. Incorporating ICT for DRR as part of sustainable development efforts

It is widely accepted that some groups in society can be exposed to greater risks because of social or economic inequalities that create more vulnerable everyday living conditions. Because of this, DRR has become increasingly associated with practices that define efforts to achieve sustainable development. ICT for DRR policies and measures, therefore, need to be implemented to reduce the level of risk in communities, while ensuring that interventions do not increase people's vulnerability to hazards.

ii. Providing an enabling policy environment

National governments play a vital role in providing an enabling environment for leveraging the potential of ICT in DRR through appropriate policies and institutional arrangements. Policies need to be in place to promote DRR measures, enhance ICT accessibility, and bridge the fields of ICT and DRR by ensuring cooperation between the two fields in developing innovative solutions that build disaster resilience. Policies to ensure interoperability and compliance with ICT standards are also crucial.

iii. Communicating with at-risk communities

Greater emphasis and priority needs to be given to the communication with people affected by disaster at all phases of DRR. Not only will this lead to more effective outcomes, but more importantly, by giving vulnerable people the right information, they can take greater control of their own lives. Instead of imposing definitions and solutions on people considered vulnerable, their perception and knowledge of risk, and existing coping strategies should be discussed. ICT for DRR interventions should focus on strengthening capacities to address any gaps and challenges that communities have identified themselves.

iv. Introducing appropriate technologies

ICTs should never be imposed on DRR initiatives, especially without an adequate assessment of needs and ICT readiness or how ready a community or nation is in taking advantage of the opportunities provided by advances in ICTs. This includes an assessment of the level of development, access to infrastructure and skills level. A mix of technology and a combination of technological and non-technological solutions may be required. The appropriate mix of information and communication channels will need to be determined by the stakeholders themselves, including the vulnerable communities, through a participatory process.

v. Advancing ICT accessibility

Increasing ICT accessibility - towards universal access to ICT services - will require favourable policies and regulations that may need to be supported with resources dedicated to reaching users located in un- and under-served areas. While expanding the ICT infrastructure, their resilience to disasters should also be considered, incorporating back up services, and diverse and redundant communication channels.

vi. Advancing information accessibility

There is currently abundant information available globally on DRR, but that does not necessarily translate into its widespread availability or utility. Information accessibility may be limited by different forms of discrimination and marginalization due to gender, disability, literacy, age, religion, race, caste, etc. The Web Content Accessibility Guidelines is an attempt to make web content more accessible to people with disabilities. These guidelines also make Web content more usable by older individuals with changing abilities due to aging and often improve usability for users in general.[83] It is also important to ensure that content is well targeted for the users. In many places and cultures there is little relevant information conveyed in local languages or suited to the actual living conditions of people exposed to natural hazards. Language barriers must also be overcome for existing information to be accessible.

vii. Creating locally available statistical and analytical skills

The data and information needed for DRR come from a wide variety of sources that are often not

83. See http://www.w3.org/TR/WCAG20/.

shared or integrated in a way that facilitates timely and accurate decision-making in a disaster situation. This is further complicated by the differences in standards used for data collection, recording and storage, creating difficulties when users attempt to access and analyse data. Some countries lack historical records of hazards and the quality of the data may vary. Frequently, historical data is not available in an electronic format, and it lacks proper classification and descriptive information, which makes it difficult to compare data. It is important to build capacities for national data collection with guidelines established for collecting data that are needed for risk assessments, hazard monitoring and disaster forecasting. Data should be appropriately classified and made widely available electronically for use by national and international stakeholders. Limitations remain due to the lack of internationally standardized collection methodologies and definitions, but initiatives such as DesInventar and EM-DAT are working toward developing such standards.

viii. Ensuring Interoperability

Interoperability refers to the ability of two or more diverse ICT systems to seamlessly exchange information and use the information that has been exchanged. Interoperability leads to better decision-making as it allow data compiled by different agencies to be used together to make better decisions, without having to provide additional human and financial resources to convert and compare data. Interoperability also allows for better coordination and trans-boundary cooperation of DRR programmes since information will be easier to obtain.

GDACS that provides near real-time alerts about natural disasters around the world and tools to facilitate response coordination promotes the use of standards for information and communication such as the the eXtensible Markup Language (XML) format for communication and the GLobal IDEntifier (GLIDE) number, a content standard, as a means to achieve interoperability of DRR models and systems. Another noteworthy initiative is the Global Spatial Data Infrastructure Association that encourages the collection, processing, archiving, integration and sharing of geospatial data and information using common standards and interoperable systems and techniques.

ix. Encouraging standardization

A standard is "a framework of specifications that has been approved by a recognized organization or is generally accepted and widely used throughout by the industry."[84] Standardization is important for the way data is collected, stored and used, allowing the same set of data to be displayed in multiple ways. Standardization is also required for the way in which the data is communicated, as a means for information exchange and collaboration. Standards reduce training, and system and data conversion costs; and ensure that the next purchase of software and systems is not dictated by the last purchase, thus increasing choices to information and services.

Using standardized ways of communicating decreases the likelihood of non-compatibility of systems and of misunderstanding, which are both essential in crisis situations. The Common Alerting Protocol, which is based on XML, standardizes the content of alerting messages. The Emergency Data Exchange Language is a broad initiative to create an integrated framework for a wide range of emergency data exchange standards to support operations, logistics, planning and finance. The GLIDE number creates unique identification of disasters, preventing confusion as to which disaster is being referred.

x. Supporting free and open source software and open standards

FOSS is software that can be used, copied, studied, modified, and redistributed without restriction. These freedoms that are for all - developers and users - are highly significant to DRR as FOSS allows immediate access, ownership, and control of ICTs. It provides a framework for the usage and sharing of intellectual capital, and allows customization to meet diverse cultural and development needs.

Most FOSS embraces a community-style software development model which is based on collaborative development of the software amongst interested parties, usually worldwide over the Internet. While there is normally a core group of developers who oversee and steer the software development effort, anyone who has an interest and the necessary skills can contribute towards the software. This opportunity, along with the source code availability and freedoms guaranteed by FOSS licenses, encourages the sharing of FOSS and their customizations, and makes available a wide community in which to address any problems encountered.

Open ICT standards are becoming increasingly important as no single technology, group or vendor can provide all the solutions. Standards that are open and non-discriminatory are preferred because there is no dependence on any single entity. All types of products can implement them and all interested parties can partake in their development. The Internet is a great example as its foundation is open standards software such as TCP/IP and HTTP.

xi. Incorporating gender dimensions in ICT for DRR

There are limited studies on gender relations in the use of ICT for DRR. But in general, women do not have as much access to information and ICTs as men. Information tends to pass through male-dominated government agencies of disaster management, meteorology and agriculture. Women also tend to suffer disproportionately when disasters strike. In some regions the 2004 Indian Ocean Tsunami claimed the lives of four times as many women as men.[85] And gender stereotypes in relief aid continue to exist, as evidenced after the Tsunami when mobile phones were distributed to men's self-help groups but not to women's groups because technology was perceived as a man's concern.[86] Women's lack of privacy and security, and exposure to gender-based violence in temporary shelters are regularly cited as serious concerns. According to the Gender and ICT e-Primer,[87] women are more inclined towards ICTs that are more audio in nature, such as the radio and even the mobile telephone. This is because the level of literacy among women is generally lower and audio ICTs allow women to multi-task, e.g. listen to radio while doing their work. Planning and implementation through all phases of DRR need to be gender-sensitive. The selection of ICTs and the crafting of messages for early

84. Nah Soo Hoe, FOSS: Open Standards, Bangkok: UNDP Asia-Pacific Development Information Programme e-Primers on Free/Open Source Software, 2006, p. 1, http://www.iosn.net/open-standards/foss-open-standards-primer/foss-openstds-withcover.pdf.

85. BBC News, "Most tsunami dead female - Oxfam," 26 March 2005, http://news.bbc.co.uk/2/hi/south_asia/4383573.stm.

86. Tsunami Global Lessons Learned Project, op. cit.

87. Angela M. Kuga Thas, Chat Garcia Ramilo and Cheekay Cinco, Gender and ICT, Bangkok: UNDP Asia-Pacific Development Information Programme e-Primers for the Information Economy, Society and Polity, 2007, http://www.apdip.net/publications/iespprimers/eprimer-gender.pdf.

warning as well as for public awareness campaigns must also be gender sensitive. Women's knowledge needs to be valued and their voices should be heard. Women need to be empowered to build resilience and protect themselves from disasters, and they need to be engaged in decision-making processes. There is also an urgent need for gender-disaggregated data.

xii. Sustaining efforts

ICT tools and systems acquired must be sustainable and regularly used. Local capacity to maintain and repair these systems is also critical so that the system is functional and ready when it is needed. ICT tools such as computers can also be used for other development interventions. For example CTEC, a community early warning centre, is planning to hold regular computer training for school children.

The use of established channels of communication such as a popular community radio programme to promote DRR contributes to its sustainability. It's also more cost-effective.

Successful telecentres can also extend their services to play key roles in providing disaster information and be a part of the EWS in alerting communities of impending hazards. The role of telecentres in raising DRR awareness and imparting DRR training, as well as their role as command centres during emergency response, should be explored.[88]

Regular tests of ICT systems, particularly those established for infrequent disasters, should be organized not only to ensure that the systems continue to function properly, but also to test the processes and procedures established in using these tools and systems for early warning or other purposes.

xiii. Promoting public-private partnerships

Public-private partnerships can help to share costs and ensure sustainability of system. The rich human, technical and material resources of private companies particularly in the communications industry should be tapped, and dialogue with these companies should begin in the preparedness and response planning stage. The report by LIRNEasia for the Maldives, for example, examined not only the use of cell broadcasting for public warning but also for commercial use - for news alerts, traffic notifications, service announcements, advertising, tourist information, and more.

xiv. Building capacities

Supporting the development of a cadre of people with expertise in both disaster management and ICT increases the likelihood of developing effective ICT for DRR applications. This requires training disaster managers in IT skills that go beyond those of a general user, and to train a group of IT workers (e.g., database and system administrators and application developers) to have domain expertise in DRR. Mechanisms include: training activities that invites both ICT and DRR experts, providing opportunities to initiate dialogue; field tests and field work conducted jointly by ICT researchers and disaster management practitioners; and combined disaster management-ICT expert teams that jointly analyses the performance of processes and systems after a disaster.

88. See ESCAP, Using telecentres for disaster risk management at the community level, Policy Brief on ICT Applications in the Knowledge Economy, Issue No. 5, September 2009, http://www.unescap.org/IDD/pubs/Policy_Brief_No.5_camera-ready.pdf.

xv. Giving priority to regional efforts

As most disaster events cross national boundaries, it is essential for national governments to invest in regional efforts. Regional and international organizations serve as critical allies by sharing knowledge and creating a common platform that national governments can harness.

One of the mechanisms for regional cooperation is the ASEAN Agreement on Disaster Management and Emergency Response (AADMER), which entered into effect on 24 December 2009 after being ratified by all the ten Member States of ASEAN. AADMER is a legally-binding agreement to promote regional cooperation and collaboration in reducing disaster losses and conducting joint emergency responses in the ASEAN region. In the context of AAMER, the ASEAN Committee on Disaster Management will be addressing gaps in DRR strategies, programmes and activities at the regional and national levels; facilitating linkages between regional and national programmes and other activities supporting the achievement of the HFA; promoting multi-stakeholder participation; mobilizing support to national disaster management organizations for the development and implementation of Strategic National Action Plans for DRR; strengthening regional technical training and capacity development programme in the areas of priority concern of the Member States; and improving access to knowledge and information on DRR issues. ICTs are essential tools for all these activities.

7. Conclusion

The Asia Pacific region is fast becoming the hub of global production and consumption. Dramatic economic growth has enabled a reduction in poverty and social progress in many parts of the region, and significant progress has been made in achieving millennium development targets. Disaster impacts, however, threaten to undermine these achievements.

At the same time, the accessibility and affordability of numerous ICT tools are growing at exponential rates in the Asia Pacific region, and policymakers can no longer ignore the use and benefits that ICTs can bring to reduce disaster risks in innovative ways.

ICTs have become essential to the effective management of all phases of the DRR cycle, and are widely used for: 1) collecting data and information in databases to manage logistics during emergencies as well as for modeling and forecasting; 2) developing knowledge and decision support tools for early warning, mitigation and response planning; 3) sharing information, promoting cooperation, and providing channels for open dialogue and information exchange; and 4) communicating and disseminating information, particularly to remote at-risk communities.

The advancement of ICTs has made DRR easier, but procuring the technology alone is insufficient - it requires a mix of political, cultural and institutional interventions, and coordination between governments, corporate sector, civil society, academia, media agencies and volunteers. ICT for DRR initiatives are more about people and processes than about the technologies. It is important to identify needs, gaps and capacities and assess which technologies will help meet a project's objectives, or one may find at a point in time that ICTs are not required to effect change and achieve goals. There is growing recognition on the need for a culture of communication that values proper information management and inclusive information sharing. Thus, the presence of essential ingredients for successful programming such as strong leadership, political commitment, multi-stakeholder participation, and capacitated human resource pools, are fundamental to the success of ICT for DRR interventions.

The latest World Disasters Report on early warning and early action caution that advances in ICT and the widespread access to the global media means a breakdown in control and potential confusion among target groups.[89] Therefore the importance of public education in disaster preparedness cannot be emphasized enough. It is also vital to incorporate in formal and non-formal education systems, the competencies to search, organize and analyse information, engage in critical thinking, and judge the intention, content and possible effects of the information. With strengthened capacity and increased knowledge on disaster preparedness, individuals and communities as groups can sift through the multitude of information and make appropriate decisions on the action to take.

ICTs are tools that when used effectively can enhance and accelerate DRR, but they rely on the actions of individuals and organizations in order to be fully effective. Without visionary policymakers and other ICT-capable government officials, opportunities presented by ICTs in reducing disaster risks are unlikely to be recognized and applied. Capacity building in this area is therefore critical.

APCICT, committed to building ICT capacity for social and economic development, is developing a training module on ICT for DRR based on demands from Member States. Demand for capacity building in the area of ICT for DRR has been requested at several forums including the ESCAP-organized Expert Group Meeting on WSIS+5 and Emerging Issues in Asia and the Pacific held on 18-19 November 2008 in Bangkok, Thailand, ESCAP's First Session of the Committee on ICT on 19-21 November 2008, and ESCAP's First Session of the Committee on DRR on 25-27 March 2009.

The training module will be part of the Academy of ICT Essentials for Government Leaders, a flagship programme of APCICT that includes a comprehensive ICT for development curriculum and over a dozen partners that are working with APCICT to roll out the Academy at the national level. Academy workshops have been held throughout Asia and the Pacific in Afghanistan, Cook Islands, Indonesia, Kiribati, Kyrgyzstan, Mongolia, Myanmar, the Philippines, Republic of Korea, Samoa, Tajikistan, Timor-Leste, Tonga and Tuvalu.

89. IFRC op. cit., page 28.

Case Studies

1. The Bangladesh Comprehensive Disaster Management Programme and ICTs
2. Integrated Information and Communication System for Emergency Management in Bangladesh
3. Space Technology Application for Disaster Management in China
4. Reaching the Last Mile through Community-based Disaster Risk Management: A Case Study from Sri Lanka
5. The Sahana Free and Open Source Disaster Management System in Haiti
6. Establishing and Institutionalizing Disaster Loss Databases: Experience from UNDP
7. SEA-EAT Blog

The Bangladesh Comprehensive Disaster Management Programme and ICTs

Shantana R. Halder and Tasdiq Ahmed

1. Disaster Management Profile

Bangladesh is a low-lying deltaic country formed by the Ganges, the Brahmaputra and the Meghna rivers. The country is criss-crossed by over 270 rivers and tributaries. Bangladesh is commonly cited as a country that is extremely vulnerable to natural disasters. The geographical location, land characteristics, multiplicity of rivers and the monsoon climate render Bangladesh highly vulnerable to natural hazards such as floods, cyclones, droughts, tidal surges, tornadoes, cold waves, earthquakes, river erosion, fire, drainage congestion/water logging, infrastructure collapse, the high arsenic contents of ground water, water and soil salinity, epidemic, and various forms of pollution.

Significant country features are:

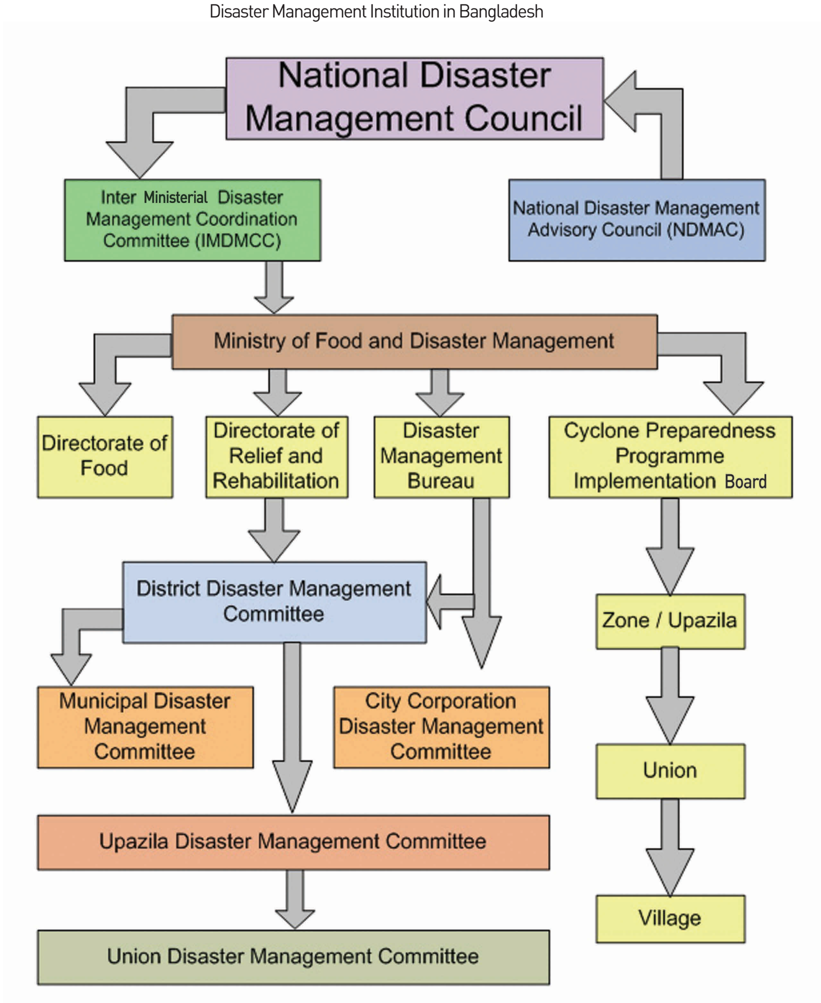
- A vast network of rivers and channels
- An enormous discharge of water heavily laden with sediments
- A large number of islands in between the channels
- A shallow northern Bay of Bengal and funneling to the coastal area of Bangladesh
- Strong tidal and wind action

Floods are an annual phenomena with the most severe occurring during the months of July and August. Regular river floods affect 20 percent of the country increasing up to 68 percent in extreme years. The floods of 1988, 1998, 2004 and 2007 were particularly catastrophic, resulting in large-scale destruction and loss of lives. The country is one of the worst sufferers of all tropical cyclones from the Bay of Bengal accompanied by storm surges in the world. On average 1.3 cyclones per annum hit the Bangladesh coast. The worst affecting cyclones occurred in 1970, 1991 and 2007 causing half a million fatalities. Annually, the country loses about 8,700 hectares of land due to river erosion and displacing around 180,000-200,000 people. Bangladesh is a seismically active country. The Centre for Research on the Epidemiology of Disasters estimates that close to 229 million people have been directly affected by natural disasters during the thirty year period from 1979 to 2008, with over 7,700 killed and economic damage in the order of US$5.6 billion.

Bangladesh is one of the countries most at risk from the impacts of climate change. It is likely that both acute hazards (such as flooding or cyclonic events) and chronic hazards (such as drought, sea level rise and saline intrusion) will increase in frequency and severity in the coming decades.

Bangladesh has gained much experience in terms of preparing for and responding to disasters, which has resulted in the reduction of human causalities. One important element of this has been improvements in early warning systems, and cyclone shelters in particular, which have been acknowledged in the United Nations International Strategy for Disaster Reduction study post Cyclone Sidr.

Disaster Management Institution in Bangladesh



Bangladesh has a well established disaster management institutional framework that extends from the highest level of government through to union and local government levels. The Ministry of Food and Disaster Management (MoFDM) is the national focal point responsible for overall coordination of disaster management activities with different actors across and within sectors. There is an Emergency Operations Centre (EOC) established within the Ministry with links to regional and local government administrative unit offices that are activated during emergencies. The roles of the EOCs are to be vigilant in monitoring on-the-ground situation and notifying senior management for necessary emergency measures. The different level of disaster management committees are assigned different roles during normal period, during emergencies and post-emergency situations through a Standing Order on Disasters (SOD) issued in 1997. The SOD has been further revised to incorporate roles and responsibilities for disaster risk reduction and climate change adaptation.

The Government of Bangladesh (GoB) works closely with non-governmental organizations (NGOs) and various international agencies in managing disaster risks. The Cyclone Preparedness Programme is a joint effort of the International Federation of Red Cross and Red Crescent Societies, the Bangladesh Red Crescent Society and the GoB, and has a total of 42,000 volunteers assisting the local government offices in early warning dissemination to the community, evacuation, search and rescue, and emergency response management.

These systems are mobilized quite quickly immediately before and after a crisis event, but they lack proactive leadership in driving risk reduction initiatives. Similarly, those officials appointed to leadership roles often lack the professional skills and competencies, and the frequent transfer of staff makes capacity building a continual challenge.

2. ICT Profile

The GoB recently approved the revised Information and Communication Technology (ICT) Policy of 2002 with the vision of expanding and diversifying the use of ICTs for establishing a transparent, responsive and accountable government; developing skilled human resources; enhancing social equity; ensuring cost-effective delivery of citizen services through public-private partnerships; and supporting the national goal of becoming a middle-income country within ten years and joining the ranks of the developed countries of the world within thirty years.

The 2002 ICT Policy aimed to create an enabling environment to accelerate the use of ICT in every sector in terms of information generation, utilization and application. The 2002 policy document included 103 policy directives in 16 areas to be achieved by 2006 of which 8 were fully or largely accomplished, 61 were partially accomplished and 34 remained unaddressed. The 2002 ICT Policy could not reach the professed levels of success due to the lack of appropriate plans to achieve the goals set in the policy; therefore the Government took the initiative in May 2008, and reviewed the National ICT Policy 2002 and formed a 17-member Review Committee.

The approved ICT Policy of 2009 is very much aligned with the national goals as envisioned in Poverty Reduction Strategy Papers[90] and other national policy documents. It has incorporated new policy directions in line with technological advancements, and included a methodical framework of the policy document and an action plan.

Bangladesh is a country of over 144 million people, residing within the 147,570 sq. km of territory with a per capita GDP of US$ 554 per annum. The national vision to raise the economic profile of the nation to that of a middle income country within a decade, would require more than doubling the current level of per capita GNP by pushing the growth rate to about 7.5 percent. Conditions cited for achieving this vision include the extensive use of ICTs, as well as optimal resource utilization, certified skills development; efficient communication and quality education delivery.

The 2009 ICT Policy is structured as a hierarchical pyramid with a single vision, 10 broad objectives, 56 strategic themes and 306 action items implementable in the short term (18 months or less), medium term (5 years or less) or long term (10 years or less).

The objectives set under the policy related to environment and disaster management are: enhancing creation and adoption of environment-friendly green technologies; ensuring safe disposal of toxic wastes; minimizing disaster response times; and enabling effective climate change management programmes through the use of ICTs.

The following action agendas have been identified for disaster management:

- Protect citizens from natural disasters through ICT-based disaster warning and management technologies
  - i. Utilize remote sensing technologies for disaster management and mitigation.
  - ii. Web-based environmental clearance certification system
  - iii. Promote cell phone/SMS-based disaster warning systems targeted to the population likely to be affected
  - iv. Utilize Geographic Information System (GIS)-based systems to monitor flood and cyclone shelters (including equitable distribution in vulnerable areas)
  - v. Promote efficient relief management and post-disaster activities monitoring
- Utilize GIS-based systems to ensure equitable distribution of relief goods with special focus on the hard-to-reach areas.

90. Poverty Reduction Strategy Papers describe the country's macroeconomic, structural and social policies and programmes that promote broad-based growth and reduce poverty. These papers help guide the International Monetary Fund and the World Bank's concessional lending as well as debt relief under the Heavily Indebted Poor Countries Initiative.

Table 1 summarizes the current ICT profile of the country.

Table 1. The Bangladesh ICT Profile

Total populationRural	144.5 million (estimated)
population as a percentage of total population	75% (estimated)
Life expectancy at birth	65.6 years
Per capita/power Generation	170 KWh
Per capita/power Consumption	150 KWh
Literacy in the national language(s)	56%
Personal computers per 100 inhabitants	2.2
Telephone lines per 100 inhabitants	0.7
Internet subscribers per 100 inhabitants	0.1
Internet users per 100 inhabitants	0.3
Cell phone subscribers per 100 inhabitants	21.7
Mobile telephone usage	249 minutes/user/month
Population covered by mobile cellular network	90%
Households with a television set	48%
ICT expenditure	8.0 % of GDP

Source: http://devdata.worldbank.org/ict/bgd_ict.pdf; BBS (2009).

3. CDMP Overview

The Comprehensive Disaster Management Programme (CDMP) is a multi-donor framework to assist the GoB in the achievement of the following Vision, Mission and Objective.

GoB Vision

To reduce the vulnerability of the people, especially the poor and disadvantaged, to the effects of natural, environmental and human induced hazards to a manageable and acceptable humanitarian level and to have in place effective emergency response systems.

MoFDM Mission

To bring a paradigm shift in disaster management from conventional response and relief practice to a more comprehensive risk reduction culture.

Overall Objective

To strengthen the capacity of the Bangladesh disaster management system to reduce unacceptable risk and improve response and recovery management at all levels.

CDMP is a very high profile multi-hazard, multi-sector and multi-stakeholders programme supported mainly by the United Nations Development Programme (UNDP), the UK Government's Department for International Development (DFID) and the European Union, with the Secretary of MoFDM as the National Programme Director. The overall aim of CDMP is to take a multi-hazard approach to disasters and to generate a 'paradigm shift' in disaster management, away from relief and rehabilitation and towards a more holistic approach to reducing risks and vulnerabilities. Significantly, CDMP was also designed to institutionalize the adoption of DRR approaches, not only in its host ministry (MoFDM), but more broadly across mainstream sector ministries. Lastly, CDMP was conceived, and has been developed, as a multi-development partner framework in an attempt to harmonize development assistance across the field of disaster risk reduction.

CDMP introduced the concept of risk reduction as a critical part of development planning and community safety considerations. Key benefits associated with this approach include:

- The resources and expertise of government, NGO, private sector and the community are deployed according to national priorities and community risk reduction programming needs, not organizational preference.
- It provides a big picture of what needs to be done and therefore acts as a mechanism for identifying gaps, monitoring and observing achievement.
- It provides the basis upon which formal collaborating partnerships are developed and nurtured.
- It facilitates the validation of new projects against country risk reduction needs.
- It serves as a management tool for development partners and regional organizations to guide their inputs.
- It provides a holistic partnership framework to integrate the programmes, priorities and resources of government, NGOs and private sector in one consolidated risk reduction programme.

CDMP strategies have been designed to achieve objectives associated with a number of key global and national drivers.

Global Drivers	National Drivers
Millennium Development Goals	Poverty Reduction Strategy Paper
United Nations Framework Convention on Climate Change	Standing Orders on Disasters
Hyogo Framework for Action 2005-2015	Draft Disaster Management Act
SAARC Framework for Action 2006-2015	Draft Disaster Management Policy
	Draft National Plan for Disaster Management 2007-2015

CDMP has created a number of policy and operational frameworks to drive and manage the disaster and climate risks in an integrated manner. Emphasis is placed on carrying out systematic and comprehensive risk assessments, and involving both 'high-tech' and 'peoples' knowledge in identifying, assessing and evaluating the risks in order to formulate and implement community and sector-specific risk reduction action plans.

CDMP is a whole-of-country strategy. Communities within high risk areas are the immediate beneficiaries of programme interventions. The direct beneficiaries of the programme are:

- Communities and community-based organizations (CBOs) through improved country and local capacity to design and implement disaster management programmes that are based on community risk assessments.
- Key national, district, upazila and union officials (including NGOs) who have disaster management programming and operational response coordination responsibilities.
- Key government decision makers, politicians and elected local government officials through advocacy and awareness programmes.
- National planning officers and all line government departments or agencies involved in development planning activities, through the promotion and incorporation of risk management measures within the development project validation process by way of the Disaster Impact and Risk Assessment, like the Environmental Impact Assessment, which has been incorporated in all development project analysis.
- NGOs, through their formal involvement in the CDMP process.
- Private sector through increased interface and involvement in disaster management programme design and implementation.

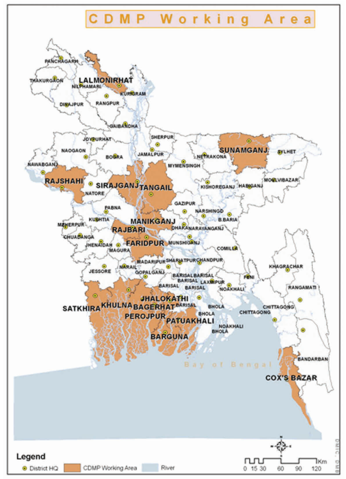
CDMP has been designed as a two-phase programme. The first (pilot) Phase 2004-2009 focused mainly on :

- Policy and institutional reform
- Professional development and capacity building
- Mainstreaming disaster risk reduction within and across sectors
- Building community resilience through a range of structural and non-structural supports to assess their risk environment and reduce the risks identified
- Earthquake and tsunami preparedness
- Climate change capacity building, impact scenario mapping and adaptation options
- Strengthening emergency response management systems
- Information management and networking

The programme built partnerships with more than 100 technical and academic institutions, and international, national and local level NGOs and CBOs. Its community level interventions, initially targeted at seven pilot districts to test the frameworks and guidelines developed in different hazard conditions, was expanded to nine more districts. CDMP did some pioneering work on community risk assessment and mapping; earthquake, tsunami and storm surge risk mapping; climate variability and climate risk mapping; and livelihood adaptation to climate change, which received recognition nationally and internationally.[91]

The CDMP Phase II (2010-2014) came into force from January 2010 and focuses primarily on consolidating, extending and expanding upon the achievements of Phase I. Fifty million US dollars have been committed by UNDP, DFID, the European Union and the Swedish SIDA for Phase II with other donors showing interest.

91. For more details on CDMP, visit http://www.cdmp.org.bd



The overall goal of CDMP Phase II is to reduce the country's vulnerability to adverse natural and anthropogenic events, including cyclones, hurricanes, floods, tidal surges, earthquakes, tsunamis, climate change and variability, avian flu, fire, and toxic chemical/gas/pollutant leaks, through technical assistance in risk reduction and comprehensive disaster management activities. CDMP II will use the existing CDMP I implementation experience, methodologies, management systems and disaster risk reduction professionals with practical experience of executing this type of complex and ambitious project.

4. CDMP-DMIC ICT Strategy

In its mission to support the MoFDM's goal, CDMP has been launched to strengthen the Ministry's operational capacities to reduce disaster risks, including the timely response to emergencies and actions to improve recovery from these events.

The establishment of a National Disaster Management Information Centre (DMIC) linked with all actors and sectors from the national level down to the community level, is a key instrument in CDMP strategy to complement, if not replace, the EOC of MoFDM. The goal of DMIC is to put in place a more effective and better coordinated information management system, aimed to improve coordination among agencies at all levels with access to appropriate, timely and accurate information before, during and after emergency situations. The EOC of MoFDM is ill-equipped and lacks adequately skilled professional staff and mainly depends on district and upazila[92] authorities to report critical information for decision-making using traditional communication methods that delay response.

To understand different stakeholder needs for disaster management information, their willingness to share the information they have, and their ICT capacity to receive, use and send information, CDMP conducted a needs assessment survey in early 2006 and had consultations with national, local and community stakeholders. The assessment focused on five major hazards of the country - cyclone, flood, earthquake, erosion and drought. The survey involved participation from staff of the MoFDM and its departments (Directorate General of Food, Disaster Management Bureau (DMB), Directorate of Relief and Rehabilitation (DRR), and CDMP's implementing partner institutions). Primary data providers, donors, government agencies with roles and responsibilities in the SOD, major NGOs, and other users of disaster management information also participated in the survey.

The assessment examined stakeholders' risk reduction, emergency response and long-term recovery activities for their information needs. The assessment team also analysed GoB policy and procedures for disaster management, and mapped the information flows specified in the SOD. They identified linkages among GoB agencies reflected in SOD requirements to maintain communication between respective emergency control rooms, and met with CDMP component managers to understand their needs for DMIC support.

4.1 National level information needs assessment

Information needs at the national level reflect many priorities, which in general map to disaster phases, sectors and hazards. Disaster management specialists want tools and information to understand the vulnerability of elements of the population and the nature of the hazards they face, so that they can prepare action plans to reduce the risk. They need demographic, topographic, infrastructural and hazard incidence information with localized granularity fine enough to optimize risk reduction implementations.

Agencies in the agricultural, transport, health and public safety sectors want training resources and other means to raise the hazard awareness of their staff, operational partners and people in vulnerable communities. These sectors agencies want to know about disaster preparedness measures and best coping practices in the event of a hazard. All stakeholders want early warning of hazards, often with much more lead time than is currently possible. City corporations, some of which are especially at risk from earthquakes need vulnerability maps, emergency equipment resource inventories, localized shelter/water/food/medical resource identification and volunteer network coordination system. During and after an emergency, all stakeholders want situation reports to help them to understand current conditions and coordinate actions.

The government institutions involved in relief and early recovery activities want reports of casualties, losses and damage. The MoFDM with its Inter-Ministerial Disaster Management Coordination Committee and NGO Coordination Committee on Disaster Management wants prediction of hazard severity, onset and duration; real-time situation reports from all actors; and localized reports of relief materials inventories.

The SOD requires many action plans, updates and periodic status reports from the GoB agencies with disaster management roles and responsibilities specified in it. This information is essential for maintaining a common understanding of the current disaster management environment and effectively reducing disaster risks, and should be available to all stakeholders.

92. Upazila is the lowest administrative tier of the government.

Hazard	Risk Reduction	Emergency Response	Rehabilitation
River flood	· Vulnerability of settlements and infrastructure · Availability of shelter · Availability of relief food and medicine	· Flood onset · Flood extent · Flood depth and duration · Water level changes · Affected areas and population · Availability of shelter · Availability of relief	· Areas and people affected · Nature of loss and damage · Strategy for agricultural rehabilitation · Availability of resources for rehabilitation
Flash flood	· Vulnerability of settlements and infrastructure · Availability of shelter · Availability of relief food and medicine	· Flood prediction · Rainfall prediction · Expected time of flood recession · Flood depth · Affected areas and population · Availability of shelter · Availability of relief	· Areas and people affected · Nature of loss and damage · Availability of resources for rehabilitation
Riverbank erosion	· Vulnerability of settlements and infrastructure · Possibility of erosion induced flooding · Availability of shelter and land for rehabilitation	· Erosion prediction · Risk of erosion induced flooding · Affected areas and population · Time when erosion expected · Shelter and land for rehabilitation, resettlement · Availability of food relief	· Extent and type of land eroded · Loss of private and public infrastructure · Number of people affected · Availability of resources for rehabilitation
Drought	· Source of water for irrigation · Water for drinking and other domestic purposes	· Duration of drought · Possibility of rain · Water for irrigation · Water for domestic purposes · Affected areas and population · Availability of food relief	· Loss of crop due to drought · Strategy for agricultural rehabilitation · Availability of resources for rehabilitation
Monga[93]	· Opportunities for alternative employment · Availability of relief food stocks and programmes	· Severity predictions of exacerbating flood and erosion · Opportunities for alternative employment · Availability of relief materials	· Availability of credit · Alternative employment training · Agricultural extension to alter cropping pattern · Availability of resources for rehabilitation
Cyclone	· Availability of shelter · Volunteer network	· Cyclone prediction: severity, area affected · Availability of shelter · Volunteers available · People affected	· Loss of lives · Damage to private property · Damage to public property · Availability of food, medicine and clothing as relief

Table 2. Institutional needs for disaster management information (by hazard)

93. Monga is a Bangla term referring to the yearly cyclical phenomenon of poverty and hunger in Bangladesh. The Northern Region of Bangladesh is situated in the Tista and Jamuna basin, and contains many tributaries. Topography and climate make the area ecologically vulnerable to floods, river erosion, drought spells, and cold waves, all of which occur more frequently and intensely than in other regions. While Monga is not a new phenomenon, it has only recently caught public interest. This is in part due to its prevalence in media, and its focus in the political debate between the government and opposition parties. It was cited in Bangladesh's Poverty Reduction Strategy Paper, and has been the subject of NGO aid programmes (Source: http://en.wikipedia.org/wiki/Monga).

4.2 Information needs at local levels

Local level institutions with disaster management roles include divisional (Divisional Commissioner), district (Deputy Commissioner), upazila (Upazila Nirbahi Officer) and union (Union Parishad Chairman) administration offices, the network of district, upazila and union Disaster Management Committees connected to the DMB and DRR through the DMIC, GoB agencies such as Local Government Engineering Departments, Civil Surgeon, Department of Agriculture Extension, Roads and Highways Department and many others. They all need hazard awareness development, information to support risk reduction actions, hazard early warnings, emergency situation reports, damage and loss reports and relief and recovery resource inventories.

Community members need information to develop their awareness of hazards, understand their vulnerability and take action to reduce disaster risk. They need timely, accurate and understandable early warning of hazards. During emergencies they want to know what the authorities are doing to relieve their hardship and where relief resources are available. They need information to expedite their recovery from disaster, particularly about availability of credit, building supplies, medical attention and livelihood alternatives.

4.3 ICT capacities and gaps

National level institutions vary greatly in their capacity to use the proposed information sharing facilities of the DMIC, and in general, in their ability to implement the e-governance objectives of the GoB. Some technical agencies and major NGOs, have good ICT and GIS infrastructure including high speed Internet connectivity and well conversant ICT staff. Most government agencies, on the other hand, have primitive ICT environments and rely on traditional office technology that does not support effective sharing of information. Their Internet connectivity is mainly dial-up and available to few staff. They need significant cultural shift, more computers, more training and reliable Internet connectivity. The recent connection of a high-speed undersea cable and the government decision to reduce Internet cost will encourage domestic Internet development.

Local level institutions in general suffer from more severe ICT capacity limitations. The Internet is penetrating the rural areas on the back of the expanding Bangladesh Telecommunications Company Limited network and Internet Service Provider market but is still beyond the budgets of many agencies. At the district level, fax remains the main medium for information exchange. Upazila centres rarely have fax and rely on letters and telephone. Union centres are relatively isolated from any but mass media and postal delivery.

Table 3. Community needs for disaster management information

Hazard	Risk Reduction	Emergency Response	Rehabilitation
River flood	· Availability of drinking water and health facilities	· Prediction of flood and rainfall · Area expected to be inundated · Duration of flood · Daily changes in water level · Shelter	· Availability of medical facility · Availability of seed and fertilizer · Availability of relief materials
Flash flood	· Water levels in secondary rivers	· Prediction of flood and rainfall · Expected duration and depth of flooding · Water levels in secondary rivers · Duration of flood · Water drainage through network of rivers, canals · Shelter	· Availability of medical facility · Availability of seed and fertilizer · Availability of credit
Riverbank erosion	· Shelter · Resettlement land	· Prediction of erosion · Availability of relief · Information on shelter and land for resettlement · Availability of credit · Employment opportunity	· Shelter · Land for resettlement · Availability of credit · Employment opportunity
Drought	· Availability of water for domestic use · Availability of water for irrigation	· Prediction of rainfall · Water for drinking and domestic uses · Availability of relief material · Availability of irrigation water · Duration of drought	· Availability of relief material · Agricultural recovery strategy · Availability of credit
Monga	· Employment opportunities · Availability of credit	· Prediction of flood and riverbank erosion · Availability of relief · Employment opportunities	· Availability of credit · Training programmes for new types of employment · Availability of seed and fertilizer

Source: CDMP-DMIC Needs Assessment Survey Report, 2006.

The mobile networks, on the other hand, have penetrated 90 percent of the country. More than eight staff per organization possess personal mobile phones. The deep penetration of mobile networks throughout the country makes this the most common medium of communication, enabling SMS transmission for timely dissemination of localized early warning messages and other disaster management information.

The mobile networks provide rapid communication but mobile communication has low information sharing capacity. Bangla displays on mobile handsets are generally not available and will not be until the mobile operators have the will to implement it. Rural literacy is not adequate for English text, and presently a significant proportion of rural subscribers cannot read or write adequately to use Bangla SMS. This will change over time. Cell broadcasting is a mobile technology being used by many countries, including Bangladesh, to provide warning service (see section on cell broadcasting below).

Table 4. Local level ICT capacities

Institutional ICT Resources	Count	%
How many use E-mail?	1	2
How many have computers?	50	93
How many have a network?	2	4
How many have Internet?	1	2
How many maintain a website?	0	0
How many have land phones?	39	72
How many have fax?	7	13
How many have HF radio?	1	2
How many share data?	1	2
How many staff have mobile phones?	432	

Source: CDMP-DMIC Needs Assessment Survey Report, 2006.

Most cellular base stations are enabled to support GPRS and EDGE, which effectively extends the Internet everywhere to people and institutions that can afford the cost. Field level data collection and applications in areas such as emergency response coordination and telemedicine can immediately exploit this technology. Recently WiMax services have been launched in the capital city and are expected to cover most of the areas of the country within the next five years. Mobile operators are testing 3G or third generation technology,[94] and hopefully this will add significant value in providing increasing access to the Internet.

The DMIC needs assessment study suggested a set of functions for DMIC to meet stakeholder needs (see Table 5).

Table 5. DMIC functions

Mode	Phase	Function
Risk Reduction	Daily use	· SOD, directives and SOD-required outputs online · Historical hazard/disaster incidence and impacts database · Knowledge base of best practices for disaster management · Repository of disaster management literature · Training resources: materials, lesson plans, computer based training modules · Maintenance of information sharing MoUs · Information quality assurance · CDMP component / GoB / NGO communication support · DMIC user directory / contact / expertise lists · Portal features: news feeds, forums, alert subscription tools
	Preparatory	· Risk assessment tools and status · Emergency response readiness plans and status · Rescue equipment inventory · Relief resources availability · Institutional capacity status
Emergency Response	Response	· Hazard warning analysis and dissemination · Loss (deaths, damage, etc.) reporting and analysis · Relief needs (water, food, shelter, medical), availability and accounting · Emergency response coordination - Internal DRR operations - Multiple GoB agencies and NGOs - International response: Global disaster alert coordination system
	Recovery	· Resource requirements, availability and accounting · Agricultural inputs, credit, infrastructure, health, reconstruction materials · Central relief management information system for MoFDM · Other agencies' recovery programmes status

Source: CDMP-DMIC Needs Assessment Survey Report, 2006.

The user survey also suggested a number of DMIC information products and media to support Bangladesh's disaster management objectives (see Table 6).

Table 6. Proposed DMIC information product and media

Hazard	Information Products	Media
Cyclone	· cyclone shelter locations and capacities · relief material inventory · early warning map with probable storm path and vulnerable upazilas · damage reports · rehabilitation resource inventory	· web · web · web, e-mail, fax, TV · e-mail, fax, courier · web
Flood	· flood shelter locations and capacities · relief material inventories · early warning water level predictions · damage reports · rehabilitation resource inventory	· web · web · web, e-mail, fax, TV · e-mail, fax, courier · web
Earthquake	· vulnerability maps · building quality assessment database · emergency equipment status · situation and damage reports · rehabilitation resource inventory	· web · web · web · e-mail, fax, courier · web
Erosion	· vulnerability maps of infrastructure and probable bank line movement	· web, e-mail, courier
Drought	· computer model that analyses location variables including rain forecasts, irrigation resources, soil types and crop requirements for water, to predict drought	· web, offline computer
General	· disaster management knowledge base · training materials · resource directories · emergency response coordination tools · early warning/alert subscription	· web · SMS, e-mail, IVR[95]

Source: CDMP-DMIC Needs Assessment Survey Report, 2006.

94. The common term used to describe third-generation mobile telephone services. 3G affords users a greater range of communications options, including access to Internet content and video data.

95. IVR or interactive voice response is a technology that allows a computer to detect voice and keypad inputs (Source: http://en.wikipedia.org/wiki/IVR).

A set of administration tools have been suggested to manage the information it handles, the media it uses and the users it supports (see Table 7).

Table 7. Administration tools

Administration Tools	Purpose
Portal framework	An application server that provides portal structure, user authentication and authorization, user preference management, flexible security policy and a variety of functions including: · forums · event calendar · customer relations management tool · project management tools · database support · GIS tools · dissemination servers: e-mail, fax, SMS and IVR
Content management system	Enables standards-compliant maintenance of portal content by clerical staff with limited website creation skills, and displays content according to user preferences
Mail/SMS/IVR list server	A database application that manages subscriptions of e-mail, SMS and IVR users who receive information in those media

Source: CDMP-DMIC Needs Assessment Survey Report, 2006.

4.4 Media

Analysis of commonalities among communication characteristics of the various hazard warnings reveals limited opportunities for employing one communication medium for several hazards. Their diverse nature in terms of message size, frequency and user capacity requires that the choice of medium for hazard warning dissemination varies with the hazard and audience that the warning message is intended for. The needs assessment survey report suggested ways in which various communication technologies can be effectively used (see Table 8).

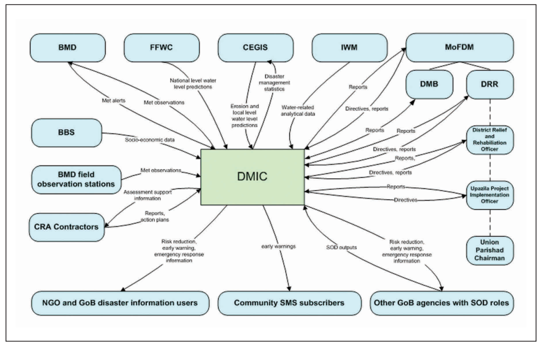
Table 8. DMIC media

Medium	Purpose
e-Mail	Send early warning information, bulletins and newsletters to subscribers of these services.
Web portal	Display information proposed in Table 5, and offer tools for decision support and emergency response coordination to users. Provide an administrative interface for management of content, media and users.
SMS	Implement an SMS gateway, message generation tools, subscriber lists to support generation and dissemination of SMS alerts for early warning, and data acquisition functions.
IVR	Implement an IVR gateway, Bangla voice content tools and subscriber lists to support dissemination of alerts by voice.
Couriers	Courier information products that are too large to be disseminated by other media, or are aimed at users with no capacity to receive them by electronic means.

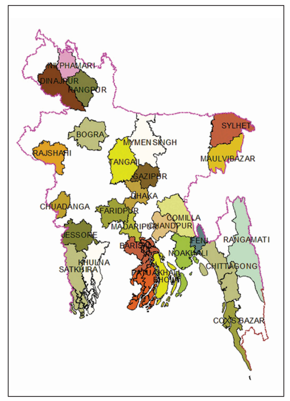
Source: CDMP-DMIC Needs Assessment Survey Report, 2006.

5. DMIC Operations

The national DMIC has become fully operational on a 24/7 basis and is playing the role of a catalyst in early warning dissemination from the national level down to the upazila level. It has signed Memorandums of Understanding (MoUs) with two central early warning data providers (Bangladesh Meteorological Department (BMD) and Flood Forecasting and Warning Centre). As per the agreement, CDMP upgraded all 35 meteorological observatory stations of BMD and replaced all its single-side-band-based data transmission system with the Internet-based data acquisition system. These stations are now computerized to fetch real-time data from regional met-observatory stations. To ensure wider access of weather-related information to the people, CDMP assisted BMD in designing and developing its website (http://www.bmd.gov.bd), which is being frequently updated. In return, DMIC availed the permission of utilizing its early warning information for its 500 stakeholder organizations and user groups.

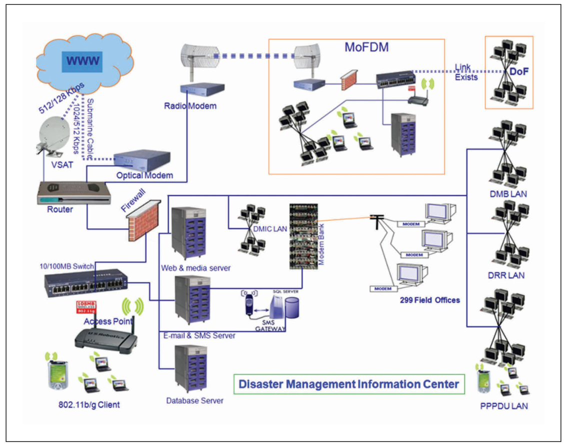


DMIC has built the internal capacity to produce and issue daily situation reports, which are composites of damage, loss and response data received through its communication networks from several sources. DMIC technical staff uses image analysis and GIS tools to develop these reports. They combine GIS functionality with web applications that automate production and provide users with online GIS tools to manipulate data. Since 2006, DMIC has issued more than 200 situation reports on floods, storm surges, cyclones and landslides.



DMIC uses a range of ICTs to disseminate information. DMIC is currently equipped with high-end servers, SMS/Fax gateway, a GIS unit and redundant data connectivity.

But because fax still predominates in institutional information transmission, the DMIC has fax transmission and reception capability. However, fax machines are problematic in several senses: in



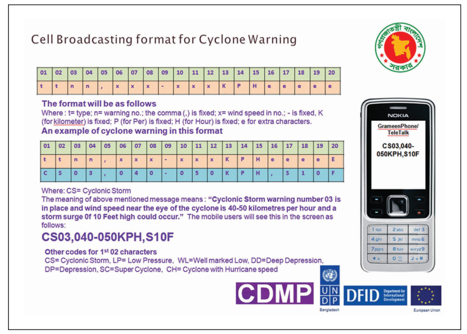
transmission mode they have to be attended by a human operator; being mechanical they are inherently unreliable; the original image must first be printed and then may have to be physically stored for traceability of transmission; recovery from failed transmissions may be awkward; and distribution lists are not easily maintained. An implementation based on fax modems and software servers integrated with product generation systems, and distribution and archiving achieved by means of database queries, avoids these problems. The DMIC implemented an alert subscription system in which local users can register to receive e-mail, SMS or fax early warning messages. The messages are automatically composed to address the user's location and hazard concerns. Already, some stakeholders prefer the newer ICTs.

Traditionally, early warning information originates in central institutions, propagates by fax to district and upazila offices, and continues down the administrative hierarchy in hand- and voice-carried bulletins to the community. This traversal erodes prediction lead time, often entirely, and a single broken link starves all of the nodes below it so that some communities may not receive the message at all. Mass media, especially state-operated media, broadcast early warnings directly to communities throughout the country, but necessarily due to time constraints they aggregate the information to the extent that it is no longer as localized as it began or should usefully be.

The DMIC generates time-sensitive information items such as early warnings, situation reports and other real-time data, and presents them in information products delivered through communication channels that cause the least delay, and are consistent with the capacity of users to receive and comprehend them.

6. Cell Broadcasting of Early Warning Messages

In the last few years, mobile penetration in Bangladesh has escalated rapidly, and mobile technology is increasingly being used as a tool for early warning dissemination. SMS is commonly used to disseminate early warning but it has some disadvantages, such as slow transmission time, costliness, and difficulty in sending location-based warning. Considering these drawbacks, DMIC is now piloting early warning dissemination through cell broadcasting in two districts Sirajgonj (for floods) and Cox's Bazaar (for cyclones). With cell broadcasting technology it is possible to reach millions of subscribers in a couple of seconds, with warning messages tailored to specific locations.[96]



An MoU has been signed among MoFDM, Grameen Phone and Teletalk. Based on the result of the pilot this technology will be expanded to other high risk areas of Bangladesh. CDMP is providing technical support to the MoFDM in preparing the Early Warning Cell Broadcasting Policy and planning for the establishment of a Cell Broadcasting Centre within DMIC under the second phase of CDMP.

7. Use of ICT Tools and Software by CDMP

For day-to-day office management CDMP established a local area network (LAN) within its project management office and expanded it to two other departments of MoFDM (DMB and DRR) located in the same building. MoFDM, DMB and DRR were provided with a number of computers, fax machines, printers, LAN and server machines, and their websites have been redesigned. The important desks were then connected with broadband Internet for real-time data and information sharing.

CDMP also assisted the Bangladesh Meteorological Department in establishing LAN in their offices. To reach out to the partner institutions CDMP provided ICT support including the equipment and training, and formed a number of user groups for e-mail communication.

96. Cell broadcast is designed for simultaneous delivery of messages to multiple users in a specified area. Whereas the Short Message Service - Point to Point (SMS-PP) is a one-to-one and one-to-a-few service, Cell Broadcast is a one-to-many geographically focused messaging service. Since it is not as affected by traffic load, it may be used during a disaster when load spikes tend to crash networks. During the tsunami catastrophe in Asia, Dialog GSM, an operator in Sri Lanka was able to provide ongoing emergency information to its subscribers using cell broadcast technology.

By December 2008, CDMP equipped all the 64 districts and 235 upazilas DRR sub-offices with computers and established wireless Internet connections to the National DMIC located on the 6th Floor of the Disaster Management and Relief Building.

CDMP conducted different types of risks assessments and mapping and developed a number of databases for which different ICT software was utilized (see Table 9). Risk mapping is essential and is targeted at policymakers and planners for use in making informed decisions. CDMP follows an all hazard, all sector and all risk approach and is working in both urban and rural settings. GIS-based multi-hazard maps are particularly useful in identifying risk reduction interventions for a third of the country's population residing along coastal areas which are highly vulnerable to consequences of sea level rise, and in urban areas, for a third of the buildings of Dhaka, Chittagong and Sylhet cities that are highly vulnerable to any medium intensity earthquake due to unplanned urbanization and poor construction practices. Because of the narrow lanes it is always difficult for the fire brigade to reach the fire hazard on time.

The choice of ICT tools has been dependent upon the availability of data and information as well as the consideration of international best practices for such kind of work. The maps already generated are uploaded in the CDMP web portal with open access. Different national and international NGOs, donor organizations and government departments have consulted these maps when choosing specific locations for their programmatic activities. The hard copies of the maps have also been distributed among the relevant stakeholder groups with proper orientation for their use.

CDMP sponsored a number of training programmes on the use of GIS in disaster management that need to be scaled up further. Availability of reliable data and their access is always a challenge since for many of the data generating agencies it is their major source of income. CDMP signed MoUs with a number of government data generating agencies and received commitment for easy access to required data. CDMP also contracted a number of private sector agencies to generate further data and information necessary for such kind of maps that are not readily available. A number of databases have been established under CDMP web portal with provision for regular updating by different partner entities. This effort will continue in Phase II of the CDMP.

CDMP is also foreseeing a huge demand for an interactive web and CD-based training module on comprehensive disaster management that will be launched during its second phase in January 2010.

Table 9. Details of risk assessments, mapping exercises and databases of CDMP

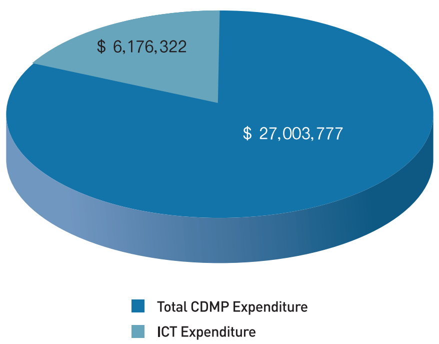
No.	Type of Assessment/ Database	ICT Software Used	Minimum Requirements	Achievements	Current and Future Challenges
1.	Community risk assessment and mapping	· ArcGIS Server 9.3 · ArcGIS Desktop 9.3 · ENVI · ArcPad · Linux Platform · MapServer · SDE · PstgeSQL/PostGIS	· Shape files up to union level · GIS/IT knowledge · Location-based data/information · Scientific data	· Produced hazard, risk and vulnerability maps for 611 unions	· Inadequate GIS/IT knowledge among the NGO practitioners · GIS hardware and software limitations · Lack of scientific data
2.	Community level hazard zoning maps	· ArcGIS Server 9.3 · ArcGIS Desktop 9.3 · ENVI · ArcPad · Linux Platform · MapServer · SDE · PstgeSQL/PostGIS	· Shape files up to union level · GIS/IT knowledge · Location-based data/ information · Scientific data	· Produced multi-hazard risks and vulnerability maps for 67 unions	· Inadequate GIS/IT knowledge among the NGO practitioners · GIS hardware and software limitations · Lack of scientific data
3.	Climate change impact assessment and scenario mapping	· PRECIS · RegCM · MM5 · MIKE BASIN	· Super computer · LBC data · Skilled manpower · High quality hydro-meteorological data · Data length · International and national institutional linkages	· Projected monthly scenario on rainfall and temperature for 2030-2070 · Projected monsoon flooding and their impact for 2040	· Unavailability of the appropriate equipments · Lack of relevant expertise · No institutional capacity · No inter-institutional coordination
4.	Seismic risk assessment and mapping	· Satellite images · ArcGIS Server 9.3 · ArcGIS Desktop 9.3 · HAZUS software package · GPS Machine	· Shape files up to union level · GIS/IT knowledge · Scientific data · Skilled human resource · Existing secondary data and field survey data	· Seismic risk assessment of the buildings, essential facilities and lifelines in 91 wards of Dhaka, 41 wards of Chittagong and 27 wards of Sylhet City Corporation areas	· Inadequate GIS/IT knowledge among the stakeholders · Unavailability of the appropriate equipments · Lack of relevant expertise · No institutional capacity · No inter-institutional coordination
5.	Tsunami risk assessment and mapping	· Satellite images · ERDAS Imagine software · ArcGIS Server 9.1 · ArcGIS Desktop 9.1	· GIS/IT knowledge · Shape files up to Union Level · Skilled human resource	· Inundation risk maps for tsunami and storm surge have been prepared for the entire coastal	· Lack of new topographic survey data · No updated bathymetry data

No.	Type of Assessment/ Database	ICT Software Used	Minimum Requirements	Achievements	Current and Future Challenges
		· MIKE 21 modeling system · QuakeGen model	· Surveyed topographic information data · Scientific data	region of Bangladesh considering decay factor for land use, geomorphology and slope	· No inter-institutional Coordination, collaboration and information sharing and management. · Lack of relevant expertise · Inadequate GIS/IT knowledge among the stakeholders
6.	Economic risk analysis and mapping	· MS excel database · ArcGIS Server 9.1 · ArcGIS Desktop 9.1	· GIS/IT knowledge · Shape files up to union level · Skilled human resource · Data collection (primary and secondary)	· Exposure of the population and their livelihood to physical vulnerability to cyclone and tsunami inundation and also nature and extent of the vulnerability of the economic sectors of cyclone and tsunami hazards in the coastal region of Bangladesh	· Inadequate GIS/IT knowledge among the stakeholders · No inter-institutional coordination, collaboration and information sharing and management
7.	Spatial distribution map of formal/informal cyclone shelters	· MS Access database · ArcGIS Server 9.3 · ArcGIS Desktop 9.3 · Visual basic 6.0 · SQL Server 2000 · GPS tool	· GIS/IT knowledge · Shape files up to union level · Skilled human resource · Data collection (primary and secondary)	· 16 districts coastal areas haves been considered for updating cyclone shelter information	· Inadequate GIS/IT knowledge among the stakeholders · Lack of updating Cyclone shelter database · No inter-institutional coordination, collaboration and information sharing and management
8.	Disaster incident database	· PHP/MySQL · Linux Platform	· Shape files up to union level · Hosting facility · Regular flow of information	· Since January 2009 maintained date-wise detailed record of all disaster incidence and their damage scenario reported in the national dailies and other available sources	· Source of small scale or localized disaster information
9.	DMIC-DMIN portal	· PHP/MySQL · Linux Platform · MapServer · Fax Server · SMS Server	· Portal framework developed · Data sharing agreement · Updating/ Maintenance policy	· Portal is up and running with limited functions · Provided warning alert at free of cost through fax, SMS and e-mails	· Lack of ICT knowledge · Inadequate disaster data/information · Cost of alert subscription through fax and SMS · Activating the user groups
10.	Disaster damage information system	· Java-based web application · JBoss Application Server · MySQL · BART	· Internet access · Well conversant on the tools and formats	· Created a platform for generation of real-time disaggregated damage	· Accessing Internet from the field · User training
11.	Inventory of Community Risk Reduction Programme (ICRRP)	· Java-based web application · JBoss Application Server · MySQL · BART	· Database designed and developed for storing and processing of damage information · Data entry is done properly at the field	· Preparation of ICRRP at national and seven pilot districts level · Risk and Hazard, SWOT and gap analysis of disaster management stakeholders including NGOs · GIS-based MIS	· Lack of updated data

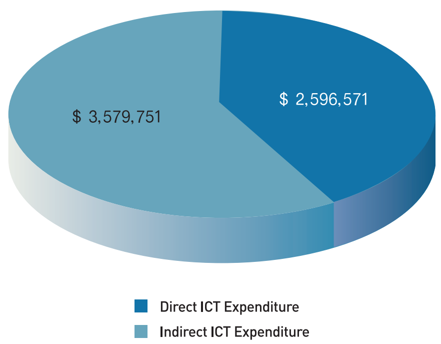
Figure 3. DMIN portal being introduced to the key stakeholders

7.1 CDMP ICT budget and the expenditure

Although the direct spending on ICT equipment and software may not be very high (US$3.60 million) compared to its overall budget of CDMP Phase I (US$27.0 million), the use of ICT is very prominent in its programmatic activities. All the CDMP components utilized services of different IT software companies and the sub-implementing partners while analysing their data and information and preparing their reports. A rough estimation shows that the overall ICT spending (including this indirect use) has reached up to US$6.2 million.



CDMPICT and Non-ICT expenditure (2004~2009)



CDMPICT direct and indirect ICT expenditure (2004~2009)

8. Conclusion : Looking Ahead

In Bangladesh, ICT is playing an increasingly important role in all phases of disaster risk reduction. Information is the key to managing disasters and reducing risks, and the establishment of the DMIC within the GoB is a 'good practice' for ensuring that communities at risk have access to relevant information that they can act upon.

The nation's early warning capacity increased through the inclusion of automated data acquisition system for BMD and dissemination through DMIC. DMIC also provides information and data services through its web portal, http://www.dmic.org.bd. Telecommunication links have been established with all 64 district headquarters and 235 high risk upazila. Direct ICT support has been provided to improve the operational capability of BMD, including 35 regional observation stations. Three hundred officials and technicians from MoFDM, BMD, DMB and DRR have received ICT training. These CDMP achievements have enhanced the use of ICT in disaster risk reduction in Bangladesh.

The smooth functioning of DMIC and its technical operation heavily depends on both the constant supply of quality equipments and adequate IT professionals with practical and relevant knowledge. Quality IT experts are costly as well as very short in supply. Very often they are unwilling to work in the public sector due to low salary and limited facilities. Regular maintenance, repairing and updating of both hardware and software is another big challenge for the success of DMIC. All these are considered as potential challenges for DMIC once it is integrated with the DMB's organizational structure, especially after CDMP Phase II in 2015.

DMIC continues to explore suitable mechanisms and tools to reduce disaster risks. Some possibilities include public-private partnerships, sponsorships, and other means, such as direct links to the mobile phone system for early warning and data collection, or Internet portal sponsorships to ensure that the system will be operated, maintained, and upgraded in the future.

9. References

CDMP DMIC ICT Strategy Report, 2006
CDMP DMIC Needs Assessment Report, 2006
Bangladesh ICT Policy of 2002
Bangladesh ICT Policy of 2009
CDMP Annual Progress Report, 2008
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Integrated Information and Communication System for Emergency Management in Bangladesh

Manzul Kumar Hazarika, Dwijendra Kumar Das and Lal Samarakoon

1. Introduction

Bangladesh is highly vulnerable to natural disasters due to its location and topography. It regularly experiences floods, droughts, tornadoes and cyclones, and as it is located in a tectonically active zone, Bangladesh has a long history of seismic tremors. Four major earthquakes of magnitude exceeding 8.0 during 1897, 1905, 1934, 1950 and another 10 high magnitude earthquakes were experienced during the last 100 years. Major cities such as Dhaka, Chittagong and Sylhet are extremely vulnerable to earthquakes due to high population density and unplanned growth over the years. A major earthquake could cause large scale damage/collapse to poorly constructed/old buildings, and interrupt major lifelines such as electricity, water and gas supply. The coastal areas of Bangladesh have been severely affected by catastrophic cyclones and accompanying storm surges from time to time with 166,981 causalities since 1980.[97]

A multi-sector, multi-agencies, coordinated effort is necessary to face the consequence of such catastrophic disaster events in Bangladesh. Damages to existing communication infrastructure in the event of a disaster can adversely affect coordination essential for effective emergency and relief operations. Thus, an independent, dedicated bi-directional and robust communication system is essential for not only communicating among the rescue and relief workers but also for coordination with the National Emergency Operation Centre (NEOC). The system should facilitate seamless communication between the NEOC and rescue and relief units through voice, video and data exchange (including maps) regardless of their accessibility to traditional communication systems at any location in Bangladesh.

97. EM-DAT ? The OFDA/CRED International Disaster Database, 2009, Universite Catholique de Louvain, Brussels, Belgium, http://www.emdat.be.

2. Present Capacity of Service Providers and Gaps

The existing telecommunication network infrastructure in Bangladesh is comprised of satellite/microwave, optical fibre, very small aperture transmission (VSAT), and mobile phones, operated by both government and private players. The Bangladesh Telecommunications Company Ltd. (BTCL) has the largest communication network in Bangladesh. All the District offices are linked with Dhaka through microwave. District offices are connected with respective Upazilas (sub-districts) and Thanas (police stations) by UHF radio links, while many of the Thanas are linked with villages/bazaars through base/PCO radios and other terrestrial means.

Optical fibre links in Bangladesh were established in 1986.[98] The optical fibre link between Dhaka to Chittagong was completed in 2001. Bogra-Joypurhat-Ragpur-Dinajpur in the north-west portion of the country is connected by an optical fibre link, while a Dhaka to Bogra optical fibre link via the Jamuna Bridge is being carried out. For satellite communication, Bangladesh relies primarily on the IO-Inmarsat satellites and this geo-stationary satellite/terrestrial microwave link network is being used for international telecommunication that consists of four earth stations located at Betbunia (40 km from Chittagong), Mohakhali (in Dhaka City), Talibabad (30 km north of Dhaka) and Sylhet city. BTCL is also a member of the SEA-ME-WE-4 submarine cable network consortium. The 10 Gbps bandwidth of this network is serving Bangladesh's needs for international communication. This link uses Chittagong as the landing station.

With the intention of accelerating the growth of Internet, the Bangladesh Telecom Regulatory Commission (BTRC) licensed the use of VSAT satellites for data-com use about a decade ago. There are more than 120 users of VSAT, consisting mostly of foreign organizations such as gas companies, embassies and financial institutions, and some Internet service providers. These users are linked to Internet hubs located in Singapore or Hong Kong.

There are six licensed private mobile phone network operators in Bangladesh (Grameen, Banglalink, Aktel, Warid, Citycell and Teletalk) with 46.50 million subscribers as of April 2009. Due to limited availability of land-based networks in the country (1.4 million subscribers as of April, 2009), mobile phones serve a major part of the total telephone traffic in rural and remote parts of Bangladesh as well as in cities. Mobile phone operators use both fibre optics backbones connecting major cities and microwave

98. International Telecommunication Union, Emergency Telecommunications for Disaster Management in Bangladesh, 2006.

transmissions for reaching other parts of the country. Mobile phone operators also facilitate Internet services using GPRS and/or EDGE technologies, and many of them are expected to provide third generation (3G) services in the near future.

Although the telecommunication coverage in Bangladesh is quite satisfactory, it does not cover Sundarban and some hilly tracks in Chittagong area. From a disaster management point of view, this may not be very significant as the population density in these areas is quite low. BTCL has a very good communication infrastructure, but as of now, they cannot readily be used for disaster management purposes due to lack of system integration, which is an essential requirement for developing a robust emergency telecommunication system. Furthermore, some of the essential services for an emergency telecommunication system such as VoIP, are not yet legal in Bangladesh. Similarly, licenses for Wi-Max operation in Bangladesh have only recently been issued and it is not clear what kind of services will be provided by the Wi-Max operators. Both the VoIP and Wi-Max services will be essential to design and develop an independent, reliable and robust communication system for emergency response and management.

3. Current Problems in Emergency Telecommunication Services

Although, as indicated above, a good telecommunication infrastructure is in place in Bangladesh, there is yet no comprehensive well-defined system in the country to designate the institutions and their responsibilities for emergency communication in a post-disaster situation. There is a disaster management plan embodied in the Standing Orders on Disasters,[99] but the aspect on emergency telecommunication is not clearly defined. For private telecom operators, there is also a disaster contingency plan, but this has not yet been institutionalized. Among government agencies, only the Cyclone Preparedness Programme (CPP) and the Police have dedicated communication facilities for emergency purposes. Existing VHF radios for disseminating cyclone warnings to the community level by CPP has been so far very effective due to its good maintenance and training of radio operators. CPP is jointly managed by the Government of Bangladesh and Bangladesh Red Crescent Society and it is one of the most successful cyclone preparedness programmes in the world. CPP has an extensive HF and VHF radio network in the coastal areas of Bangladesh that is linked to its headquarters in Dhaka.

In the immediate aftermath of disasters, existing emergency telecommunication services might be adversely affected. For example, in 2004, flood water entered the cable ducts, affecting the communication cables in many districts. Almost 108 km of optical fibre cable link between Dhaka and Chittagong was damaged. Similarly, associated strong wind from cyclones usually disrupts telecommunication links. In the April 1991 cyclone, national and international telecommunication networks were interrupted due to the collapse of a vital microwave tower at the port city of Chittagong, and Bangladesh was cut off from the rest of the world for several days. Similar situations cannot be ruled out in case of an earthquake event in Bangladesh. Furthermore, during disaster events, one of the most common problems for the telecommunication operators (both public and private) is power failure, which hampers the delivery of services and disruption of communication. Most mobile phone operators have limited power back-ups (6-10 hours), especially in remote areas. Some of the mobile phone operators have generators, but supplying fuel at the time of disaster, and moreover to remote areas, is difficult logistically.

For effective disaster management, an integrated system is indispensable, both in terms of communication channels as well as involving diverse groups of stakeholders. So far, in Bangladesh, government agencies work independently in an emergency situation, depending on the type of disaster they need to deal with. Most of the agencies' services are restricted to disseminating early warnings. For post-disaster operations, an independent, dedicated and robust communication line should be in place for ensuring uninterrupted communication among the NEOC, rescue and relief units as well as all the line agencies. To date, neither communication systems integration nor standard operating procedures for coordinated emergency communication have been established.

From a technical point of view, there will be three major obstacles for emergency communication when a natural hazard strikes in Bangladesh. First, the heavily damaged or destroyed communication networks will lead to a complete communication blackout in the affected areas. Second, even if part of the existing communication system is operational, they may quickly become oversubscribed by increasing traffic volume at the time of the disaster, making communication difficult. Third, in an event of an earthquake in Bangladesh, there is a very high possibility of a major breakdown in power supply in and around the affected areas. Most of the mobile phone network operators have limited power back-ups, especially in remote areas.

99. Disaster Management Bureau, Standing Orders on Disasters, 2000.

4. Existing Regulatory Functions, Gaps and their Policies

The BTRC was established in January 2002 under the Telecommunication Act of 2001 to formulate and implement telecommunication policies and facilitate the provision of affordable telecommunication services of acceptable quality throughout the country. BTRC issues all types of licenses for telecom operators and stipulates the conditions for their activities. It has recently issued Wi-Max licenses to two private operators and 116 community radio licenses to NGOs and other operators for establishing such services in the country. Nevertheless, there have been no specific rules and regulations formulated for emergency disaster management.

An 'Integrated Information and Communication System' for carrying out the relief and rescue operations immediately after a disaster event has been proposed as part of a project to mitigate earthquake risks in a few major cities in Bangladesh, which is expected to be implemented under the Comprehensive Disaster Management Programme of Bangladesh.[100] Such a system will use all available means for communication such as satellite and microwave, Wi-Fi/Wi-Max, VHF/UHF, PSTN, mobile phones and community radio services for efficient rescue and relief operations by assuring communication links among the rescue and relief units as well as with the NEOC. The system will have a feature of interoperability by bringing different kinds of communication systems together and provide a seamless communication medium. The system follows the ITU standards (ITU-T/ITU-R/ITU-D) for communication. Common Alerting Protocol (CAP) base data formats will be used that allow messages to be disseminated over a wide range of warning systems. The system will use CAP to broadcast text and voice messages to the communities through private mobile phone networks as well as community radio services.

5. Development of an Integrated Information and Communication System

Requirements for an integrated information and communication system are as follows :

- Facilitate broadband applications such as chat, voice, video and data sharing (maps and non-spatial data)
- Offer a robust and reliable platform for communication
- Bypass the traditional networks, if damaged or failed
- Facilitate network interoperability
- Scalable to meet diverse needs during the rescue and relief operations
- Portable enough to reach any geographical location in the country quickly
- Require minimal power
- Easily deployable and cost effective

Recent advances in the field of ICT provide an opportunity to meet the above challenges and provide a reliable platform for quick and easy deployment of a communication system in the event of a catastrophic disaster. A completely independent communication network can be established in an affected area after a disaster to provide maps and data promptly to the rescue and relief units using the network to carry out rescue and relief operations on the ground. Existing data and information such as earthquake hazard/vulnerability maps, population, road networks, critical infrastructures, utilities, urban land uses, possible evacuation routes/areas, shelters etc. will be made accessible to the rescue and relief units through the system and they will be able to update these maps onsite using portable devices (such as PDAs or laptops) and send them in real-time to the NEOC. The updated maps will eventually include information on damage, accessibility information (i.e., road status), logistic or medical needs, etc. in the disaster affected areas. NEOC can then disseminate these maps in digital form to all the line agencies and stakeholders through web portals so that they can visualize, plan and execute their response missions accordingly. Furthermore, NEOC will be able to provide early warnings to the communities and other stakeholders, as well as provide updates on the disaster situation at regular intervals through community radio services and mobile phones.

The specific objectives of developing the system are:

- Design and develop a communication system integrating satellite and microwave, Wi-Fi/Wi-Max, VHF/UHF, PSTN, mobile phones and community radio services for efficient and assured rescue and relief operations.
- Develop multimedia applications for supporting bi-directional broadband communication such as chat, voice, video and data sharing (maps and non-spatial data).
- Design and develop a disaster information system by integrating the available maps and information Allow update in real-time through rescue and relief units operating at the field and conduct a rapid damage assessment.
- Develop web portals as channels for line agencies to easily access updated maps for planning and executing their operations.
- Integrate the system with community radio services and mobile phone networks to provide alerts as well as updated information to the communities and other stakeholders.

100. For more information on the Comprehensive Disaster Management Programme, see case study entitled, "The Bangladesh Comprehensive Disaster Management Programme and ICTs."

5.1 Communication System

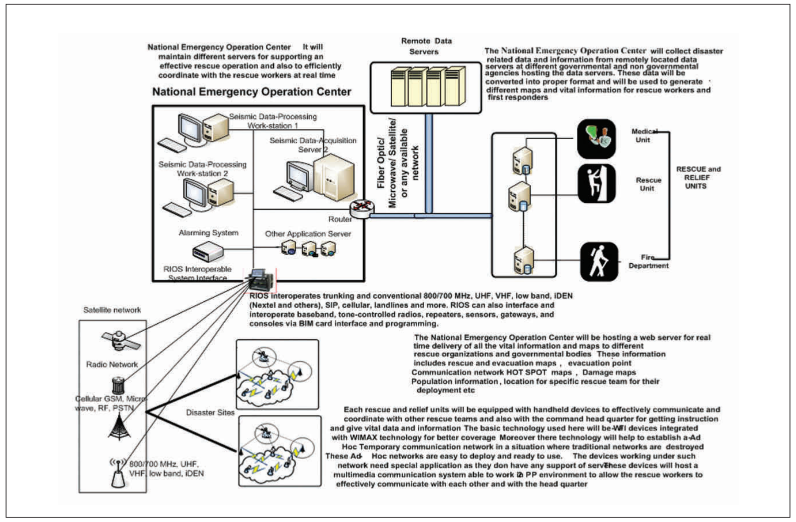

Figure 1. Architecture of the Integrated Information and Communication System

Immediately after a disaster, an ad-hoc communication network with Site Command Centres has to be established in the affected areas, which will be connected to the NEOC through satellite links. The Site Command Centres are actually portable roaming units that are kept at the NEOC. In the event of a disaster, these Site Command Centres will be moved to the affected areas by mounting and transporting in a vehicle or using any other suitable conveyance. Site Command Centres will have the capacity to provide onsite communication link within an interoperable network. This communication network will allow rescue and relief units two-way communication using voice, video and text regardless of format, frequency, or physical distance. The communication network will seamlessly interoperate trunking and conventional (800/700 MHz), UHF, VHF, mobile phones, microwave, Internet, Wi-Fi, Wi-Max and others. This will facilitate the rescue and relief units to communicate among each other readily, while communication with the other Site Command Centres or the NEOC will be provided primarily through satellites, but other communication channels can also be used if available. Figure 1 shows the architecture of the communication system.

Prioritization of to and fro information with the rescue and relief units is also important in post-disaster operations, and all the communication will be categorized and prioritized on the basis of urgency so that important ones are immediately transmitted and attended. All the commands and instructions from the NEOC will have the highest priority. All the high priority messages will be transmitted as broadcast message so that the rescue and relief units receive them immediately.

The system can be also linked to early warning systems, for example, to an earthquake alert system or to a cyclone warning system. Since the system is capable of seamless interoperability, the early warning messages received by the NEOC can be directly sent to the individuals or communities through mobile phones.

It is also worth mentioning that the success of the CPP has been by and large a result of the large pool of trained volunteers at the ground. Upon receiving the warning information from Headquarters, these volunteers use various warning equipment such as megaphones, sirens, public address equipment, signal lights and flags. This proposed system will provide an additional channel to reach not only the CPP volunteers but also the communities directly, for example, by sending simple text or voice messages to their mobile phones from the NEOC using the system.

5.2 Disaster Information System

The communication network is integrated with a customized disaster information system and data can be accessed from remote data servers being maintained by various line agencies. However, datasets available in these servers cannot be readily used due to their various native formats. An application has been developed to convert all the datasets into a homogeneous format and highly compressed form. Information coming from the field in real-time (through rescue and relief units) will be integrated to develop value-added products for serving the line agencies through web portals to plan their missions in advance in the affected areas.

Having real-time field information in hand, the NEOC will be able to carry out rapid damage assessment, supported by remote sensing data when available. The NEOC can communicate the updated information to the various line agencies through a web portal. The main advantage of the system is that all the stakeholders will be working under one umbrella and overall coordination of the relief and rescue operations will be carried out by the NEOC.

5.3 Redundant Emergency Operation Centre

If the NEOC becomes affected by a catastrophic disaster, its services need to be relocated to a redundant Emergency Operation Centre. While considering such a redundant Emergency Operation Centre, the following primary networks will be taken into account: 1) Optical fibre network, and 2) Microwave link and satellite link as a back-up. Since the NEOC will operate in Dhaka, therefore, the redundant Centre will be located in Chittagong and Sylhet. The primary link for the Chittagong Centre will be optical fibre, while satellite and microwave link will also be available as a back up. In the case of Sylhet, the primary link will be microwave and the satellite link will be the back up.

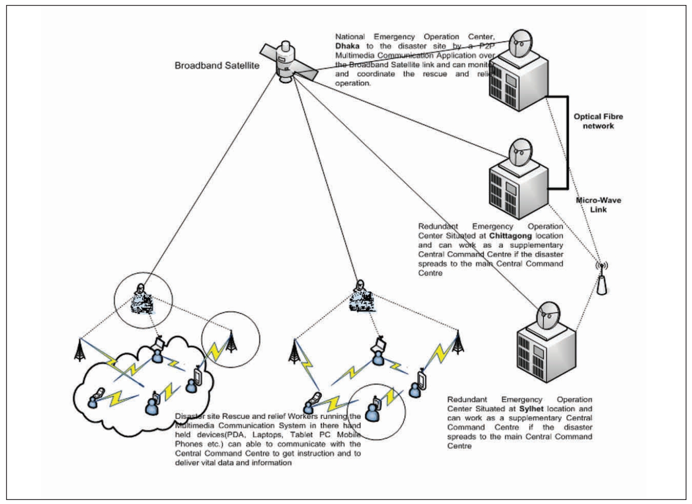

Figure 2. Communication Networks of the Redundant Emergency Operation Centre

6. Beneficiaries

The Disaster Management Bureau of Bangladesh will be the primary beneficiary of the system, while all the line agencies engaged in rescue and relief operations will benefit. Logistic supports will also benefit from the system for planning and executing their operations at the field immediately after a disaster event. Affected communities will also directly benefit from the messages and information provided to them through the mobile phones and community radios.

7. Workshop and Training

A workshop will be organized to provide an overview of the system to the senior officials and managers. The main aim of the workshop will be to apprise them with the essential functions of the system so that they can make use of it while making decisions. Trainings will also be organized for the staff members responsible for operation and maintenance of the system at NEOC.

For training of the field units, a critical mass will be developed at the NEOC. Accordingly, 'Training of Trainers' at the NEOC will be conducted in which basic training on the GIS component of the system will be provided to selected staff from the NEOC and Disaster Management Bureau. The aim of this training will be on 'handling spatial datasets'.

8. Conclusions

Bangladesh has a very good communication infrastructure, but as of now, it cannot readily be used for disaster management due to lack of system integration. For effective disaster management, an integrated system is indispensable, both in terms of communication channels/modes as well as involving diverse groups of stakeholders. So far, in Bangladesh, government agencies work independently in an emergency situation, depending on the type of disaster they need to deal with. Most of the agencies' services are restricted to disseminating early warnings.

For post disaster operations, an independent, dedicated and robust communication system should be in place for ensuring uninterrupted communication among the NEOC, rescue and relief units as well as all the line agencies. The proposed 'Integrated Information and Communication System' is robust enough to harmonize all available communication channels and signals during an emergency situation. For instance, the BTRC, which is the sole authority in Bangladesh to formulate and implement telecommunication policies, has shown interest in this system and is willing to provide necessary support to make the system operational. Both public and private players need to participate in the system, since the government has a very diverse and high capacity communication infrastructure, while private players have good mobile phone network coverage in the country, even to remote communities. Under the social corporate responsibility initiatives, some of the private mobile phone operators are willing to participate in the proposed system by providing access to their networks for disseminating early warnings and updated information to the communities, coming from the field (through field units) after a disaster event or in any emergency situation. Training for effective use of the system, and multi-stakeholder participation in the development of standard operating procedures are integrated in the proposed system.

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Space Technology Application for Disaster Management in China

Li Jing, Shen Li and Tang Hong

1. Introduction

Affected by a monsoon climate and special geographical and geological conditions, It is frequented by typhoons, floods, landslides, droughts, forest fires and earthquakes. China is vulnerable to all kinds of natural disasters, with the exception of volcanic eruptions. As the population density is high, these natural disasters often result in high casualties and enormous economic losses.

Since the 1990s, China has seen a high frequency of weather and climate extremes, a sharp increase in losses, a series of chain reactions and a variety of disaster types. Every year, on average, there are 370 million disaster-struck people, four million collapsed houses, over four million relocated people, and direct economic losses exceeding CNY 100 billion (about US$14.7 billion). Disasters have become increasingly severe. For example, in 1991, economic losses caused by floods were no more than US$ 10 billion. However, in 1994 they were more than US$ 20 billon, and in 1998 more than US$ 30 billion. Statistics show that in 2006, 434.5 million people were affected by disasters, among which 3,186 people were killed, and 13.8 million people were resettled. More than 40 million hectares of crops were affected, (of which 5.4 million hectares crop were destroyed), and about 2 million houses were destroyed. The direct economic loss was CNY 252.8 billion (about US$ 37 billion). Natural disasters seriously affect social and economic activity and regional sustainable development.[101]

Against the background of the worsening disaster situation and international efforts towards the promotion of disaster risk reduction, the State Council of the People's Republic of China approved a name change of the coordination body responsible for disaster management, to the National Committee for Disaster Reduction (NCDR). Originally, it was the China National Commission, established in 1989 for the United Nations International Decade on Natural Disaster Reduction. It was renamed China Commission for International Disaster Reduction in 2000 and to NCDR in 2005. Headed by a Vice Premier of the State Council, the NCDR consists of 34 member units from the ministries, commissions and bureaus of the State Council, the military forces, and the institutions of science and technology (see Figure 1). It is headquartered in the Ministry of Civil Affairs.

The Expert Committee of the NCDR, consisting of many academicians and experts in the area of disaster risk reduction, serves as the think tank, providing references in its decision-making. The Ministry of Civil Affairs and Ministry of Education collaboratively established the Academy of Disaster Reduction and Emergency Management in Beijing Normal University, as a centre for disaster study and technical development for the NCDR. It has four institutes and a Key Laboratory of Environment Change and Natural Disaster of the Ministry of Education. As an open research institution, the Academy makes effective use of advanced science and technologies, as well as related products, databases and models from all over the world, and organizes scholars from relevant institutes and universities, to conduct research on disaster risk reduction and emergency management.

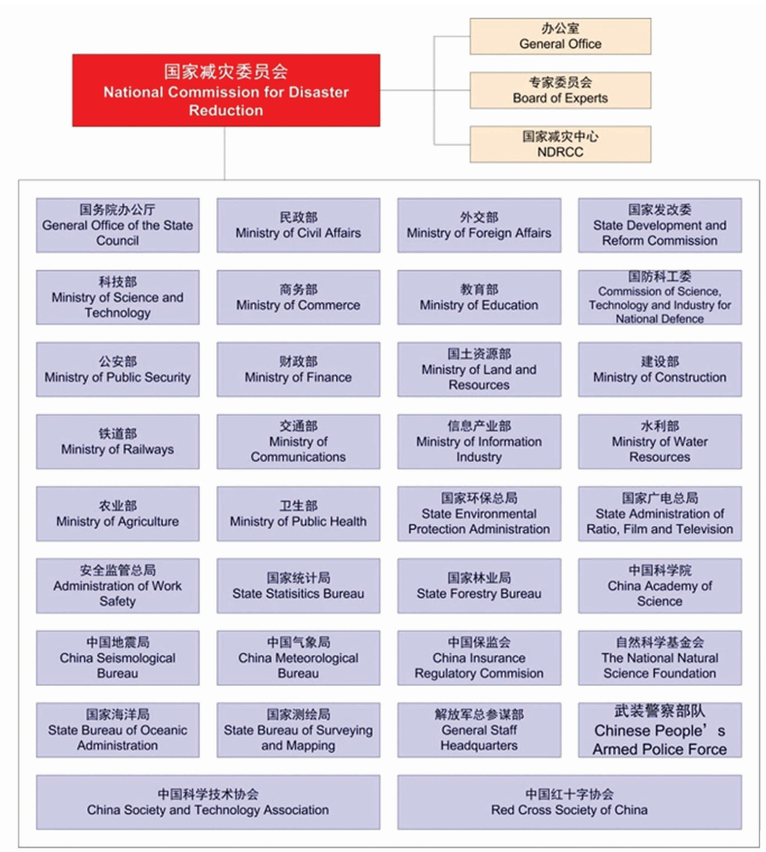


Figure 1. The Structure of China's National Committee for Disaster Reduction

101. Li J. and Guan Y., Natural disaster and emergency response management, International Disaster Reduction Conference 2007, 21-25 August 2007, Harbin, China.

When a natural disaster happens in China, NCDR will immediately launch its disaster risk reduction and relief efforts. All member units of NCDR work together very effectively as good communication and exchange mechanisms have been established between each other. Various types of disaster-related information is collected by different units, such as agriculture losses from the Ministry of Agriculture, abnormal weather information from the Meteorological Bureau, affected population from the Ministry of Civil Affairs and base geographical information from the State Bureau of Surveying and Mapping. They make a firm foundation for disaster management, and provide sufficient data sources for the use of space-based technology in disaster management.

Space-based technologies are increasingly being recognized as a crucial application for providing information, information services and decision support tools for disaster management. This paper introduces the Chinese disaster management system and the use of space-based technology in disaster management. This is followed by a case study on the use of space-based technology for flood risk management in China.

2. Disaster management system and space-based technology application

Integrated regional disaster management system research is an important research area for sustainable development study. It also provides the scientific basis for the establishment of an integrated regional risk management system. This area of research has, therefore, attracted a lot of attention in academia. Figure 2 shows the disaster management system.[102]

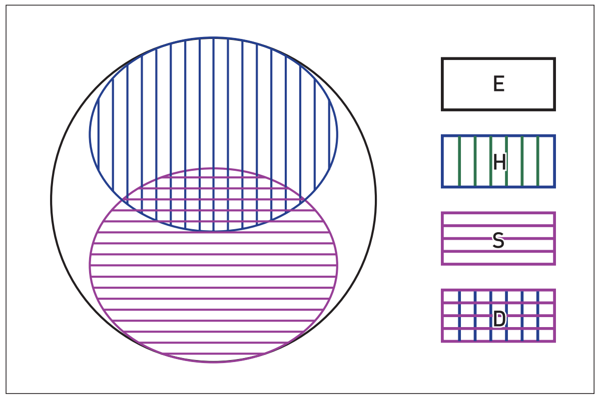


Figure 2. Disaster Management System

102. Shi P., "Theory on disaster theory and disaster dynamics," Journal of Natural Disasters, 2002, 11(3): 1-9.

Hazard-formative environments (E) in a broad sense are the natural environment and the human environment. The former can be divided into the atmosphere, the hydrosphere, the lithosphere and the biosphere; while the latter includes human and technology aspects. Hazard-formative environments have characteristics of zonality or non-zonality, fluctuation and suddenness, as well as gradual change and inclination. Hazard-inducing factors (H) include three systems - natural, human and environmental - and can be further divided into two systems of sudden and gradual changes. Hazard-affected bodies (S) contain human and life systems, various structure and production systems, and different natural resources. Apart from the human system, the others can be classified into real estate and movable property. Disaster effects (D) involve casualties and psychological impacts, direct and indirect economic losses, house collapses, and damages to the environment and resources.

Disaster risk reduction and emergency response management require adequate information on these three key aspects - H, S and D - to make effective decisions. However, as disasters often strike suddenly, develop at a rapid rate and affect large areas, it is difficult to monitor the process and develop a model through conventional methods. When serious disasters like flash floods and earthquakes hit, instrumentation and information (including monitoring and communication systems) are often destroyed, severing information flows that are critical for effective emergency responses and mitigation of losses.

The situation has changes with the rapid development of space-based technology, which includes geographic information systems (GIS), remote sensing, satellite navigation systems and satellite communication technologies.[103] In fact, only space-based systems can enable two-way communication without being affected by natural disasters. Thus, space technology, especially remote sensing technology has been widely applied to all phases of disaster management (see Figure 3), including preparedness and early warning, monitoring and rapid assessment, and loss assessment and relief.

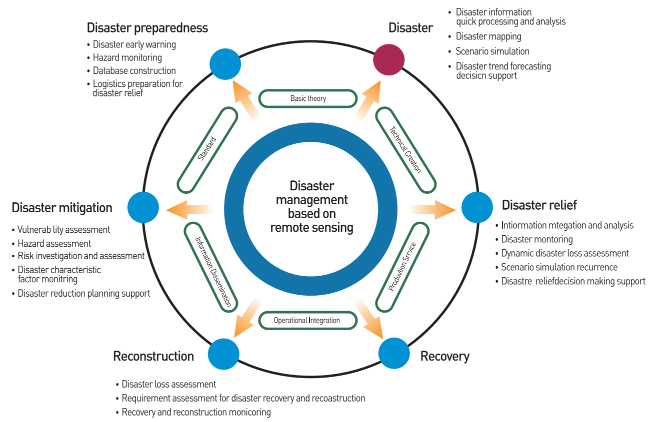


Figure 3. Disaster management based on remote sensing and GIS technology

103. Gonzalo J., Martin-De-Mercado G. and Valcarce F., °∞Space Technology for Disaster Monitoring, Mitigation and Damage Assessment,°± Space Technologies for the Benefit of Human Society and Earth, 2009: 305-330.
104.A digital elevation model (DEM) is a digital representation of ground surface topography or terrain. DEMs are commonly built using remote sensing techniques, but they may also be built from land surveying. DEMs are used often in GIS, and are the most common basis for digitally-produced relief maps (Source: http://en.wikipedia.org/wiki/Digital_elevation_model).

In the preparedness phase, remote sensing, GIS and satellite navigation systems are used mainly to establish a background database, from which the data can be used to analyse the disaster risks. The GIS database includes natural data (digital elevation model or DEM,[104] land cover, geology and geomorphology, hydrology, etc.) and socio-economic data (residents, key facilities, land use, population density, national income per capita, etc.) The background database is very important for each phase in disaster management. It also provides the necessary parameters for building models to support early warning and for conducting disaster risk assessment. Risk assessments are extremely valuable for decision-making in disaster preparedness and mitigation.

When a hazard is identified, remote sensing can be used for hazard detection and hazard process monitoring that offers information on hazard type, location, scope, developing and moving path, affected area and duration. Target identification and parameter inversion are the main methods. Target identification technology realizes the detection of surface features (shaped by point, line or area) from remote sensing images, and it can help to locate the site where a disaster happens. Remote sensing parameter inversion mainly involves establishing a quantitative relationship between remote sensing signals and surface parameter by using an appropriate model, which reveals disaster background information. In addition to satellite remote sensing, airborne remote sensing such as digital photography with digital camera, and laser scanning with airborne laser scanners are being utilized to monitor disasters.[105] In particular, laser scanner or LIDAR is useful for measuring the precise height or elevation of the damaged areas and structures, which can be manipulated for three dimensional measurement and analysis.

Loss assessment immediately after a disaster includes the extent and intensity of damage, economic losses, impact on lifelines (transportation, power, water supply, gas supply, and post and telecommunication), victims, damaged and collapsed houses, the deceased and the injured, environment pollution, disease outbreak and spread, social influence, etc. Space-based technology can be used to evaluate the effects of relief after disaster, and the safety of the evacuation plan.[106]

105. Dash J., Steinle E., Singh R. P., et al., "Automatic building extraction from laser scanning data: an input tool for disaster management," Advances in Space Research, 2004, 33(3): 317-322.

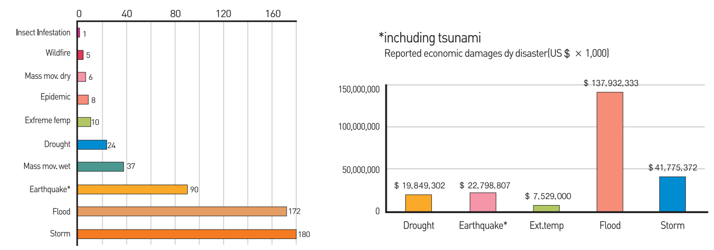
106. Garshnek V., "Applications of space communications technology to critical human needs: rescue, disaster relief, and remote medical assistance" Space Commun, 1991, 8(3): 311-317.

3. Flood disaster management case analysis

The application of space-based technology in disaster management not only has solid theoretical basis, but also rich practical evidence.

Among all kinds of natural hazards, floods are probably most widespread and frequent. In the humid tropics and subtropical climates, especially in the realms of monsoon, river flooding is a recurrent natural phenomenon.[107] Floods resulting from excessive rainfall within a short duration of time and consequent high river discharge damage crops and infrastructure.

China is extremely vulnerable to floods, experiencing 172 flood disasters between 1980 and 2008. People living in China are most affected by floods than any other hazard. This also results in exponentially high economic damage (see Figure 4).



Disaster	Date	Affected (no. of people)
Flood	1998	238,973,000
Flood	1991	210,232,227
Flood	1996	154,634,000
Flood	2003	150,146,000
Flood	1995	114,470,249
Flood	2007	105,004,000
Flood	1999	101,024,000
Flood	1989	100,010,000
Storm	2002	100,000,000
Drought	1994	82,000,000

Figure 4. China's Disaster Profile

A. Natural Disaster Occurrence Reported (1980 - 2008)

B. Reported economic damages by disaster type (US$ X 1,000)

C. Top 10 Natural Disasters - by Affected People

(Source:http://www.preventionweb.net/english/countries/statistics/?cid=36)

3.1 Pre-disaster phase

In preparation for flood disasters, a background database is fundamental to each phase in flood management and should be established. Utilizing the satellite images of a flood and the normal water body range, the development and changing stages of a flood can be monitored and dynamically assessed. The land use/cover background database, normally established by remote sensing, is very useful for loss assessment during a disaster, such as devising schemes for disaster relief, and rebuilding after

107. Zhang J., Zhou C., Xu K., et al., "Flood disaster monitoring and evaluation in China," Global Environmental Change Part B: Environmental Hazards, 2002, 4(2-3): 33-43.

the disaster. The DEM is an essential parameter for the hydrology model. In addition, many kinds of products can be derived from DEM, such as aspect, slope, slope length, 3D model, and density of drainage networks; which can be used to predict, monitor and assess a flood. DEM is the main basis for calculating the inundated area and estimating the depth of the flood. Using GIS in combination with remote sensing images, map information, socio-economic information and DEM during a flood disaster, allows for the flood to be dynamically simulated and analysed, which in turn allows for the 'trend' of the flood to be predicated. From this analysis a basis upon which to make decisions for flood prevention, mitigation and preparedness can be developed.

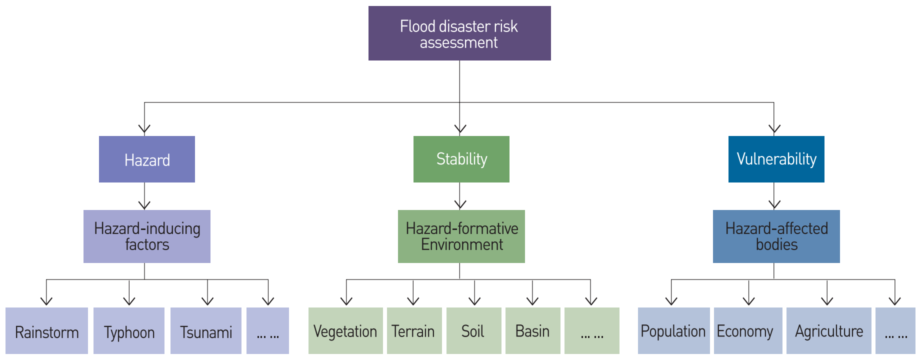
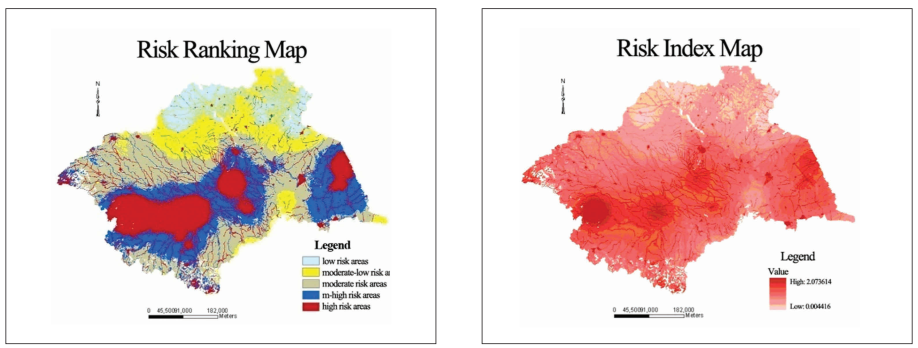


Figure 4. Flood risk assessment hierarchical structure

According to the composition of the flood disaster system, flood disaster risk assessment mainly involves the analysis of the stability of hazard-formative environments, the hazard of hazard-inducing factors and the vulnerability of hazard-affected bodies.[108] A flood disaster system has obvious hierarchical structure, according to the risk assessment of the relationship between objects, so a flood risk assessment hierarchical structure can be formulated, as shown in Figure 4.

Figure 5 is the flood risk ranking map and risk indices map for Huaihe River, made using the



(a) Flood risk ranking map

(b) Flood risk index map

Figure 5. Flood risk assessment map with the use of normalization AHP

108. Shi P., op. cit.

normalization analytic hierarchy process (AHP) method for analysis using natural data and socio-economic data. The map is used by local government for disaster risk reduction planning.

3.2 During the disaster

During flooding, cartography and fast evaluation of inundated areas are among the most successful applications of remote sensing in disaster management. Satellite images can clearly show the trend and changing movements of floods.[109] With the help of these images, disaster areas, flooded crops, dilapidated dykes and dams, submerged and destroyed towns, etc. can be plotted and used to take effective actions to 'build back better' that focuses not only on restoring normalcy but also on building disaster resilience.

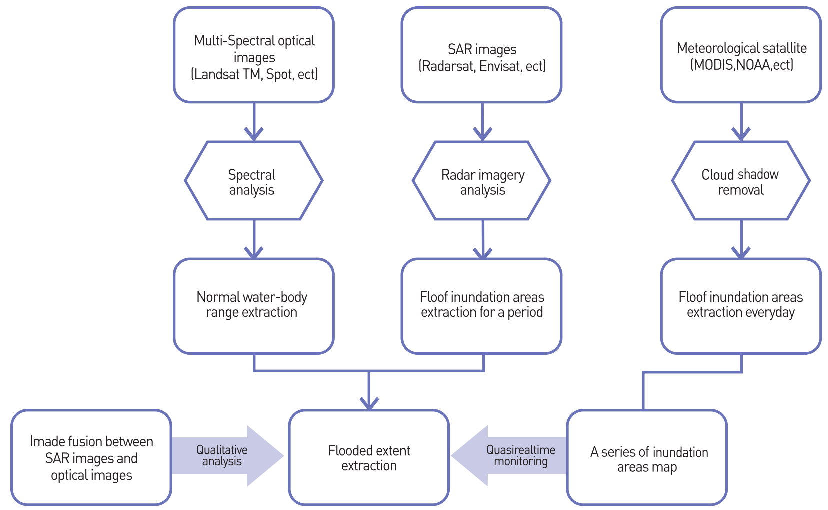


Figure 6. Flood monitoring technique routine with optical and microwave remote sensing

The use of remote sensing technology to identify inundated areas has conventionally focused on a single type of data, and has not fully leveraged its ability to combine multi-source data and information. Consequently, these methods usually have some defects. For example, meteorological satellites are able to see the same swath of the Earth every 12 hours, realizing dynamic monitoring of flood process, but are limited to the spatial resolution. Landsat TM and Spot have features such as high-resolution, and, multi-spectral images, that are good for water-body boundary identification. Nevertheless, the existence of cloud cover appears as the most important impediment to capturing the progress of floods in bad weather condition. The development of microwave remote sensing, particularly synthetic aperture radar (SAR) imagery, solves the problem because the radar pulse can penetrate cloud cover. However, in mountains, slopes positioned perpendicular to the radar beam appear bright while all other

109. Zhang J., et al., op. cit. and Barber, D. G., Hochheim, K. P., Dixon, R., et al., "The Role of Earth Observation Technologies in Flood Mapping: A Manitoba Case Study," Canadian Journal of Remote Sensing, 1996, 22(1): 137-143.

areas appear as dark and shaded. This poses an obstacle to effectively identifying the flooded areas in the mountains. Due to its shaded appearance it is very common to erroneously identify the mountainous areas as inundated in radar images. As a feasible complementary strategy, fusing high-resolution optical remote sensing images with SAR images provides a perfect approach for flood monitoring. Figure 6 describes the technique routine with both optical and microwave remote sensing technologies for better flood monitoring.

The multi-spectral optical images are used to extract the accurate size of the normal water-body range due to its high spatial resolution, and SAR images are used to identify the inundated area in the course of a disaster. In order to satisfy the service need of quasi-real-time flood monitoring, it is conduct useful to water-body extraction on meteorological satellite images. Through the integration from multi-source data, the extent of flooding is obtained, along with qualitative analysis images. Real-time flood monitoring can also be done on meteorological satellite image.

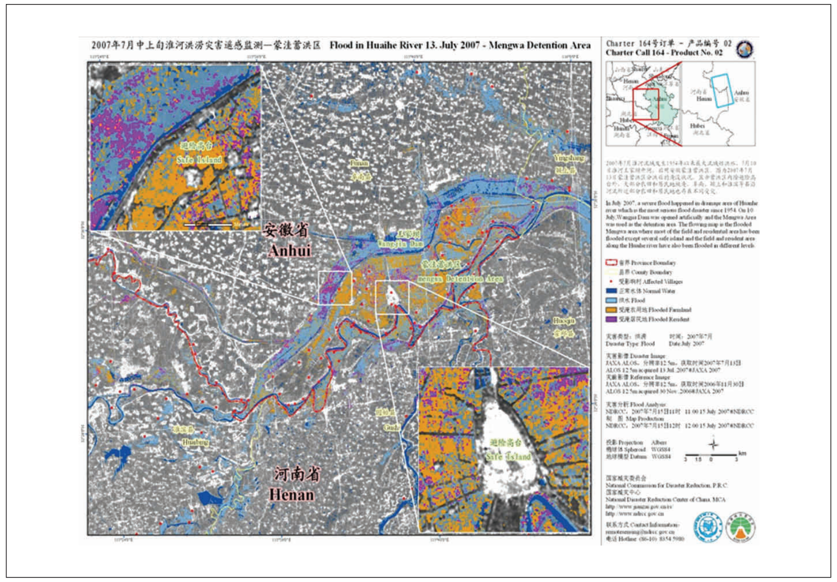


Figure 7. Flood monitoring map and fast assessment based on ALOS image on 13 July 2007

Figure 7 is a flood monitoring and fast damage assessment map for Huaihe River. The map was made on 14 July 2007 based on analysis by ALOS satellite images of 13 July 2007. Local governments have used it to analyse disaster loss and make plans for disaster relief.

3.3 Post-disaster phase

After the flood disaster, loss assessment is important for post-disaster recovery planning and management - Knowing the extent and types of losses to be expected in existing areas is a great help to recovery management by enabling better targeting of resources to identified key areas. There are two categories of loss caused by flood to be assessed:

Direct losses: Those losses resulting from direct contact with the flood disaster, for example, flood damage to buildings and infrastructure.

Indirect losses: Losses resulting from the event but not from its direct impact, for example, transport disruption, or business losses that cannot be made up.

The flowchart of space-based technology used to assess the flood damage losses is shown in Figure 8.

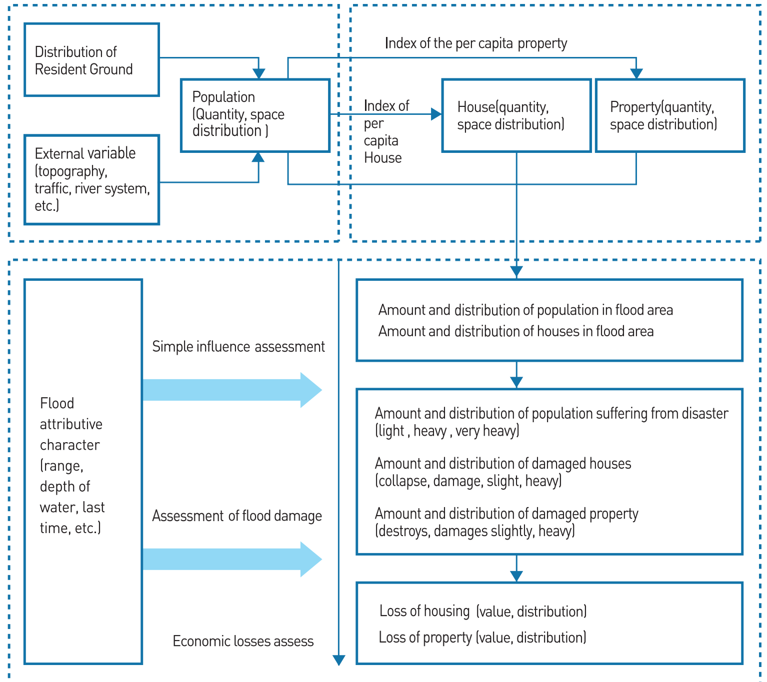


Figure 8. Flowchart of Loss Assessment for Flood Damage

4. Conclusions

We cannot eliminate natural disasters, but we can minimize the sufferings through proper awareness of the likely disaster and its impact by developing a suitable warning system, disaster preparedness and management of disasters through the use of space-based technologies. Information derived from GIS and remote sensing satellite imagery plays an important role in disaster management. Their effective application depends not solely on technical specifications, but is influenced by factors such as data collection, processing and distribution, capacity building, institutional development and information sharing.

Building a framework that will include the ground-based systems together with space-based systems is still in an emerging phase. Space-based system costs and benefits should be quantified to show that regardless of the disaster, the benefits have always been greater than the average cost; though this may be hard to quantify.

Over more than 20 years of continuous effort, China has developed space-based and airborne remote sensing platforms, and built a ground receiving station, data processing centre and related advanced facilities, which provide technical support for disaster risk reduction. In February 2003, the State Council of China formally approved a project for "Small satellite constellation for environment and disaster monitoring and forecasting." Under the project, two small optical satellites were launched in 2008; another two optical satellites and four synthetic aperture radar satellites will be launched and together will make a satellite constellation. There are four types of payloads on the constellation: a wide filed multi-spectrum camera, an infrared scanner, a hyper-spectrum imager and synthetic aperture radar.

The constellation's orbit is sun-synchronized and the revisit period for each satellite is 96 hours. After the launch of all the eight satellites forming the constellation, it will be possible to monitor the disaster situation in any location every 12 hours.

International cooperation will be promoted in the areas of on government capacity building, information sharing, publicity, education, personnel training, scientific research and development as well as international humanitarian assistance. Closer international cooperation on disaster risk reduction is an important part in China's undertaking towards sustainable social and economic development.

Reaching the Last Mile through Community-based Disaster Risk Management[110]

Gabrielle Iglesias, Novil Wijesekara and Nirmala Fernando

1. Fable of the boy who cried wolf

You must remember the story about the boy whose task it was to watch a flock of sheep. The sheep grazed on a hill that gave him a good view of his village. Out of boredom, he shouted, "Wolf! Wolf!" and those who heard him came running to help him drive the wolf away from his sheep. Of course, they only found the boy laughing at them and no wolf. The boy cried, "Wolf!" several more times, just to laugh at the people who tried to help him. One day, a wolf did appear and started to eat the sheep! The boy was terrified and shouted, "Wolf! Wolf! It's eating the sheep!" but no one believed him this time, and the whole flock was lost to the wolf.[111]

The moral of this fable is that even when liars tell the truth, no one believes them. For tsunami disaster management, this fable is useful for understanding the tendency to disbelieve tsunami alerts as more alerts are raised but no tsunami comes. This disbelief is a big problem for tsunami disaster management because tsunami prediction for the Indian Ocean is still under development. The consequence of not acting appropriately after receiving a tsunami alert can be death. How can we assure that an alert is always given credibility by those who receive it?

2. Introduction : The 2004 Indian Ocean Tsunami

Huge waves poured into coastal areas of Sri Lanka after an earthquake of magnitude 9.0 on the Richter Scale occurred off the coast of Sumatra. The Tsunami claimed 35,386 human lives, and injured 23,033 people. It damaged or destroyed more than 100,000 houses, and 380,000 persons were made homeless. Almost two-thirds of the country's coastline was

110. This case study has been adapted from Asian Disaster Preparedness Center's Safer Cities 18 entitled, "The Boy Who Cried "Wolf!" or Why a Community-based Alert System is a good idea." This is part of a series of case studies on mitigating disasters in Asia and the Pacific. For more information visit http://www.adpc.net or e-mail Gabrielle Iglesias ←iglesias@adpc.net→.
111. Based on Aesop's Fables. A new translation by Laura Gibbs (2002) and on George Fyler Townsend's 1867 translation of the fables.

affected, with damage to roads, bridges, railways, water supply systems, telecommunications, schools, universities, hotels and private property. The total estimated damage for Sri Lanka is at US$ 1.1 billion, and the total estimated losses are at US$ 310 million.[112]

It is widely acknowledged that the damage would have been drastically reduced if the communities on the Indian Ocean were made aware that such a disaster was imminent. It took between two to three hours for the tsunami waves to strike the Sri Lankan eastern coastline and parts of the western coastline after the earthquake hit. No early warning system (EWS) was in place and the people received no information about the impending disaster or of the need to evacuate. Of course, even if a warning system did exist at the national level, there is still a need to disseminate the message to the local level where people need to be prepared and ready to react to the warning. However, on that fateful day many of the beachside inhabitants had neither heard of a tsunami nor experienced similar events. Most did not seek shelter when the sea receded from the coast, and so were struck by the waves shortly after.

In the aftermath, given the bad memories of the Tsunami disaster, the slightest rumour could cause Sri Lankan's to panic. Many times, people ran away due to false tsunami fears. It was noted that some people even experienced minor injuries as a result of such incidents. People feared living close to the sea, due to tsunami fears. This is the context within which an alert system had to be placed. This case study discusses the salient aspects of community, hazard, and warning system, followed by a description of the establishment of a Community Tsunami Early Warning Centre (CTEC) and its community-based disaster preparedness initiatives.

3. What is the wolf?

The wolf in our story is the tsunami. Tsunami waves are generated primarily by earthquakes occurring below or near the ocean floor; underwater volcanic eruptions and landslides can also generate tsunamis.[113] The earthquake rupture lifts part of the seafloor near the epicentre, and then drops it down, moving the entire water column above it up and down. The energy that results from pushing water vertically is then transferred by pushing the water horizontally in what we know as the tsunami wave. A tsunami traveling over the open ocean can be small, perhaps a few feet high or even less; thus detection is difficult, and is the reason why a tsunami EWS requires a network of ocean-bottom pressure sensors to detect and confirm the generation of a tsunami. As the tsunami wave travels over the continental slope, its wave height increases rapidly as the water becomes increasingly shallow. Much of the damage inflicted by tsunamis is caused by strong currents and floating debris during inundation as the waters go up the shore and back down to the sea. Tsunamis will often travel much farther inland than normal waves.

4. What is the village?

The village represents the urban coastal communities that must face the wolf. Urban coastal communities face several hazards, including storm surge, tropical storms, flooding and tsunamis. A global-level analysis of the location of multiple hazards found that hazards driven mainly by hydro-meteorological processes-floods, cyclones, and landslides-strongly affect the eastern coastal regions of the major continents, as well as some interior regions of North and South America, Europe, and Asia.[114] This calls for an integrated and multi-hazard approach to reducing disaster risks.
Coastal areas are becoming more vulnerable to disasters due to continuing rapid urbanization and coastal development in hazard-prone regions. Asia again accounts for eight of the top ten countries (in descending order: 1 - China, 2 - India, 3 - Bangladesh, 4 - Vietnam, 5 - Indonesia, 6 - Japan, 9 - Thailand, 10 - Philippines) with populations in the coastal zone with elevation from 0 to 10 meters.[115] The potential for increases in the intensity and frequency of some hazards pose a serious challenge to sustainable development and monitoring of the disaster risk of coastal cities.

5. Who is the boy?

The boy corresponds to the system used to disseminate alerts about oncoming hazards such as tsunamis, windstorms and other detectable hazards. The boy embodies two components of a warning system. First is the technical component, in that it must be able to detect a hazard and give an appropriate warning. Second is the societal component, wherein it must inspire both confidence and appropriate responses from the villagers who listen to the boy.

112. Regional Analysis of Socio-Economic Impacts of the December 2004 Earthquake and Indian Ocean Tsunami.
113. The Great Waves, jointly published by the U. S. National Oceanic & Atmospheric Administration (NOAA), UNESCO/ Intergovernmental Oceanographic Commission (IOC), International Tsunami Information Center (ITIC), and Laboratoire de Geophysique, France (LDG), 2002.
114. Maxx Dilley, et al., Natural Disaster Hotspots: A Global Risk Analysis, Washington DC: World Bank, 2005.
115. Gordon McGranahan, Deborah Balk and Bridget Anderson, °∞The rising tide: assessing the risks of climate change and human settlements in low elevation coastal zones,°± Environment & Urbanization, 19(1), 2007, p. 26.

5.1 End-to-end early warning system approach

> The end-to-end multi-hazards early warning systems approach is the provision of timely and effective information, through identified institutions, that allows individuals exposed to a hazard to take their action to avoid it, or to reduce risk and prepare for effective response.

An EWS is described as end-to-end if it connects the technical (upstream) and societal (downstream) components of warning through identified institutions. The effectiveness of an EWS will depend on the detection technology, as well as socio-economic factors that dictate the manner in which people at the local level can understand and react to disasters.

5.1.1 Technical components

The technical components of an EWS are: 1) the understanding and mapping of hazards and vulnerabilities (risk mapping); and 2) monitoring and forecasting of impending events (technical monitoring and warning, including information and communication technology).
One of the essential components of comprehensive EWS is its capability for predicting and detecting hazards. Detection of hazards may need the collection of various types of data like weather data, seismic data, and ocean-bottom pressure sensors.

The community can monitor hazards by monitoring and recording water height gauges in rivers, rain gauges showing the amount of precipitation over fixed time intervals, and by constantly monitoring alerts from the government over radios and other communication equipment.

Early and accurate detection also requires an efficient communication system, because the lead-time (for example, the time between the detection of a tsunami until the time it hits a coastal area) for early warning varies widely from a few months (drought, monsoons, and ENSO[116]), to a few days (cyclone/typhoon and volcanic eruptions), or only a few minutes (as in a tsunami or landslide).

5.1.2 Societal components

The societal components are: 1) processing and disseminating understandable and actionable warnings to political authorities and the population at-risk (dissemination); and 2) undertaking appropriate and timely actions in response to warnings (knowledge and preparedness to act). This will be initiated by identifying the institutions involved in disaster management, describing the flow of information from the detection of a tsunami by instrumentation to the distribution of the alert to the relevant authorities, to identifying communities who are exposed to tsunami waves and preparing action plans for mitigating tsunami impacts, evacuation drills, and emergency response.

An EWS should provide communities with timely information, enabling them to prepare for anticipated hazards in order to minimize the impact on lives, livelihoods and property. This communication should proceed in a way that is easily understandable for people, and causes them to react appropriately to disasters. Community participation in the formation of effective early warning messages can improve the communication process.

Comprehensive EWS should have an 'end-to-end' approach, addressing all stages of early warning from initial hazard detection and warning to community-level response to warning messages. It should also address multi-hazards in that it will simultaneously provide warning for tsunami hazards, as well as a number of other critical hazards such as cyclones, floods and earthquakes.[117]

There should be a single authority (national or regional) to originate the hazard warning in a given area in order to avoid confusion. For example, the Disaster Management Centre is the authority responsible in Sri Lanka for issuing early warnings. In addition, there are specific agencies who issue warnings with their specific technical capacity (see Table 1).

Hazard Monitoring	Lead Agency
Meteorological Observation and Forecasting	Department of Meteorology
Flood Monitoring and Forecasting	Irrigation Department
Landslide Protection and Early Warning	National Building Research Organization
Drought Monitoring and Forecasting	Department of Agriculture
Cyclone Tracking and Storm Surge	Department of Meteorology
Seismic Monitoring (Earthquakes and Tsunamis)	Geological Survey and Mines Bureau
Early Warning System for Dams	Mahaweli Authority of Sri Lanka
Oceanographic Monitoring System	National Aquatic Resources and Research Development Agency
Radiological Monitoring	Atomic Energy Authority

Table 1. Official Sources of Hazard-specific Warning

(Source: Towards a Safer Sri Lanka: Road Map for Disaster Risk Management, Disaster Management Centre, Ministry of Disaster Management and Human Rights, 2005, pp. 28-30)

Next, the hazard warning should disseminate quickly to the population at risk. In order to ensure the success of the system, the message should be easily understood and delivered on time. A good communication network/system is vital in disseminating warning messages on time, especially for a disaster that has a short lead time. Broadcasting communication systems such as radio and television can be used to warn the public as well as relevant officials. Telephones, mobile phones, satellite phones and two-way radios can be dedicated for alert systems. It is also effective to use local community warning systems such as loudspeakers and sirens. However, all these are only useful if there is constant monitoring of the alert system, if the equipment is well-maintained, and if names of contact

116. ENSO or the El Nino-southern oscillation refers to the complex interaction of the tropical Pacific Ocean and the global atmosphere that results in irregularly occurring episodes of changed ocean and weather patterns in many parts of the world, often with significant impacts, such as altered marine habitats, rainfall changes, floods, droughts, and changes in storm patterns (Source: http://www.unisdr.org/eng/library/lib-terminology-eng%20home.htm).

117. According to the 2009 World Disasters Report, an advantage of the multi-hazard approach is that by pooling resources and hazards, the EWS will be triggered more often, and they improve only through use and practice. A multi-hazard approach, however, does not mean the creation of one 'mega' early warning system for all hazards as the lead time and response required vary from hazard to hazard. Instead, the approach emphasizes the identification of data-sharing possibilities and collaborative opportunities, to remove any duplication and ensure synergies.

people and the relevant telephone numbers are available and kept up-to-date. This is one area where trained community members can contribute their time and ensure that the 'last mile' in the communication relay is closed.

5.2 Developing locally-relevant and actionable messages

Communities in tsunami-risk areas need to be prepared to receive and use the enhanced forecast products. Of course, the seismic monitoring services and related institutions could also be involved to provide the technical knowledge on the hazard, and to provide the foundations for the local risk communication strategy and plan. However, communities should determine the formulation of the warning message to ensure that they will be familiar with the messages, and therefore more likely to accept a disseminated hazard warning and respond accordingly. An effective warning message should include:

- Characteristic of hazard (location, time, strength)
- Identification of the general area at risk
- Recommended action to be taken

5.3 Community-Based Disaster Risk Management

When developing an end-to-end EWS, it is a good idea to form and train a local technical working group in each member community to facilitate the community processes for promoting a culture of safety. The working group's main task would be to guide the community to assess local risks for and by themselves, with support from experts. Training in community-based disaster risk management (CBDRM) is intended to raise the capacity of community members to identify the hazards they face and the vulnerabilities they have, to sum these up as the risks to their community, and to plan and implement risk reduction activities. These activities are collectively called participatory risk assessment.

The communities receiving the alerts should be encouraged to prepare a sustainable risk reduction plan. Resources will be mobilized to augment community resources for implementation of local mitigation activities as prioritized in their risk reduction plans. Effective relationships and communication between all the stakeholders can lead to an effective EWS in practice.

Capacity building of the community is critical in making the connection between disaster information and appropriate action. The community should be made aware of the risks it faces, and helped to understand, trust and accept warning messages. Based on a participatory risk assessment, capacity building programmes could be developed to raise awareness on tsunamis and other hazards faced by the local community that were identified in the risk assessment, and to familiarize it with the local disaster management system. The communities' members should be educated on the warning messages used, and anyone disseminating a warning message should follow the agreed system. Finally, for a warning to be effective, the community should perform the recommended action. The community should therefore be involved in evacuation planning and emergency drills.

5.4 Evacuation Planning

Local authorities must coordinate evacuation planning. This covers the designation of safe places, the assessment of risks, the designation of evacuation routes, and the scheduling of emergency drills. Evacuation planning can ensure an orderly system for all the communities in their area of responsibility. Evacuation routes should be planned and created from all areas that may be reached by hazards to designated safe places within the anticipated evacuation times. The route planning should include an estimation of evacuation times from different points of human activity or residence.

The local authorities should ensure that signs marking the evacuation routes are posted at visible points. They can periodically schedule emergency drills or exercises to test if people are familiar with the routes, and if people and emergency personnel can respond quickly to alerts. Local authorities also play a key role in ensuring that the evacuation routes are always kept clear in times of emergency.

5.5 Land Use Planning

Local authorities can employ land use planning as a valuable tool for both disaster mitigation and disaster preparedness. In the case of tsunami disaster mitigation and preparedness, there are techniques to determine risks based on the anticipation of how high the run-up could go, identifying various degrees of exposure to the tsunami waves, surveying the vulnerability of people and infrastructure, and combining all these elements into risk maps. Risk maps can be zoned, and for zones of high risk, it would be important to promote regulations that require evacuation routes leading to safe places, building codes that require the anchoring of heavy structures, and the use of protection and evacuation strategies.[118]

6. The Story of the Community Tsunami Early-Warning Centre

Coastal urban communities are exposed to many hazards. From their location on a coast, they may have to deal with tsunamis, storm surge, windstorms (typhoons or cyclones). As an urban community, they will have to deal with fire, traffic accidents, the collapse of buildings and infrastructure due to poor construction, gas explosions either from piped networks or from tanks.

118. Reduce Tsunami Risk: Strategies for Urban Planning and Guidelines for Construction Design, A handbook developed by the Italian Ministry for the Environment, Land and Sea and ADPC, Thailand, March 2006.

Peraliya was one of the worst damaged urban areas in the Indian Ocean Tsunami, located in the Hikkaduwa Divisional Secretariat Area of Galle District in the Southern Province of Sri Lanka. It is situated close to the picturesque beach of Hikkaduwa, the well-known beach resort. Peraliya drew much media attention during the 2004 Tsunami disaster due to the train accident that claimed over 1,270 lives, including 249 from the village. This case study highlights an intervention for a safer coastal urban community that began as a local initiative, and was later integrated into the national disaster management system, and to date continues to grow.

6.1 The beginning of a Community Tsunami Early Warning Center

CTEC was established in Peraliya. CTEC started out as one of the rehabilitation activities carried out by the community, backed by a group of volunteers from both Sri Lanka and abroad. A mechanism was needed to obtain, analyse and disseminate information about tsunamis and other natural disasters to the community. CTEC was born as a solution to the above problem, after consultation with community members and other stakeholders.

6.1.1 Vision

The vision of CTEC is to create a disaster preparedness culture at the community level in Sri Lanka through community participation and empowerment, with special emphasis on the protection of vulnerable groups, while sharing the benefits of information technology with rural communities for culturally appropriate and sustainable development.

6.1.2 Linkages to the government's alert system

While CTEC was growing, much was done at the national level in the field of disaster management. The Disaster Management Act No. 13 of 2005 was passed. Under this Act, a Disaster Management Centre was established, and a Disaster Management Coordinator was assigned to the each district. The Geological Survey and Mines Bureau (GSMB) was assigned as the national focal point for issuing tsunami warnings. All these developments were bringing a lot of importance and weight to the activities of CTEC because the Act recognized and promoted community-based initiatives for disaster management.

CTEC has worked closely with the District Disaster Management Coordinator, the Department of Meteorology, and the GSMB. The Hon. Mahinda Samarasinghe, Minister of Disaster Management and Human Rights, extended his fullest support to CTEC and has agreed to integrate it into the national tsunami warning system. CTEC links with the Disaster Management Centre through the District Disaster Management Coordinator. A number of community awareness and capacity building programmes were conducted in collaboration with the District Disaster Management Coordinator.

For its part, CTEC does not issue any warning on its own. CTEC is in constant contact with the relevant departments and agencies such as the Department of Meteorology for weather updates, and connects its technological and human communication network to disseminate warnings issued by the government to the community. In addition, it promotes a tradition of community-level vigilance, which can turn into a cycle of safety that grows from the grassroots up to government. CTEC observes the best practices and guidelines advocated in the District Disaster Preparedness and Response Plan for Galle.

The GSMB has worked closely with CTEC since its inception. GSMB installed an automated siren on the CTEC premises that can be controlled from Colombo. Later, the GSMB contributed to the public address system of CTEC. In addition, CTEC and GSMB have conducted joint community awareness programmes.

6.2 Development of a community-based alert system

The CTEC Office is operational for 24 hours a day, seven days a week. Youth volunteers continuously monitor for emergency information/warnings issued by international and national warning agencies, and for news from the local and international media. They follow procedures for verification with the Disaster Management Centre and subsequent emergency response.

6.2.1 Set-up

CTEC has simple information communication facilities such as television, radio, telephone, satellite television, Internet access and email. Fifteen loudspeakers connected to a public address system were set up over an area covering three villages; the speakers link the centre to the community. Subsequently, the loudspeaker towers were upgraded through the participation of the communities in their design and construction.

The youth volunteers were selected from the community in Peraliya and trained on topics such as: concepts of disaster preparedness and disaster mitigation; the role of the community in disaster preparedness; the Indian Ocean Tsunami Warning System; and public relations, team work and time management.

6.2.2 Community Focal Points

CTEC has extended its services to the whole of the Galle District through its concept of the Community Focal Point (CFP) network. In communities that are too far from the speaker system, a CFP is the point of contact with CTEC for a cluster of houses. The people living in the houses around the focal point may get together and call CTEC to ask for disaster information.

CTEC has established CBDRM teams in line with its CFPs. The volunteers of these teams have been trained on procedures to be taken in an emergency situation. In addition, they are equipped with important skills such as basic life support, first aid and fire preparedness. Evacuation areas have been identified and tsunami signs have been established as a part of the community contingency plan. Educational and awareness programmes are continuous throughout the year to keep the CFP volunteers up-to-date.

6.2.3 Moving to a multi-hazard approach

Any urban community is prone to more than one type of hazard. At the beginning, CTEC was an effort to find a possible solution to reliable information about tsunamis. The approach of CTEC was later modified from the single-hazard type (tsunami) to multiple-hazard.

A fire destroyed about 50 temporary houses about eight months after the Tsunami disaster in the Thelwatta area of Peraliya. The CTEC public address system was instrumental in evacuating the people from the fire area. In addition, it was noted that people had grab bags or emergency supply kits ready in their houses as a result of the tsunami awareness programme that was carried out a few weeks prior to the fire.

Following this event, fire was identified as another hazard in the wooden temporary shelters for tsunami survivors. Thus, with funding from another source, a fire preparedness programme was conducted in 15 temporary shelter areas. Community fire awareness programmes were conducted along with tsunami preparedness in the above camps. Unsafe bottle lamps were identified as a hazard in these temporary shelters. A safe bottle lamp was developed by Dr. Wijaya Godakumbura. The community members were educated on the benefits of the safe bottle lamp over the traditional bottle lamps. The participants were requested to bring all the unsafe bottle lamps in their homes and each was replaced with a safe bottle lamp. A fire extinguisher kit was handed over to each tsunami survivors' camp committee. A group of volunteers from each community was given special training on fire fighting and the use of fire extinguisher kits with the participation of an official from the fire brigade and CTEC staff.

Other potential hazards were identified in Peraliya, and may be areas for CTEC to monitor in the future. These hazards include coastal erosion, floods, storm surges, tornadoes, oil spills from ships, and coral mining. Without this expansion, a community eventually loses interest in disaster preparedness as time passes from the last tsunami event. Thus, it is important to cover other disasters in preparedness plans.

6.3 Community-level activities

In most disasters, community members are the first to respond before any outside assistance can reach the disaster site. Community mobilization through community disaster preparedness can reduce loss of life and property and at the same time, build confidence in self management. CTEC believes that the community should monitor reports of seismic activity and other natural disasters using the data in the public domain as a key component of effective CBDRM. This approach promotes the development of a community database on natural disasters and strengthens the community knowledge on such disasters. This kind of community-based monitoring for natural disasters can operate as a complementary or a parallel system to the government system.

6.3.1 Community database

CTEC keeps a Community Database where specific disaster information is translated into Sinhala (the local language) and displayed on a public notice board. The community is informed that the Community Database is updated daily, and anybody interested in it can come to use it. The Community Database has few components:

- Seismic Activity: Every 15 minutes, the duty officer looks at relevant websites and records in the Centre Logbook the earthquakes with a magnitude more than 5. All earthquakes that occur in the Indian Ocean region are extracted every 24 hours and are displayed in the CTEC notice board.
- Weather Information: The daily weather report issued by the Meteorology Department is read and recorded by the Duty Officer. The daily weather report is also displayed in the CTEC notice board so that anyone interested can drop into the centre and obtain the weather information.
- Community Inquiries: The inquiries made by community members are recorded in the incoming call book. The date, time, name of the person who calls, location, contact telephone number, and the inquiry are recorded. Later the action taken is also recorded. This list helps to identify the areas where 'rumors' are generated, and the Centre officers could reach out to these areas to educate the people about their fears.
- Disaster Information: The Duty Officer records the disaster related local and foreign news in the Log Book. In addition, important and relevant newspaper articles with regards to natural disasters are collected.

6.3.2 Awareness-raising Workshop Series

Well-informed communities will respond before, during and after disasters in a more effective manner. The Peraliya community had little or no prior knowledge about a tsunami or its mechanism, thus enhancing the awareness amongst the community members about a tsunami was very important. The CTEC Community Awareness Team conducts awareness and educational programmes to equip the public with knowledge, skills and attitudes concerning emergency preparedness. Workshops and campaigns, identification of tsunami evacuation areas and routes, and putting up tsunami evacuation sign boards have been among the awareness activities. A community library has been established to share information with the community members.

The presentations are made simple by using pictures and diagrams. Tectonic plates, earthquake activity and the generation of tsunami are explained with the use of models. A role play is used to introduce to the emergency kit or the grab bag. The participants of the workshop are distributed pamphlets/ stickers containing the emergency numbers of the national warning agencies as well as of CTEC. Tsunami-related myths are then discussed with the community members. Each myth is presented to the community members, who are then asked about their perception about the myth. The scientific background of the myth is then explained.

Community participation is enhanced through interactive workshops. The participants are divided into groups, and are given guide questions to discuss. After some time, representatives form each group present their findings to the rest of the community.

The CBDRM Workshop presents videos of successful CBDRM initiatives to the community, specifically the Bangladesh Tidal Wave preparedness programme and/or the Viet Nam flood preparedness programme. The lessons learned from these videos are then discussed. The community also plays a game to illustrate how rumours can spread and how they affect early warning. The awareness programme ends with the community selecting and appointing a Village Committee to promote disaster preparedness activities. CTEC maintains continuous contact with this group in support of their disaster preparedness interventions.

CTEC has also focused on awareness raising in schools and among school children, and organized essay and art competitions for them. CTEC has plans to organize computer classes for these children and promote the sharing of Internet-based disaster information, to promote information and computer literacy, as well as instill a culture of disaster risk reduction. CTEC is also involved in the Island-wide Youth Training Programme on Disaster Preparedness. CTEC's programmes and initiatives have been developed in close consultation with the District Disaster Management Coordinator, Major Wijerathna.

6.4 Developing the organization

People from other districts have contacted CTEC to find out about emergency situations, thus CTEC is planning to expand its activities to other areas of the country. It is planning to adopt the multi-hazard approach for CBDRM. In line with the National Road Map for a Safer Sri Lanka, it is planning to establish CBDRM resource centres. It is also networking with national and regional organizations with experiences in the field of CBDRM to develop itself into a CBDRM training centre and a national centre of excellence in the field.

7. Conclusions

The story of CTEC in Peraliya is one of how a community initiative can grow into a viable and sustainable intervention against the threat of disaster. From a voluntary organization in one village, it has expanded to cover three villages in Galle, and has helped assuage fears of tsunamis in other districts. It has moved from supplying monitoring tsunami alerts to multi-hazard application. CTEC has not only educated people about disasters and CBDRM, it has also promoted the social and economic development of the villages, thus strengthening their resilience to future disasters.

CTEC recognizes the importance of ICTs for CBDRM and has used ICTs effectively in obtaining disaster-related information from national, regional and international sources. The Centre has proactively ensured that relevant information is translated and posted on notice boards, enabling community members who do not readily have access to various ICTs and/or the capacity to use them, to still be able to obtain timely disaster information. Moreover, a database has been developed to systematically capture data and information from relevant sources.

Different ICTs have also been used by CTEC to communicate warning messages and to raise public awareness on the importance of CBDRM. In the near future, CTEC has plans to develop children's ICT capacity by combining disaster awareness sessions with computer training for school students.

We must keep in mind the story of the boy who cried wolf. There may be false warnings from time to time, especially while the Indian Ocean Tsunami Warning System is still being installed. Community initiatives like CTEC will be important to reinforce the value of always heeding warnings, and to explain why false warnings can happen.

One day, the little boy will be able to consistently tell the truth about the wolf. Until then, at least Peraliya has CTEC. For more information on CTEC visit http://www.communitytsunamiwarning.com.

The Sahana Free and Open Source Disaster Management System in Haiti

Chamindra de Silva and Mark Prustalis

1. Introduction

In the afternoon of 12 January 2010, a 7.0 magnitude earthquake struck the poverty-stricken Caribbean nation of Haiti. The impact of the earthquake, occurring just south of the densely populated capital city of Port-au-Prince, was devastating as scores of multi-storied concrete structures in the capital and surrounding municipalities collapsed, killing tens of thousands instantly, injuring and trapping thousands of others beneath the rubble.

The earthquake struck mere weeks after the five year anniversary of the Indian Ocean Tsunami. Haiti also represents the first time since the Tsunami that the international community has been called upon to respond to a disaster of such magnitude with a lifesaving search and rescue and emergency relief effort under the coordination of the United Nations and foreign governments. The use of Sahana Free and Open Source Disaster Management System (Sahana) in the Haiti relief effort is only fitting as the system grew out of the devastation leveled by the Tsunami. Haiti, and Sahana's application in the relief effort, represents another instance of what the international community has learned since the Tsunami in terms of humanitarian response, and how it has applied such lessons to disaster relief and management.

This Case Study examines the development of Sahana that grew out of the devastation of the Tsunami in Sri Lanka, and has evolved to serve and support a variety of ICT related needs of the disaster response and relief operations in Haiti. Sahana and its community of dedicated contributors illustrate the potential and lifesaving power of effective and coordinated ICT use in disaster relief and management operations.

2. Sahana Genesis and Vision

The Sahana Free and Open Source Disaster Management System (Sahana) was conceived during the December 2004 Indian Ocean Tsunami in Sri Lanka. It was developed by volunteers from the ICT industry in Sri Lanka to help manage the scale of the disaster, and was deployed by the Sri Lankan government to help coordinate its relief efforts. The initial system helped to track families and coordinate work among relief organizations during and after the disaster. Based on the success of this initial application and the lack of good large scale disaster management solutions, a second phase was funded to make the project a global public good by utilizing Free and Open Source Software (FOSS) in conjunction with humanitarian response operations. Humanitarian FOSS (H-FOSS) was the result these efforts.

Box 1. Sahana H-FOSS

Humanitarian FOSS (H-FOSS) is the application of Free and Open Source Software in the support of humanitarian response. In conceptualizing Humanitarian-FOSS (H-FOSS), the Sahana community references the Red Cross and its Code of Conduct[119].

- No Access Discrimination : FOSS eliminates delays in getting permission for a license as anyone has the freedom to download and use the software. Once available under a FOSS license, the software effectively becomes a global public good, available for anyone from around the world
- Trust and Transparency : The software design and mechanism for building FOSS is transparent, thus building trust. Additionally, with truly global and diverse FOSS communities, the software becomes resistant to any particular political agenda.
- Low Cost and Local Capacity : Few countries, whether rich or poor invest significant resources in pre-disaster management, because there are always higher priorities that need funding. H-FOSS helps reduce the digital divide as there is no additional cost for the product itself. Though people are still needed to maintain the software. a nation has the freedom to reduce costs by promoting the type of local capacity development encouraged by FOSS communities.
- Shared Inter-Organizational Development : NGOs and humanitarian relief groups all need software tools to be effective; however, not all have the funds to purchase the needed tools. H-FOSS projects can be developed and shared globally when a disaster strikes. The FOSS community has a proven track record to build, distribute and maintain such global systems. FOSS can easily provide a vehicle by which organizations can contribute a fraction of the resources, yet benefit from the whole.
- Adaptability : No two disasters are alike; often localizations and customizations are needed for the software before it can be applied effectively to a disaster. Furthermore, no two nations handle the humanitarian response in the same manner. Thus, there are many variances expected of software, including translation, before it can be used by different nations. With FOSS and its blueprints so freely available, anyone is able to modify the software as required to suit a nation's disaster needs.

119. http://www.ifrc.org/publicat/conduct/).

The second phase of Sahana was funded by the Swedish International Development Cooperation Agency (SIDA) and run by the Sri Lanka Software Foundation. The funds supported a core team of 6 full time people that built a more generic disaster management platform, and worked with the growing number of volunteers that joined the Sahana community during subsequent disasters and use of Sahana applications. Today, the Sahana community includes over thirty active individuals supplemented by over hundred members and organizations that further disaster response research and development.

2.1 Disaster Coordination and Information Needs

The vision of Sahana is to help alleviate human suffering and help save lives through the effective use of ICT to help manage disaster coordination problems during a disaster. During its development, Shana identified scale as the primary cause of coordination problems. Large scale disasters affect a million or more people within a very short span of time, and wipe out transport, communications and local emergency management infrastructure such as policing forces, hospitals or fire brigades. Even if infrastructure is left intact, the scale of the disaster can still greatly overwhelm the local resources available to handle those emergencies. To effectively handle the scale of the situation, therefore, the response needs to be quickly supplemented with foreign and local donations, support from civil society, and often the very victims acting as first-responders. Though support is often forth coming, coordinating chaos ensures because each relief group on scene has little idea what the other is actually doing. As a result there is a waste of pledged support, imbalances in aid distribution and a lack of proper coverage of support and services.

Obtaining the right information in these scenarios is critical in preventing chaos and in order to alleviate human suffering and save lives. The right information can provide relief and support to a host of effected peoples; from a crying mother desperately searching for news about her missing child, to camp personnel waiting for the right medical supplies to treat victims; and relief coordinators trying to distribute resources to the right place and in the right quantity. However, managing information is also crucial as large scale disaster relief involves hundreds of humanitarian agencies and organizations that in turn generate massive amounts of data. That is where ICT helps manage information. Through ICT the right data can be shared and accessed instantaneously by government, field operatives, civil society groups, victims and the victims' friends and relatives to enhance the relief effort. If used properly, ICT managed data will empower these stakeholders to build off each other's work. Governments, especially in developed nations, often have 'in-house' systems that manage the tracking of people during disasters. These systems and the data they contain, however, are often protected by privacy regulations that prevent access by relief groups and volunteers that want to help. Furthermore, government operated relief infrastructure can sometimes get in the way due to inadequate resources on the ground, which can then prevent independent relief groups and volunteers from directly and immediately helping the victims.

Clearly then, the right information needs to be both shared and well managed to allow all relief entities to coordinate and operate as one, and effectively distribute aid and services. A centralized portal for government and relief groups would provide a lot of value, if it were not so inflexible to allow for customization necessary in unique disaster environments. Sahana, however, is flexible and does not dictate a portal approach, though it can be deployed as one if required. Sahana's strength lies in its Open Source nature and its ability to be downloaded and customized by anyone to work with specific countries, organizations and purposes. Many governments welcome this approach as it allows them to maintain ownership and control over the system and the data.

3. The Sahana Platform

In order to face the challenges created by large scale disaster and meet the needs of those responding to them, the Sahana platform was designed on principles reflecting an ability to adapt to the constrained environment ICT solutions encounter during a disaster response effort. In addition to the macro-level problems of scale and quantity of data noted about, disaster response initiatives also encountered every day, operational constraints.
The additional ICT related problems that are faced include:

- Telecoms and Internet access is either down, or intermittently available.
- Bandwidth is often at a premium, so every character counts.
- Power outages reduce reliability and availability.
- Potential data center or infrastructure damage due to the disaster.
- Human resources unfamiliar with new systems.
- Off the shelf systems often have to be customized for the requirement or risk not capturing specific aspects of gathered data.
- Local developers have very little time to learn and support the system.
- Interoperating with existing systems and creatiing ad-hoc spreadsheets is often difficult.

When a systems does not address many of these concerns, it was noted that most organizations and volunteers quickly revert to using spreadsheet based systems, which eventually become difficult to clean, match and collate into useful information. However, even if a system is available to address the above, it will not be available to all responders. Thus, one organization will always have to handle the import and export to spreadsheets as part of the solution. Therefore, Sahana was designed by taking such considerations into account.
The principles the Sahana platform was built upon are:

- Bandwidth Efficient : The system has to make efficient use of bandwidth. Thus, the architecture was built so that the developer was quite aware of what his/her module will produce in XHTML or XML on the wire. XHTML without style information is sent back and the entire visual look and feel of the UI is generated entirely from CSS style sheets.

- Quickly Accessible Interface : The system was build to have a clean, uncluttered and simplistic interface which a responder could understand intuitively. Additional help text and tool tips are provided to help familiarize the new user to the system.
- Easily Modifiable : As no two disasters are identical, the system strives to be a rapidly customizable solution. Many of the key customizations (e.g. localization) are available to be done through supporting administrative interfaces. However, if more is needed, the framework's simple design is such that not much more than knowledge of vanilla PHP development is required.
- Framework Components : Features such as GIS, From creation, Security, Language, Tool-tips, translation and reports are built into the Sahana framework, so that a new developer can focus primarily on the business logic.
- Portability and Synchronization : Sahana is also available as a portable application and, thus, moving the program with its data is as simply a matter of copying a directory to a USB disk. If the USB disk is fast enough, the entire program can be run from the disk. When necessary, the data in the portable version can be synchronized with another instance[120] or a central server.
- Ubiquitous Hardware : Though Sahana in using the LAMP stack and can scale up to a server farm to support higher concurrency and throughput, it can also run on low hardware specifications. Therefore, it will run on most existing hardware in developing countries that run XP or above on the server side. Linux is, however, a more efficient way to run Sahana as it supports Ubunutu and Redhat versions on the server
- Resilient Architecture : The architecture adheres to the KISS (Keep it Simple Stupid) principle, which in turn makes the system easy to maintain and reduces the number of potential failure points. Dependencies in the system are kept to a minimum. For example, though internet access is needed to display map tiles, the system degrades gracefully by using alternative GIS to plot points if an internet connection is not available.
- Open Standards Support : Currently, Sahana supports multiple Open Standards from the GIS options such as WFS, WMS, GeoRSS, KML, GML, GPX, to domain specific ones like EDXL-HAVE, CAP and PFIF found in Table 1. Data from these standards can also be exported onto any number of spreadsheet formats[121].

Open Standard	Definition
WMS	The Web Map Service provides georeferenced map images over the Internet that are generated by a map server using data from a GIS database
WFS	The Web Feature Service provides an interface allowing requests for geographical features across the web using platform-independent calls
GeoRSS	Is a standard for encoding geographical location as part of a Web feed
XML	The Extensible Markup Language is a standard for encoding documents electronically, noted for its simplicity and usability over the internet
GML	Geography Markup Language is used to encode geographic content for any application
KML	The Keyhole Markup Language code allows for the visualization of geographic information found on 'Google Earth
GPX	The GPS eXchange Format is an XML schema designed as a common GPS data for software applications
EDXL-HAVE	The Emergency Data Exchange Language is tailored to provide information on hospital availability (Hospital Availability Exchange)
CAP	The Common Alerting Protocol is a data format used for exchanging public warnings and emergencies between ICTs
PFIF	the People Finder Interchange Format is used to provide a cyclical flow of data relating to missing and found persons

Table 1. Sahana Employed Open Standards Definitions

120. An 'instance' refers to a specific deployment of Sahana in either a portable form, or as server
121. Sahana can import data onto the following spreadsheets; JSON, RSS, XML, CSV and XLS

4. Sahana Applications

Sahana and its principled Humanitarian Free and Open Source Software (H-FOSS) approach (see Box 1 for detailed explanation) helps empower a diverse set of actors from Government, Emergency Management, NGOs, INGOs, volunteers and victims allowing them to share and coordinate information on a common platform.

However, Sahana should not be considered one platform, or one simple tool, but rather a rapid application development framework for the rapid creation of solutions for the preparing and relief phase of a disaster. The system supports multiple sub-applications that address the common coordination problems governments and relief agencies encounter in the aftermath of a disaster. Each of these sub-applications exists as independent pluggable modules that can either be included or removed from the final custom solution.

Though the modules presented below were initially conceived during the Indian Ocean Tsunami, and continue to be quite relevant today, many more modules have been contributed by the community. New contributions are often variations of existing modules that have been customized to meet the specific requirements of relief agencies working in unique disaster.

4.1 Sahana Missing Persons Registry

The objective here is to reduce the trauma caused by waiting to be found and to help connect families and acquaintances quickly in order for them to support each other. This type of trauma damage is especially acute for children waiting for loved ones to find them. For example, in Sri Lanka after the Tsunami there were hundreds of bulletin boards with pictures of missing people pinned on them. Physical reviews of hundreds, even thousands of pictures can take quite a while. ICT can help connect people with an online bulletin board to be searched by name, appearance, and age group. Even if the victims or family members do not have access themselves, it is quite easy for any authorized NGO/civil society group to hook up to the central portal and provide that service in the areas that they operate.

The Missing person registry is an online bulletin board of missing and found people. It not only captures information about the people missing and found, but also information of the person seeking missing persons, which adds to the chances of people finding each other. For example, if two members of a family unit are looking for the head of the family, we can use this data to at least connect those two family members. A significant amount of meta data about the individual, such as identity numbers, photos, visual appearance, last seen location, status, can be stored and searched using a 'sounds-like' name search.

4.2 Sahana Organization Registry

During the Tsunami disaster, there was a massive outpouring of support from INGOs, NGOs and the general civil society. In Sri Lanka, there were over three hundred registered NGOs providing support. If all groups are not coordinated effectively, it results in problems such as clogged up supply routes, and uneven distribution of support among within affected areas, double vaccinations and unfulfilled expectations. As a result, all the goodwill and pledged aid will be wasted and under-utilized. However, this can be an overwhelming coordination task for authorized emergency controllers to do manually. An ICT solution can help by providing an organization registry to keep track of who is doing what, where and more importantly where nothing is being done at all (or there is no coverage of a certain service). In this way, aid organizations could self-distribute themselves more evenly across affected regions just by being aware of what other relief groups are doing.

The Organization Registry keeps track of all the relief organizations and civil society groups working in the disaster effected region. It captures not only the places where organizations are active, but also captures information on the range of services they are providing in each area. The module has the ability to obtain public registrations from organizations operating in the region; registering all associated meta data to it and creating a 'who is doing what and where' view of the disaster zone. More importantly is the drill down reporting on the converge of services and support in the region, and the identification of area where no aid services are being provided. The coverage can also be visualized through mapping of relief organizations in the field.

4.3 Sahana Request Management System and Inventory

In the immediate aftermath of the Tsunami there was an unprecedented response in terms of aid and supplies; however 8 months after the Tsunami many of those pledges of aid were not utilized. The main reason for this was a lack of awareness and visibility to the aid available between those that require aid to those that can provide it. For example, while only one NGO might get a specific request for aid, probably only one out of a hundred will actually have a supply of that aid item. It would be impractical for this NGO to check with hundreds of potential places to see if that item is available. Instead, what we need is a well structured central repository of aid being pledged and a system tracking requests for aid. An ICT system should additionally help by intelligently matching requests and aid items.

The Sahana request management system is a central online repository where all relief organizations, relief workers, government agencies and camps can effectively match requests of aid and supplies to pledges of support. It essenyially looks like an online aid trading system that tracks requests through to fulfillment. The inventory system, in turn, is a simple logical system to track the storage and distribution of aid between the time a pledge is delivered to a warehouse to its final distribution among recipients. Its preset categorizations are based on the WHO catalog for the classification of items, which also tracks expiry dates and re-order levels for certain items in the inventory.

4.4 Sahana Volunteer Management System

There is often a massive outpouring of volunteer support during a disaster, as motivated people contribute their skills in support of the relief efforts. Volunteers come from a variety of professional backgrounds including medical practitioners, engineers, logistics management professionals, drivers or generic spontaneous volunteers looking to help out. This presents a vast resource that if tapped effectively can provide a massive impact to the relief effort. However, the personnel numbers to be managed can be in the tens of thousands. Thus, a system is needed to track the individuals, their skills/professions, their availability and what projects they are currently working on. The Volunteer Management module also has a self-registration system that permits the scalable entry of all the volunteer data and search a system that allows for a database search of volunteers for a particular project.

4.5 Situation Mapping System

Mapping and GIS are important features for the effective visualization of a disaster, and for preparing an effective response. Sahana supports Open Layers, which permits Sahana to get any map tile or feature layer that supports the common GIS Open Standards such as WFS, WMS, GeoRSS, KML, GML, and GPX to name a few. This is important because most of the Sahana's modules, including the organization and shelter registries, geolocate their entries as part of their workflow, which can in turn be seen on the central map. The mapping functionality is essentially a core part of the Sahana framework and is accessible to be utilized by any module that needs to enter points or display custom maps.

4.6 Displaced Victim Registry

In contrast to the missing person registry, the displaced victim registry is about tracking displaced families or groups by their composition. One does not have to enter all family members, but you need a brief break down of the number of babies, children, adult males/females and elderly in the displaced family and brief details of the head of the group. Their location is attached to a camp, organization or generic GIS coordinate. This data is used to track families and estimate the amount and type of aid to be distributed.

4.7 Shelter Registry

The Shelter Register is a simple system to plot the location of temporary and permanent shelters for victims, illustrating the main concentration points of shelters after a disaster. Shelter data includes numbers and capacity, so that organizations are aware when a shelter is reaching full capacity or when it is not being fully utilized.

5. Documented Shana Deployments

Since its inception, Sahana has achieved much in delivering value to disaster management efforts, and its vision and applications have been utilized in countries throughout the world, building a community inspired by and dedicated to relief through the use of H-FOSS. By the very nature of being a free and open source project that is available to download from popular public repositories without notification, it is difficult to determine exactly where Sahana has been used, customized and by whom. Nevertheless, the many instances of Sahana application customizations with little contact to and support from the Sahana community is a testament to Sahana's simplicity and functionality.

The deployments noted in Table 2, however, were instances when the Sahana community were actively involved in the deployment and thus, more aware of its ability to delivery. In most cases, deployments were government led and front-ended by an influential local group[122]. In the case of the New York City deployment, Sahana was implemented as a pre-disaster component of the City's Costal Storm Plan.

Year	Disaster	Location	Partner(s)
2005	Tsunami	Sri Lanka	CNO, Government of Sri Lanka
2005	Asian Quake	Pakistan	NADRA, Government of Pakistan
2005	Southern Leyte Mudslide	Philippines	NDCC and ODC, Government of Philippines
2006	Sri Lanka Disaster Preparedness	Sri Lanka	Sarvodaya - Sri Lanka's largest NGO
2006	Sri Lankan Civil War	Sri Lanka	Terre des Hommes
2006	Yogjarkata Earthquake	Indonesia	ACS, urRemote, Indonesian Whitewater Association, Indonesian Rescue Source
2007/08	Pre-deployment	New York City	Costal Storm Plan
2007	Ica Earthquake	Peru	Government of Peru
2008	Shizuan Earthquake	Chengdu	Chengdu Police
2010	Haiti Earthquake	Haiti	WFP, InSTEDD, U.S. State Department, Ushahidi, Sahana Foundation

Table 2. Documented Sahana Deployments and Users

122. IBM has been a strong partner in this regard, with its local IBM country offices taking the lead. Through the country offices the IBM Foundation often recommend and donate Sahana help with hardware to the government.

6. Sahana in Haiti

The Sahana Software Foundation and the Sahana community responded with a massive voluntary effort immediately following the earthquake in Haiti. Working around the clock, members of the Sahana community set up a hosted instance of Sahana (the first post-disaster deployment of Sahana's python-language[123] version - SahanaPy) on a public website that served to fill gaps in the information management requirements of the massive relief operation. This hosting utilized for the first time SahanaPy, Sahana's first version of the popular python programming language. Sahana's response culminated in the launch of The Sahana Haiti 2010 Earthquake Disaster Response Portal, a live and active website that provided responder with access to all of Sahana's modules[124]. Documented below is a discussion of the some of the most utilized modules, why they were utilized by responders, and what results they achieved.

6.1 Core Applications

In the first 48 hours after the earthquake, what responders wanted to know was who else was responding, what organizations already had staff in Haiti, where were they located, and what assets and resources did they have available to them. Sahana's Organization Registry (OR), served to track organizations and offices working on the ground in Haiti. The OR provided a searchable database of organizations responding to the disaster, the sector where they were providing services, their office locations, activities and their contact details. It became one of the primary repositories of organization, office and contact information for the relief operation during the first couple of weeks of the response. The Sahana team encouraged organizations to self-register by email and report their office locations, and volunteers were organized to assist with data entry and to aggregate lists from many sources. Data from pre-disaster lists of organizations working in Haiti available from the United Nations Office for the Coordination of Humanitarian Affairs (UNOCHA), as well as active contact lists used by the United Nations Disaster Assessment and Coordination (UNDAC), InterAction and other sources with official and accurate points of contact was entered into Sahana. Next, responders wanted to know where relief and life-saving efforts were most needed. To address this, Sahana provided a simple Request Management System (RMS) to allow requests for assistance (such as "send water") to be made visible to relief organizations working on the ground. Sahana added the capability for organizations to claim requests for fulfillment and later mark them as completed. The RMS

123. Python is a general-purpose high0level program language that emphasizes code readability
124. http://haiti.sahanafoundation.org

also contained a simple ticketing, tracking and reporting system.

The Sahana Software Foundation worked with the U.S. State Department, Ushahidi, Innovative Support To Emergencies Diseases and Disasters (InSTEDD) and others on a project to process SMS messages with requests for assistance and information sent from Haitian citizens. SMS text messages sent to short code 4636 in Haiti were translated from Creole by Haitian volunteers and put into a structured data format identifying the sender's name, location (to the extent possible), and category of the message. The messages were published by a GeoRSS feed from Ushahidi that was captured by Sahana. Sahana could also push updates back to Ushahidi, so that others could see which requests had been responded to. Immediate lifesaving requests were sent from Ushahidi direct to the US Coast Guard and other first responders, while Missing Persons reports went into Google's site that was aggregating missing and found persons data.

The RMS also captured structured messages posted to Twitter using a Hashtag System[125] devised by the Tweak the Tweet project that came out of the Crisis Commons/Crisis Camps community and led by Project Epic at the University of Colorado at Boulder[126]. These messages were also available for review, response and fulfillment within Sahana, although a human filter to separate actionable messages from clutter was needed to make this effective. The RMS was later adapted for use in helping to manage requests for assistance, resources, staff, medical supplies for the Hospital Management System.

During the second week of the relief operation, there were multiple requests to identify the location and operating status of hospitals and medical facilities within Haiti. Sahana organized a volunteer effort to geo-locate approximately one-hundred hospitals with names but without known coordinates over a twenty-four hour period. These efforts added over 160 hospitals to the Sahana registry that had been set up to manage medical and health facility capacity and needs assessment. Sahana's hospital data was published through open standards, making it available to others. A KML feed of the hospital location data remained the most accurate and complete source of operating hospital facilities throughout the first two months of the relief operation, and was accessed by thousands of users world-wide. Sahana also publishes all of its hospital data as GeoRSS, JSON, XML, CSV, GPX, XLS and EDXL-HAVE.

Once immediate lifesaving needs, and health and medical needs for the injured had been addressed, the next challenge faced by relief operations was ongoing support and care for the victims. To address the needs of their food distribution planning, the World Food Programme (WFP) asked the Sahana Software Foundation to adapt its request management system for use by WFP's Implementing Partners made up of relief agencies responsible for distributing food aid to the Haitian population. About one month after the earthquake, the Food Cluster Food Request Portal (FRP) system was available for such use. FTP allows WFP's Implementing Partners to identify their location and the number of beneficiaries they are serving, categorized by age and gender to allow WFP to determine the appropriate types and quantity of food aid needed. The agency also requests a delivery, or agrees to pick up the food

125. A method that allows short messages to be tagged by utilizing the hash symbol '#'
126. http://epic.cs.colorado.edu/tweak-the-tweet/helping_haiti_tweak_the_twe.html

aid at a WFP warehouse. WFP receives the request and confirms it, then schedules a delivery or pickup and communicates back to the Implementing Partner through an SMS message generated by Sahana. This simple request-based planning tool may end up being used by the World Food Programme and the Food Cluster for its global relief operations. This system was set up on a separate server to better isolate the sensitive and operational data

6.2 Additional Applications

In addition to these core modules notes, the Sahana portal supported supplementary functionality by utilizing various other applications in collaboration with other partners operating in Haiti. These applications include registries that document shelter capacity and up to date, in country responder contact information, mapping portals that track medical facilities and responders, and translation function to allow relief agencies to easily translation between English, French, Spanish and Creole. Furthermore, there were various independent deployments of Sahana, the most prominent involving the National Library of Medicine.

The two Sahana supported registries include the Persons Registry (PR) and the Shelter Registry (SR). The Persons Registry serves as the main repository of individual contact information for all Sahana registered users and organization staff. It is utilized by all other Sahana registries to store detailed contact information. The Shelter Registry (SR) used data pulled from other sources through open standards for data exchange to identify the locations of the temporary shelters that were spontaneously set up for the thousands rendered homeless by the earthquake. By pulling the data into a registry rather than simply displaying it as a data layer on Sahana's mapping client, it enables Sahana to manage transactional data in conjunction with its other efforts. Essentially, the SR allows agencies to record the population of an encampment, its needs for water, food, and other supplies, and to manage requests to send supplies; a function that cannot be accomplished with a single plotted point on a map. (At the time of publication, this module had been configured for use in Haiti, but in the absence of a specific end-user. request had not yet been enabled).

The Sahana Haiti portal is also able to map geo-referenced data. The data comes from a variety of sources including temporary shelters, food distribution centers, medical facilities and other data management systems and registries. Working with members of the OSGeo community Sahana has obtained a fast tiled set of the current imagery being made available by Digital Globe[127]. Sahana is also leveraging the constantly updated set of Open Street Map tiles. Other data sources that are being utilized within the system include informational feeds from Ushahidi, various point layers and updated road overlays from Open Street Maps, location names, USGS earthquakes, and locations from GeoNames. Sahana continued to build upon these capabilities as relevant layers were made available to the Haiti relief operation. The Sahana Situation Mapping module is the culmination of these efforts and provides an integrated annotated map of what is happening in Haiti. Sources of data for Situation Mapping are noted in Table 3.

127. http://www.digitalglobe.com/

Base Layers	Lead Agency
Open Street Maps current Haiti maps project (3 options for graphic style and amount of detail)	Sahana Registry (OR, HMS (including 4636 messages), RMS, FRP, SR)
Digital Globe Hi-Resolution Imagery (2010-1-14)	Ushahidi (haiti.ushahidi.com) Events
Ikonos Imagery (2010-1-15, 2010-1-17)	Open Street Maps as an overlay to be displayed over imagery
Google Maps (Terrain, Hybrid, Satellite)	Open Street Maps Points of Interest
1:12.5k Topo Maps for PaP	Other Sahana Locations data
1:50k Top Maps	

Table 3. Situation Mapping data sources

With regard to independent deployment, the National Library of Medicine (NLM), the world's largest medical library and an arm of the National Institutes of Health (NIH), released a version of t Sahana-based "Lost Person Finder", called "Haiti Earthquake Person Locator" HEPL[128]. The site provides an interactive website that provides information about people who have been found in Haiti, or who are still missing. The NLM also developed a specialized "Found in Haiti" iPhone application to geolocate found persons and display it on the site. The HEPL system shares information with other person finder systems using the PFIF standard, including Google's Person Finder, to ensure that all searches operate across the largest possible set of matches. It basically provides a public viewer for Google records (using an interactive Notification Wall), with filters for metadata beyond name, and a supplementary iPhone- or email-based input method (with forwarding to Google so the master registry is maintained).

7. Open Standards for Data Exchange

Sahana's use and promotion of Open Standards for Data Exchange played an important role in Sahana's successful response to the Haitian earthquake, and also had a positive impact on many other efforts and projects. Sahana's REST Controller allows data to be published in numerous standard, common formats including kml, json, georss, gpx, xml, xls, and cs. However, the value of Open Standards was, in particular, noted through the use of EDXL-HAVE and PFIF formats in a hospital management system and missing persons registry respectfully.

For the Missing Persons and Disaster Victim Identification (DVI) registries, Sahana worked closely with Google, Yahoo and others to ensure that a common standard for the exchange of Missing Persons data was implemented using the PFIF (Person Finder Interchange Format) standard. The Google site, (http://haiticrisis.appspot.com/) in turn became the main aggregator for collecting all Missing and Found Persons reports. Sahana embedded Google's widget on the Sahana site for collecting missing person information. While Sahana never established a Missing Persons registry, or its own Disaster Victim Identification registry Shana's participation in producing an agreement on a common standard for the exchange of such data was crucial. Furthermore, Building PFIF compliance into Sahana means that the registry is there to more quickly deploy next time. By importing missing and found persons data into Sahana, others can better manage that data, and utilize data found in the Disaster Victim Identification registry to identify track, trace and handle the bodies of the deceased. Through the Sahana and Google agreement on an open standard for data exchange, any updated missing persons status information that Sahana can provide can also be pushed back to the main Google repository, or another repository that can accept and process PFIF.

However, the real success story in terms of the Sahana Software Foundation and open standards in Haiti concerns the adoption of the EDXL-HAVE standard by the Pan American Health Organization, the American government and responding agencies and technology providers such as Sahana, Google and others involved in collecting hospital data. EDXL-HAVE, or Emergency Data Exchange Language - Hospital Availability Exchange is an XML-based OASIS standard that was designed to meet the type of medical reporting that is necessary in Haiti; specifically, the operational status of a hospital or health facility, its bed availability and resource inventory[129]. Within two weeks of the earthquake, the Sahana portal included a hospital management system that provided an EDXL-HAVE feed. Sahana then worked to extend the use of EDXL-HAVE to other systems working to collect similar data for Haiti, thus ensuring interoperability and the ability to seamlessly exchange data between these systems. In coordination with the PAHO, an EDXL-HAVE based framework is currently being adopted by the Health Cluster for Haiti, and eventually will be handed over to the Haitian Ministry of Health.

8. Conclusion: Recent Lessons Learned

Effective Sahana module deployments in Haiti relief operation further demonstrate the success of open source principles to humanitarian effort. The application and customization of Sahana modules, and their usability

128. http://hepl.nlm.nih.gov/inw/

129. OASIS is a not-for-profit consortium that drives the development, convergence and adoption of open standards for the global information society, http://www.oasis-open.org

and accessibility have had a positive impact on the response to the disaster. However, the application and customization by various organization and agencies in Haiti, and the challenges that this specific disaster faces will allow benefit Sahana and its community through the lessons that will be taught. Indeed, the lessons learned will do much to enhance Sahana and assist it in fulfilling its vision. Though only a short time has passed since the devastating earthquake, the Sahana community has already started to identify lessons and experiences form Haiti that have been incorporated into the way Sahana works.

Preliminary findings include :

- The Sahana community now uses a User Acceptance Testing model on deployment, so that new product versions are well tested before being deployed. With regard to deployment, three instances of Sahana are used and code is propagated from the development version to the UAT version and ultimately to the production instance.
- The use of IRC[130] has been invaluable in coordinating a live response community and also in collaborating with external parties. It is also important, however, to archive IRC chats in order to provide continuing context.
- IRC also has been a fantastic way to recruit new volunteers and to engage them in new efforts. Part of the reason for this is that unlike other systems, no formal subscription / approval is needed to join the IRC Sahana channel and thus, people can easy join a discussion in the passing.
- The CRUD model provided by SahanaPY/Web2Py provides rapid customizing capabilities to Sahana. New fields can rapidly be added to a form with very few data changes.
- Sharing references to data is just as important as sharing information. The REST reference interface in SahanaPy provides simple, transferable references to lists and data records provided that researchers have the right level of clearance to access the data.
- Though the AJAX function provides a lot of added usability, it was an unexpected bandwidth hog and thus, is not recommended in its richest form for disaster management systems.

The Sahana Disaster Management System continues to evolve in order to address coordination needs and to adapt and assimilate new technologies. Haiti was a prime example of multiple Sahana instances being customized and deployed for different purposes. This is a testament to the strength of the H-FOSS model for delivering ICT applications in the field of humanitarian relief. However, as mentioned earlier, an Open Source license is not enough; other aspects of the project need to be in place to make it feasible for rapid customization during disaster response. Open Source communities are not easy to manage as there is a substantial amount of volunteer turnover; however the Sahana project continues to be relevant and used in disaster response. The formation of the new Sahana Foundation should help the project to reach a new height of partnership with the response community and more formal actors from government and the UN. Haiti was an excellent example of such complex partnerships and the importance of open standards in information sharing. Sahana is evolving beyond a simple ICT system to include some of the best practices in the application of ICT for disaster management.

130. Internet Relay Chat is a commonly used online public chat network among Open Source communities.

Establishing and Institutionalizing Disaster Loss Databases: Experience from UNDP[131]

UNDP Regional Programme on Capacity Building for Sustainable Recovery and Risk Reduction

1. Introduction

The United Nations Development Programme (UNDP) Regional Programme on Capacity Building for Sustainable Recovery and Risk Reduction (RP) was established in response to the Indian Ocean Tsunami of 2004. Managed by the Regional Centre in Bangkok's Crisis Prevention and Recovery team, the RP aims to enhance the capacity of Tsunami affected countries in disaster risk reduction (DRR). Its programme activities are in line with the Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters (HFA).

Risk identification is one of the five priority areas of the HFA as stated: The starting point for reducing disaster risk and for promoting a culture of disaster resilience lies in the knowledge of the hazards and the physical, social, economic and environmental vulnerabilities to disasters that most societies face, and of the ways in which hazards and vulnerabilities are changing in the short and long term, followed by action taken on the basis of that knowledge.[132]

In addressing this priority, one of RP's strategies is to enhance institutional systems for building risk knowledge through the development of disaster loss databases. At the core of any risk knowledge efforts is the need for reliable and easily accessible data on hazards, vulnerabilities and risks. Disaster loss databases provides for systematic collection of relevant data, and their validation and sharing, for the historical analysis and prediction of disasters.

131.This case study has been adapted from UNDP's 2009 publication entitled, Risk Knowledge Fundamentals: Guidelines and Lessons for Establishing and Institutionalizing Disaster Loss Databases. For more information visit http://regionalcentrebangkok.undp.or.th.

132. UN/ISDR, Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters, World Conference on Disaster Reduction, Kobe, Hyogo, Japan, 18-22 January 2005.

This chapter documents UNDP's experience in implementing disaster loss databases in five Tsunami affected state/countries - Tamil Nadu (India), Indonesia, Maldives, Sri Lanka and Thailand, in which key lessons are drawn. To implement disaster loss databases in these countries the 'DesInventar'[133] methodology has been used.

2. Disaster Loss Databases

UNDP has made significant contributions to the analysis of disaster losses. An example is the development of a report entitled, Reducing Disaster Risk: A Challenge for Development, which gives a Disaster Risk Index, using a number of parameters such as mortality, for all countries in the world. Similarly, the Centre for Research on Epidemiology of Disasters maintains a global database[134] of natural disasters that provides useful information and analyses on various parameters of past disaster events. Munich Re also maintains a database - 'NatCatSERVICE'[135] for natural catastrophes. The database allows analysis of regional and global hazards as well as trends.

While these databases provide very useful information on regional and global losses and hazard trends, they provide little information on the occurrence and impacts of natural disasters at subnational levels for national governments to better understand the past and potential risks faced in different parts of the country.

A nationally-owned disaster loss database built using the data collected, and validated by national and subnational agencies provides useful information to key stakeholders in a country to better analyse the disaster trends and impacts, allowing policy makers and planners to make informed decisions.

3. DesInventar

DesInventar is based on a relational database structure and a disciplined expert assisted structure for data collection and classification that permits the homogeneous capture, analysis and graphic representation of information on disaster occurrences and losses. DesInventar was created by the Network of Social Studies on Disaster Prevention in Latin America in 1994. Over the past 15 years, the DesInventar database and methodology have further developed and been customized to meet the emerging needs of countries, and is now being used in more than 25 countries in Latin America and the Caribbean. In Asia, seven countries - India, Indonesia, Maldives, Nepal, Iran, Sri Lanka and Thailand - have adopted the DesInventar methodology.

The database software is able to generate reports, charts and maps based on the information that has been entered into the database. The database is very flexible and in Asia the DesInventar software has been customized to meet the needs of the different countries, including the use of local languages, disaster types and non-disaster categories. The successful customization has played a vital role in developing a sustainable system and initiative.

The RP has built on UNDP's experience in assisting countries develop disaster loss databases since 2002, and the use of the DesInventar methodology since 2005 in advocating and implementing the disaster loss databases in the Tsunami affected countries.

4. Country Experience

4.1 Tamil Nadu, India

The RP support to a disaster loss database in India is implemented in the southern state of Tamil Nadu. The counterpart government department at the state level responsible for DRR is the Revenue Department of the Government of Tamil Nadu (GoTN). At the district level it is the district magistrate office, and at the subdistrict level the subdistrict office. Other government agencies closely involved in the implementation of the disaster loss database include the Fire Department, Meteorological Department, Geology and Mining Department, and Forestry Department.

The online database and website is hosted by the GoTN and is physically located in the premises of the State National Informatics Centre (NIC) located in Chennai.

At its inception, a formal notice from the Revenue Department informed all relevant government departments of the establishment of the database and the data collection process. Based on these instructions, UNDP recruited two Disaster Inventories Associates and they began the data collection process by contacting government agencies at the state and all 30 districts. Data on all disasters has been collected for the period from 1976 to 2007.

All data collected has been entered in the database and they are now being used for detailed analysis, undertaken by the Vellore Institute of Technology (VIT). Once finalized, agreed and cleared by the government, the analysis will be made public.

133. For further details on DesInventar see http://undp.desinventar.net.
134. http://www.em-dat.net.
135. http://www.munichre.com/en/ts/geo_risks/natcatservice/default.apx.

The clear strengths and concerns of how the disaster loss database has so far been implemented include the following:

Strengths

- Proactive government and steadfast support from nodal agency
- Good governance structures and working conditions resulting in an enabling environment
- Clear direction from the RP
- Clear database and data collection methodology
- Support and lessons from other states in India where disaster loss databases have been implemented
- Strong draft analysis based on information from the disaster loss database
- Flexibility with regards to customization

Concerns

- At the district level, there was a lack of understanding on the use of the data.
- Data provided reflected all official data that was available and on record. However, because records are officially destroyed after a certain number of years, the aim of having information on all disasters was not possible and going back 30 years was difficult.
- While some individuals were very supportive it was not considered a priority at some levels (particularly at the district level). This combined with the high turnover/movement of government staff, made the socialization process difficult.
- No mechanisms are yet in place to record new recent disasters.
- As part of the sustainability of the database it must become part of the Revenue Departments' procedures and staffing allocation, and this has yet to take place.

Overall, the progress in Tamil Nadu to date has been very good and should result in stronger government ownership and institutionalization of the disaster loss database upon completion. The requests from neighbouring states (Andhra Pradesh, Kerala and Pondicherry) for support in the implementation of the database are testimonies to its relevance and usefulness.

4.2 Indonesia

The Government of Indonesia has demonstrated its commitment to the development of a comprehensive DRR approach by passing a Law on Disaster Management in March 2007, developing a National Action Plan for Disaster Reduction 2006-2009, and establishing a National Disaster Management Agency (BNPB) on 26 January 2008 (as stipulated in the Law on Disaster Management). BNPB replaces BAKORNAS PB (National Coordinating Agency for Disaster Management) to provide DRR guidance and support to line ministries, provinces and districts. BNPB will have counterpart agencies at the provincial and district levels in the near future to enhance coordination and cooperation.

The first attempt at the implementing the database was met with a number of difficulties, the most difficult one being that the government DRR framework was being restructured and development of a disaster loss database was not considered a priority for the government. In the absence of required support and guidance from the government due to evolution of new institutional and legal frameworks, the Indonesian database was populated with data from the media and the Internet that were not validated by the government. The database was, until very recently, hosted by the UNDP Country Office (CO) in Jakarta and data was collected by a Disaster Inventories Associate working from the Jakarta office. Very limited customization was initially offered to the government, and as a result, the government perceived this to be a UNDP initiative/database and not a government one.

With the establishment of BNPB and the conceptualization of the multi-year Safer Communities Through Disaster Risk Reduction in Development Programme as part of the Joint UN Strategic Plan on Disaster Reduction for Sustainable Development, the implementation of the database picked up pace. By mid-2008 the situation in Indonesia is very different from when the database system was first established. The database system, named DiBi, was launched by the head of BNPB in July 2008 with official data for the period 2002-2006. While much work still needs to be done to collect and validate historical disaster data for the past 30 years, great momentum and government ownership is now in place and the future for the database seems very positive.

The magnitude of the Tsunami and the restructuring of the DRR sector were very important factors that contributed to the amount of time and importance placed on the establishment of the database in Indonesia. The UNDP CO with support from the RP and in partnership with the Government of Indonesia is customizing the DesInventar system to suit government requirements. BNPB has also been leading the process of collecting and validating disaster data through the Communications Forum that meets regularly to discuss, consult and decide on issues related with DiBi. At the same time, BNPB has been organizing a series of training and socialization events on DiBi. The database is now being used for guiding the ongoing process of developing a national DRR plan and for monitoring the impact of crisis to poverty at the community level.

In summary, the transition during mid-2008 that led to government ownership of the database was a result of :

- The introduction of the Indonesia Disaster Management Law and the creation of BNPB
- The renewed understanding from UNDP CO on the importance of data and inventories of disasters as being vital to identifying and tracking patterns of disaster risk
- Sustained advocacy efforts by both the RP and UNDP CO over a long period to get the government to own and build the database
- The understanding from the government that a disaster loss database is a fundamental requirement for implementing efficient and effective DRR programmes and policies, and for enabling the government to plan and make decisions based on a full understanding of the impacts of disasters
- The flexibility from the UNDP CO in the customization of the database to meet government needs

4.3 Maldives

The Ministry of Planning and National Development (MPND) was initially the host agency of the disaster loss database before it moved to the National Disaster Management Centre (NDMC). The reason for it being, MPND was the focal agency for data and information management during the 2004 Tsunami emergency. Additionally, the ministry had the in-house capacity for data management. Immediately after the Tsunami and prior to the establishment of the RP, UNDP supported the initial establishment of the disaster loss database to record loss from the Tsunami. During that time, the database was extensively used by the government and donors, and was considered the best reference material on disaster loss from the Tsunami. As the focus moved towards recovery and reconstruction, attention to the collection and entry of loss data gradually dwindled down. This resulted in diminished support for the database and its updating.

A year after the 2004 Tsunami, the NDMC was established under the Ministry of Defence and National Security. It was declared as the nodal agency for disaster management and risk reduction through a Presidential Directive No. 2006/17. The creation of the NDMC is part the national government's effort to strengthen the DRR capacity of institutions. Over the past two years since NDMC took responsibility for management and maintaining the DesInventar, a number of modifications have been made as part of the customization of the database, making it more country specific and attractive to the government.

Challenges

Data collection challenges - Great challenges were faced in locating the sources of historical information as official government records were very limited. Initially the MPND organized a stakeholders meeting in May 2006 to identify potential sources of data from different ministries and departments, however the physical collection of data has been very difficult. Data has been sourced from selective government departments and local media. As the Maldives has only one state-owned local newspaper, the media source is considered to be reliable and mirroring government records.

Ownership and administration challenges - Greater ownership from the government counterpart is required with further allocation of government staff and the release of staff to travel to the different atolls. As limited records are available on historical data the best way to collect information is to visit the different atolls, and this process is very time consuming and expensive.

Staffing challenges - Staffing to support implementation of the database has also been a challenge. The turnover of staff has been very high while the capacity of the staff recruited has been at a lower level compared with other target countries of the RP. The high turnover of staff has had a negative impact on the collection of data and the general implementation and support of the disaster loss database.

Institutional challenges - Socialization within government has been limited and this has resulted in limited communication between relevant government departments and the NDMC to ensure the data available is collected. The absence of a focal point in most of the government ministries and departments further posed constraints on effective and timely coordination.

Technical challenges - These include mapping issues (because of the geographical spread of the islands), and thematic analysis also due to the geographic nature of the Maldives.

Overall, the status of progress in the Maldives is best described as moving forward and ongoing. To date much has been achieved, but much still remains to be done. Hopefully, with the quick recruitment of new staff and training of the staff, the process can start moving forward at a faster pace. NDMC has a new staff recruited to assist in data management. The government staff member has been coached by the Disaster Inventories Associate on data uploading and some basics of the DesInventar system.

4.4 Sri Lanka

The Sri Lanka Disaster Information System is currently the most developed of the Tsunami affected countries. The database has been populated and validated, extensive local customization has taken place, preliminary analysis has been completed and published in June 2007. The initial UNDP support to a disaster loss database in Sri Lanka started prior to the 2004 Tsunami and although it was not implemented before the Tsunami struck, the methodology and socialization process was well under way. The Sri Lanka Disaster Information System was used by the government to provide information and reports on damages to infrastructure during the early months after the Tsunami.

With the enactment of the Sri Lanka Disaster Management Act No.13 in May 2005, the National Council for Disaster Management (NCDM) was established as the highest authority responsible for the management of disasters. This was followed by the establishment of the Disaster Management Centre (DMC) to function directly under the NCDM. Thereafter, a separate Ministry responsible for Disaster Management and Human Rights (M/DM&HR) was formed. Presently, the DMC is functioning under the Ministry and is the main authority for disaster management activities covering the whole of Sri Lanka under the guidance of the NCDM and the M/DM&HR. The implementation of disaster loss database in Sri Lanka has been guided and supported by the DMC since the beginning. The UNDP Disaster Inventories Associate is based and works within the DMC.

Data was collected from different government organization, as was identified by the DMC, including the Epidemiology Unit of the Ministry of Health, Department of Wildlife Conservation, National Building Research Organization, and other government organizations including two government newspapers. All data entry was done at the DMC, and detailed quality control mechanisms were put in place and data was validated.

Overall, the progress in Sri Lanka is considered an excellent example of clear implementation and sustainability within government structures. Like all implementing countries under the RP, a number of challenges were faced, but Sri Lanka has so far progressed well with regards to institutionalization, analysis and sustainability. With government support, a number of events, training sessions and data collection were swiftly undertaken. Initial technical issues were quickly resolved, especially with support from the RP. This success is due to strong commitment and capacity of the DMC, other government departments, DesInventar staff, UNDP CO and the RP, as well as the fact that the initial socialization process started prior to the 2004 Tsunami.

4.5 Thailand

Implementation of the disaster loss database started in January 2006 with the involvement of the Department of Disaster Prevention and Mitigation (DDPM) under the Ministry of Interior of the Royal Thai Government. According to the Disaster Prevention and Mitigation Act of 2007, DDPM is the secretariat of the National Disaster Prevention and Mitigation Committee and is by law tasked to coordinate with other government agencies, local administrations and NGOs to manage DRR, including recovery activities. This makes DDPM an appropriate location for the disaster loss database.

In the initial stages of the disaster loss database implementation, DDPM established a multi-ministerial taskforce for overseeing the initiative. At the first taskforce meeting, several recommendations were made to guide the implementation process. The DDPM made available its server for installation of the online version of DesInventar that was used by the Disaster Inventories Associate. The database was then customized to adapt to local conditions and now has both an English and Thai interface, as well as other country specific customization.

A number of formal and informal meetings were held with DDPM officials, however, no data was made available to the Associate to proceed further. To demonstrate the analytical abilities of DesInventar, data from the 2006 floods was entered into DesInventar.

DDPM has an existing in-house database system to record disaster inventories. This system is online and is used as part of their routine work. In late 2007, the DDPM introduced an online GIS/MIS system with abilities to capture information about disasters and losses. This system, developed by a Thai university is similar to DesInventar, and is used for recording natural disaster impacts, road accidents and details of chemical risks.

DDPM is, however, still very interested in DesInventar and wish to link it with the GIS/MIS system so that reports and analysis can be provided in English as well as in a format that will be easier to share with other countries. Thailand is a pilot country for regional ASEAN activities and as such will need to have information in English. The DesInventar system will be able to fulfill this function. However, it is a second priority until the in-house Thai GIS/MIS system is fully established. The development of an interface between DesInventar and other systems to be able to import and export data is currently being considered.

Overall, the progress in Thailand, especially related to the institutionalization and customization aspects, has been successful. However, with development of a parallel GIS/MIS system, the next stage of DesInventar implementation will have to wait until the GIS/MIS system is fully installed. In the mean time, the finalization of the interface function could be proceeded with.

5. Key Lessons Learned

The subsections below detail areas of importance drawn from the experiences of disaster loss database implementation in the Tsunami affected countries. These key lessons learned have been identified by UNDP and government staff members that have been working with the RP.

5.1 Nodal Agency / Implementing Partners

The selection and capacity of the Nodal Agency/Implementing Partner is crucial to the successful implementation and sustainability of the disaster loss databases. The agency/partner should be mandated as the lead disaster management authority in the country.

In both Indonesia and the Maldives, there were changes to the responsible agencies/partners due to institutional restructuring during the set up of the disaster loss databases. In both countries, the 2004 Tsunami led to a review of policies and institutional frameworks by the respective governments, which resulted in establishment of new legislations and institutions for DRR. These changes did impact the implementation adversely and caused delays, but these are positive changes that helped to find a 'home' for the disaster loss database in the countries. Continuous engagement with the countries have helped to move forward and make progress that otherwise would not have been possible to achieve in the highly dynamic post-tsunami environment.

Key Lesson: Recognize the need for advanced planning, assessment and appropriateness with regards to identifying counterpart nodal agencies and human resources at regional and country levels. They are key determinants of the successful implementation of disaster loss databases. Implementation outside of the government system should only be considered as a last option.

5.2 Government Ownership (and Government Staff)

It must be very clear that the government in each country is the owner of the database and not UNDP nor the agency operating the system in the case where the government has agreed to the engagement of an NGO or private company.

Government ownership of the database, as well as the implementation and analysis processes is vital with regards to sustainability and use of the findings from the database. Sustainability will only occur if the system is tailored to the government's specific requirements and needs, and is provided with useable information for planning and decision-making.

There are two main processes/outputs - the historical data collection and the collection of current data. While these are traditionally done with the same government department they can also be undertaken by different entities.

Key Lesson: Government must own the database from the outset and be self-driven to produce the analysis to assist it with planning and management.

5.3 Database for Disaster Risk Reduction

At the core of DRR is the identification of the likelihood of disaster events and both the degree of exposure and vulnerability. One of the best ways to identify potential future disasters is by tracking previous disasters and their impact in some form of a database so that analysis can be undertaken. The identification of the risks and disasters allows risk levels and risk factors to be mitigated.

Key Lesson: Disaster loss databases must be developed as an integral part of DRR initiatives. In the absence of a nationwide risk assessment in these countries, the database is a central tool for governments to better understand the disasters and threats in order to effectively mitigate and prepare for them.

5.4 Data Collection Methodology

The data collection methodology should be agreed upon from the outset and should take into account a number of factors including: lessons from previous data collection process in the country of implementation, the definition of the end use of the data (how the information will be used should drive the data that is collected), the process of data collection, the sources of data, the validation process and the analysis that will be undertaken.

Based on all of these variables, customization of the process and the tool will need to be undertaken: The customization should include:

- End use of the data
- Sources of data (government, NGOs, media, research institutions, universities)
- Validation process
- Country specific data cards (customized)
- Country specific definitions defined (customized)
- Country specific hazards defined (customized)
- Type of analysis to be undertaken based on data

Key Lesson: Understand why the data is being collected and what the end use of the data will be. With this understanding the process and methodology can be put in place.

5.5 Data Collection Process and Sources

The data collection process and sources of data are very important with regards to the information that will be collected, then validated and entered into the database. The 'RIMRO' principle (rubbish in means rubbish out) starts here. If poor data is collected then poor data is entered into the system, resulting in poor and even meaningless analyses.

The sources of data must be reliable and government-/counterpart-approved. As a general rule of thumb, direct sourcing of data from official government records is preferred as they are usually reliable and consistent. Media sources do not always provide the level of detail required and can sometimes overestimate the impact of the disaster - they should be sourced with caution.

The data collection process must be very systematic and structured, have strict quality assurance with checks in place, and records available for different levels for quality control, cross checking and final validation. This process will often involve the recruitment of short-term and temporary staff.

All staff collecting data will need to be trained in data collection, and briefed about DRR in general, including types of disasters and disaster management. Data collection personnel should also have a clear understanding of the value of the data they are collecting and how the data will be used by the government.

The process must take into account customization of the database and the level down to which the database will record (province, district and subdistrict). In Sri Lanka[136] for example, some initial data was collected at a higher level than what was later required and further collection was then undertaken at a lower administrative level. While this makes for interesting cross checking, it is best for the government counterpart to decide at the beginning what level they require data at.

Key Lesson: The data collection process must be structured and have cross checks within it. Data records should be from 'agreed and accepted' sources and must be kept and easily accessible. Data collection staff must be trained to understand disaster terminology and the use of the data, and know exactly how to collect it.

5.6 Data Validation

Data validation is an important step in database implementation. The data must be validated prior to any form of analysis - should the analysis provide findings that are new or different from standard expectations then these will be questioned, and the source and validity of the data should be reviewed. All data must be verifiable at any point in time and as such, systems must be in place to ensure the quality and validity of the data.

Validation or quality control mechanisms should include :

- Separation of duties for data collection and data entry.
- Verification that the information on the data card corresponds with the copy of the data source attached to the data card.
- Verification that the same disaster has not been recorded based on different sources of data from different organizations.

136. Sri Lanka is a good example where the process was very systematic. Electronic copies of all data cards with attached copies of the source of data (either media or official government record) are kept on file, and based on reference numbers can be recalled and crossed checked at any time. Separation of duties for the data collection and data entry processes also enables further cross checking and oversight.

- Sampling of the data, and checking data cards and source of data should automatically be done once data is in the system.

Future version of the DesInventar platform will include a new validation tool that will enable a hidden function for data that has yet to be validated.

Key Lesson: Division of duties, clear documentation, strict quality assurance and complete records of documentation (data card and photocopy or digital copy of the source of data) kept on file are essential for data validation.

5.7 Analysis

To date, both Sri Lanka and Tamil Nadu have undertaken analysis and produced reports. The analysis that is undertaken from the database must be of high quality and provide information that will assist the government in planning and preparedness, and in making decisions. The scope of the disaster loss database, including types of disasters and the level of detailed information to be provided (provincial, district, subdistrict, village) should be discussed and agreed to by all key stakeholders at the outset and before the system becomes operational. The GIS/mapping function is a very useful tool for displaying analysis.[137]

Key Lesson: Analysis must be professional, clear, understandable and relevant to the target audience. Different levels of analysis should be prepared depending on the audience of the analysis. But in general, they should comprise quantitative and qualitative information that is user-friendly and supports the decision-making process.

5.8 Training

Training is required in technical database issues, data collection and entry, data analysis, DRR issues and disaster-related terminology. Training to date has taken place at two levels - at the regional level by the RP in the training of Disaster Inventories Associates in-country; and at the national level by the Associates to other local staff.

Key Lesson: Ongoing training and professional development for staff and counterparts are essential for effective and coordinated processes towards successful implementation of the disaster loss database and DRR. Capacity development efforts for staff, government counterparts and implementing partners through technical advice, specialist training and re-training, should also be supported.

5.9 In-country Technical Support and Staffing

Technical support for the implementation of the databases in the target countries has been provided by the RP, and in-country by a range of variously skilled professionals.

Key Lesson: Multi-skilling of the personnel involved adds greater depth to the quality of the outputs, which involve knowledge of several disciplines. As such, a team effort is essential to bring together an all-round interpretation and profile of the data collected.

137. Examples of standard mapping functions, tables and graphs are presented in Section 5.14.

5.10 Customization and Local Adaptation

Customization and local adaptation are fundamental to implementing a sustainable database that meets the requirements of a particular country's needs. It also helps to ensure that the database becomes part of government systems and not a standalone one.

In the Tsunami affected countries, customization has included, among other things, changes to local language scripts, modification of definitions based on local understanding and types of disasters, and development of local manuals and different mapping functions.

Key Lesson: Without customization, databases could be a wasted investment. There is a need to provide support in customizing the database to meet the needs of the government, and to ensure that it complements existing government systems and requirements, so that at the end of the day it is actually used.

5.11 Need for Tools / Manuals

Standard tools and manuals are vital in the establishment of the disaster loss databases. The DesInventar manual (now version 7.9) has been updated and local manuals have been produced at the country level. A quick five-step guideline has also been developed by the RP.

Key Lesson: Locally customized manuals need to be developed with the target group in mind.

5.12 Advocacy Tools / Support

A number of standard advocacy tools have been developed at the regional level and localized at the country level. The greatest advocacy tool is the production of analysis from country specific database that meets the needs of government and is able to result in decision being made based on this knowledge.

The GIS and mapping function in taking samples of country specific database provides clear, visual examples for the development of local advocacy tools.

Specialist advisors from the RP can also advocate for disaster loss databases, and if requested, presentations can be made to governments on all aspects of the disaster loss database.

Key Lesson: More effort needs to be placed in advocating for the importance of disaster loss databases. Government should be provided with a better understanding of the use and benefits of a disaster loss database for DRR policy development, planning and programming.

5.13 Examples of the Use of DesInventar for Decision-making

As can be seen from the country specific sections above, the implementation of the disaster loss databases and the integration of the databases into government systems have not yet been fully achieved, although in countries such as Sri Lanka the process is very close to fruition.

The use of the information from the disaster loss database will only occur when the correct and complete analysis of data from within the database is undertaken and provides the government with the information they require to make decisions.

The importance of clear analysis is key to the institutionalization of the system, and this is based on the use of the information from the database by the government and other entities to make informed decisions. The Maldives, Sri Lanka and Tamil Nadu databases have all been used by the government and donors for generating information and reports detailing the impact of the Tsunami and other more recent disasters. However as an institutionalized tool supporting the development of government policy and decision-making, this has yet to be achieved.

5.14 Support / Specialist Technical Backstopping from RCB RP

The RP has developed substantial in-house expertise in DRR. This expertise includes not only the physical development of disaster loss databases but also the creation of an enabling environment required to manage disasters, the detailed technical knowledge of the system and experience in its customization.

For the Tsunami affected countries the RP has provided substantial financial support to the UNDP COs to recruit specialist staff, procure equipment and implement the activities associated with the disaster loss databases. This support from the RP has played a crucial role in the successful implementation of the disaster loss databases in the target countries.

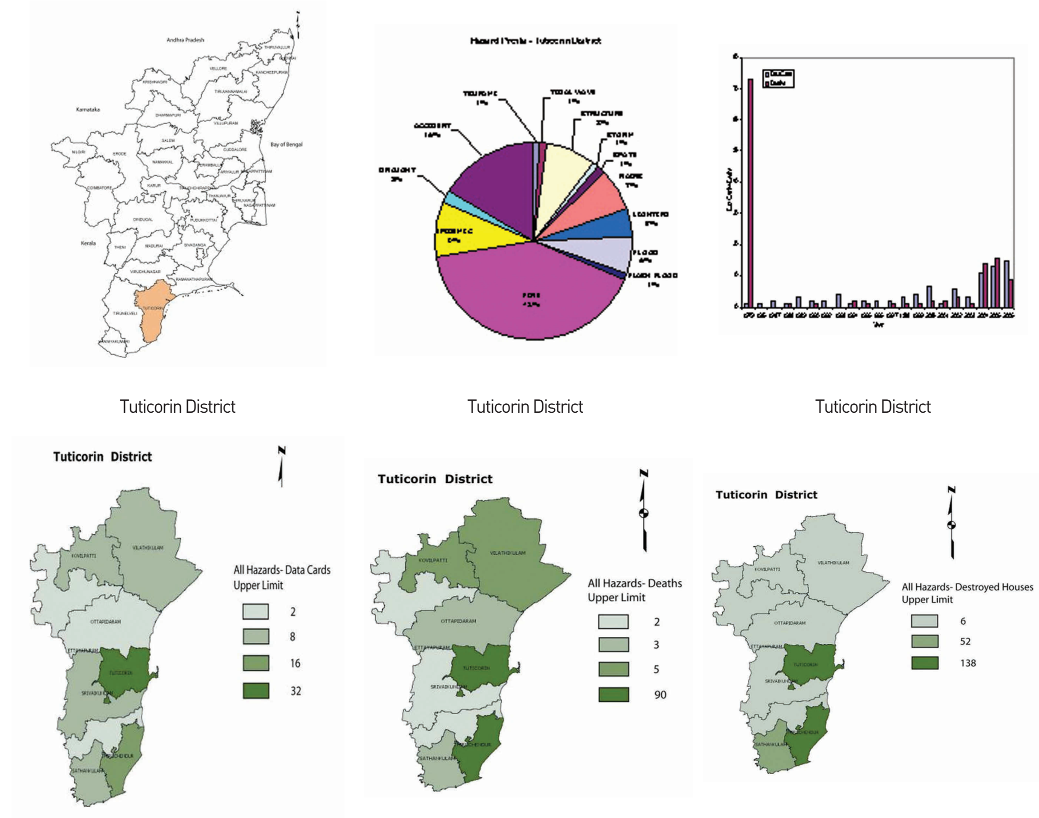
5.15 Mapping and GIS

The mapping function of the disaster loss database being implemented in the Tsunami affected countries has a strong interface. Digital maps can be imported into the disaster loss database using standard formats such as ArcView and Mapinfo.

Some knowledge of mapping (GIS) is required to import and adjust the maps within the database and can be done relatively easily; the Maldives, however, has had some issues as a result of the large number of islands/atolls and the distances between each island.

The GIS mapping function is a useful tool and a clear way to display information for analysis and advocacy purposes. The maps and charts in Figure 1 are taken from the Tamil Nadu database and are very much a standard function of the disaster loss database being implemented in all countries under the RP. They are an excellent way of presenting the data and analysis from the database.

There is also scope for the GIS components of these databases to be better integrated into the GIS/MIS systems of other UN agencies such as for food security and poverty mapping. The Vulnerability Analysis Mapping System of the World Food Programme has useful data as does the Food and Agricultural Organization, the United Nations Environment Programme and the World Bank with their in-country databases that could be linked to. Possible links or interfaces with other UNDP specific databases such as the Development Assistance Database would also provide interesting analysis.



Block	Data Cards	Deaths	Houses Destroyed	Houses Damaged	Affected	Evacuated	Losses in Rupees	Damages in crops Ha	Lost Catle
ETTAYAPURAM	1	1	0	0	0	0	0	0	0
KOVIPLATTI	8	5	0	0	0	0	650000	0	0
OTTAPIDARAM	2	3	0	0	0	0	0	0	0
SATHANKULAM	8	3	52	1	12	0	1900000	0	0
SRIVAIKUNDAM	6	2	6	4	32	0	808300	0	3
THIRUCHENDUR	16	11	138	7	0	60	1120000	0	0
TUTICORIN	32	90	66	8	15	350	158622000	0	0
VILATHIKULAM	8	4	0	0	38	92	600000	0	0
TUTICORIN DT	5	9	143	786	0	0	0	7140	2
TOTAL	86	128	405	806	97	502	163700300	7140	5

Figure 1. Maps and Charts Generated from Indisdata

5.16 Benefits of a Disaster Loss Database

The key benefit of a validated disaster loss database are without doubt that it empowers the host government to clearly identify and follow patterns of disaster risk, thus, contributing to the implementation of efficient and effective disaster risk management programmes and policies.

The populated database can identify disaster prone areas and destructive hazards by a number of different variables including financial cost (loss), damage to infrastructure, loss of life and many other variables depending on the customization of the database. The disaster loss database can also be used to monitor progress on DRR initiatives. For example, the impact of policies aimed at reducing the destruction of houses can be measured using the database. Based on information from the database, the governments are then able to prioritize future DRR activities.

6. Conclusion

Based on the experiences and lessons learned, guidelines have been developed by UNDP where two options are proposed for the implementation of disaster loss databases. The first option is its implementation within government. The second is a transitional option of implementation by a non-governmental organization endorsed by the government. The government-managed option is the preferred option but should only be selected when a number of essential conditions are in place relating to government's institutional arrangements and legislation. The second option involves the establishment of a disaster loss database 'outside' of government structures. Reasons for selecting the latter option could be that the government does not have policy frameworks in place to support the implementation and use of a disaster loss database and/or cannot see the full value in such an initiative. Both options follow five generic steps as follows:

Step 1 - Create an enabling environment for DRR
Step 2 - Find an appropriate 'home' for the database
Step 3 - Establish the disaster loss database within a DRR framework
Step 4 - Collect, enter and validate data
Step 5 - Conduct analysis, manage data and ensure sustainability

SEA-EAT Blog[138]

Peter Griffin

On 26 December 2004, South-east Asia was hit by a double tragedy; a huge earthquake off the Indonesian coast, followed by a tsunami that wreaked havoc on the coastlines of countries around the Indian Ocean. The death and destruction that those waters brought defied description. The world was shocked. And then came the second wave: a huge outpouring of concern, sympathy, desire to help, and a need for information.

With a disparate bunch of people from all over the world, most of whom I never knew before that day, most of whom I will probably never meet but who I now count as friends, I was part of an online initiative that started out as TsunamiHelp, and became the South-East Asia Earthquake and Tsunami Blog, known also as the SEA-EAT blog.[139] It took up large chunks of my waking hours until the end of January, and in many ways, big and small, changed my life.

This isn't a definitive account. It's a very personal view; half a narration of the events as I remember them, half an attempt to understand it better myself.

I had been blogging since late 2003, and in mid 2004, I began to develop a fascination with collaborative blogs. Caferati, a collablog[140] I set up for an online writers' forum I comoderate, had done reasonably well for itself. I was also one of Rohit Gupta's early invitees to the (now defunct) media watch blog, DesiMediaBitch. In mid-December, I had been helping Rohit and the other members invite guest bloggers from among India's neighbours to take part in this great idea that he came up with, to take DesiMediaBitch beyond the desi (local/indigenous): a week, starting 26 December, of exclusive bitching from across our borders, after which our guest bloggers would become permanent members. DesiMediaBitch

138. This case study is a reproduction of "Candle in My Window,"in Sarai Reader 06: Turbulence, (Eds: Monica Narula, Shuddhabrata Sengupta, Ravi Sundaram, Jeebesh Bagchi, Awadhendra Sharan and Geert Lovink) produced and designed at the Sarai Media Lab, Delhi and published by the Centre for the Study of Developing Societies. More information and free downloads at http://www.sarai.net/publications/readers/06-turbulence.
139. SEA-EAT: http://tsunamihelp.blogspot.com (blog) and http://www.tsunamihelp.info (wiki).
140. A portmanteau neologism I coined for 'collaborative weblog'.

morphed into Dogs Without Borders, which became Chien(ne)s Sans Frontiéres or just CSF, a tongue-in-cheek homage to Médicins Sans Frontiéres.

And then the tsunami hit.

As the news began coming in, I shuttled between TV in the living room and the computer on my desk; the extent of the disaster started to dawn on me. Part of me desperately wanted to do something, anything, to help. I considered heading south, but for a variety of reasons, partly financial, but mostly selfish and personal, that wasn't an option. At some point I realised that vast quantities of help would be needed, and that there really wasn't anything like a single repository for aid information that I knew of. Perhaps the best thing I could do would be to collate that information, put it all together in one place. It didn't occur to me to try this on my own. I didn't have the kind of reach or readership to have any useful impact, for one. And it was just too big a task for one person, anyway.

1. First Steps

Rohit Gupta (who, by the way, I had not met in person at that time) and I exchanged a flurry of SMSes and phone calls. He promptly agreed to join in. I quickly set up a blog on Blogger.com, a popular free web publishing service. I chose Blogger without really thinking about it too much. It was the only blog provider I knew of that permitted multiple contributors; and it was, thanks to Caferati and DesiMediaBitch, an interface I was comfortable with. Besides, it was pretty simple to use, and since it was popular, chances were that most of the people we contacted would know how to use it. I put up a placeholder post stating our broad intentions - later deleted - and we began hunting up information, while simultaneously carpet-bombing our address books to invite bloggers we knew to join in. Dina Mehta, an influential blogger (and another person I only knew online), was one of the first to jump into the effort.

Dina and Rohit both wrote for World Changing (WC),[141] a highly-regarded group blog. They both wrote about TsunamiHelp, as we called it then, on WC. One of WC's leading members in turn tipped off Boing Boing,[142] who linked to us. Around the same time, I had mailed Prem Panicker, Managing Editor at Rediff in the US (yet another online-only friend). Almost immediately, all Rediff's coverage[143] began to feature a link to our blog. Out of habit, I had plugged a Sitemeter[144] counter in to the blog. Suddenly, I noticed that the viewership had started multiplying: from the few hundred initial visitors that probably resulted from our mass mailings, to thousands every hour. Somewhere around then, we realised we were in the middle of something far bigger then we had imagined.

The next day, the New York Times and the Guardian in the UK had written about us, and put our URL in their articles. Shortly after, the BBC linked to us as well, listing us as a reliable resource. These and many other news organisations across the world cited us as an authoritative source for information.[145] The search giant Google put a tsunami aid link on their home page (unprecedented for them), and linked to us from their dedicated Tsunami page.[146] Later, through the efforts of one of our members who had friends working in Google (the owner of Blogger) we were guaranteed unlimited bandwidth, ensuring that the site wouldn't go down. And of course, bloggers and webmasters linked to us by the thousands too.

Traffic, as a result, was overwhelming: over a million visitors in the first eight days. Sitemeter, the provider of the free tracker I had installed, had to shut down our counter several times because the load was hampering their service to their paid clients. Our mailboxes were bombarded with offers to help, not just from people wanting to blog with us, but people asking how they could help directly.

There was much discussion in the group about what exactly we were trying to do, at times (as can happen even in the best-intentioned groups) at the cost of constructive action. To some of us it was clear that news organisations had the resources to provide much better hard news coverage than we could hope to. Wikinews, in its first real test as a news source, was doing a sterling job of newsgathering via collaboration[147] too. What was missing was a single place to find information about the NGOs and aid organisations working on the ground. The press was already referring to us as the leading clearinghouse for information on the victims of the disaster.

All this helped us hastily, but formally, define our task: collate news and information about resources, aid, donations and volunteer efforts. We set some ground rules: no politics, no opinions, steer away from controversy, just find out about and link to aid efforts.

Around then, because some of us felt that Tsunami Help as a name didn't encompass the earthquake which was the cause of the tsunami, we also formally changed the name of the blog to the South-East Asia Earthquake and Tsunami blog.

141. See http://www.worldchanging.com/
142. See http://www.boingboing.net/. Started in 1988 as "the world's greatest neurozine" and focused on cyberpunk subculture, developed into a website in 1995, then to an award-winning weblog in 2000.
143. For Rediff's dedicated tsunami section, see http://www.rediff.com/news/tsunami.htm
144. See http://www.sitemeter.com. Sitemeter is a counter that many bloggers and webmasters use to track traffic.
145. For press descriptions of the TsunamiHelp effort, see http://www.tsunamihelp.info/wiki/index.php/In_the_media
146. Google°Øs Tsunami relief page: http://www.google.com/tsunami_relief.html
147. Wikinews page on the earthquake and tsunami: http://en.wikipedia.org/wiki/2004_Indian_Ocean_earthquake

2. Adapt, Improvise, Innovate

The group self-organized very smoothly, with very little centralised control. Email addresses and phone numbers were exchanged via group mails and instant messengers. The Google Groups[148] mailing list I had attempted to start as a coordination mechanism was in limbo. I had invited too many people in a short period, so it went into automatic review for spam. Someone else started a Yahoo!Groups list,[149] which became the main channel for communication.

Thanks to the furious pace at which this very enthusiastic group was working, the blog had already become huge. Searching within all those posts was tedious for us, its creators; it would be much more difficult for a first-time visitor anxiously looking for something specific. Part of this was due to the limitations of the template we were using. We realised that while Blogger made collaboration by multiple contributors easy, it had serious limitations as well: no native way to classify or tag individual posts till date; and, at that time, no comment moderation or ways to avoid comment spam.[150] We worked around this by splitting the blog into sub-blogs with different focus areas. Teams took charge of each one, and began copying content from the main blog into Tsunami Enquiries/Helplines/Emergency Services, Tsunami Missing Persons, Tsunami News Updates, Tsunami Help Needed and Tsunami Help Offered. Meanwhile, a design pro in the team took charge, corrected my initial ham-handed efforts to tweak the design, and created a template that wasn't just much easier on the eye, but also organized the information far more efficiently.[151]

Someone suggested that a wiki[152] would be an even better idea, and perhaps what we should have done in the first place. But since so many organisations and individuals were already directing traffic to the blog URL, moving home would mean unnecessary extra clicks for visitors. Besides, not everyone in this blogger-heavy group was wiki-savvy. So, instead of replacing the blog with a wiki, we decided to make it a parallel effort. Initially, we created a wiki as part of Wikinews, but ran into disagreements with the administrators there.[153] To cut out the squabbles, Dina paid to register a domain name, tsunamihelp.info, Rudi Cilibrasi donated server space, and a team of wiki-adepts began work, copying, categorising and pasting content from the blog. Another team worked on creating a database of volunteers and volunteer efforts, based on all the requests and offers of help, a project which evolved into AsiaQuake.

Rather than everyone trying to do everything at the same time, the teams evolved sets of duties. Janitors checked posts and cleaned up typos, made sure links worked, that the correct info was going into the correct places, that unvetted or controversial things weren't going online. Monitors checked the various dedicated e-mail addresses we had set up and information that readers were leaving in the comments to our posts. Linkers made sure the data in the sidebar stayed current, after some erroneous and outdated coverage was discovered. Aside from e-mail, we also used Yahoo! Messenger for instant communication, both one-on-one and using its conference facility[154] to hold meetings. When inaccurate information about the effort began appearing in the media, a few of us who had experience in the field worked out a system for answering questions from the press. Those of us with the necessary contacts networked with NGOs to get information from the ground. Blogger's native search wasn't delivering well enough, so Pim Techamuanvivit paid for a professional search tool that we plugged in. Someone came up with the idea of using Flickr[154] and its tags to help the Missing Persons effort, and quickly set up a Flickr pool. A working-group page with presence indicators that keep track of things like who was doing what, and what needed to be done, was set up on space given to us by SocialText.[156] A translations group took charge of creating versions in other languages. Work on a database began alongside.

3. Pulling Together (and, Sometimes, Apart)

To this day, I haven't been able to figure out precisely how many people chipped in to help. Sure, you could tot up the numbers: the contributors listed on the blog's side panel; the IDs and IP numbers on the wiki; the subscribers to the newsgroup. You'd wind up with a number over 200 ... but that's just part of the story. They came from everywhere, Asia, Europe, North America, South America, Australia (I don't recall too much African traffic, strangely enough) connected only by the web. They included veteran bloggers, geeks, poets, lawyers, executives, academics, teenage students, foodies, lit-lovers, database wonks, wiki fans, cooks, stay-at-home moms, designers, artists. They mailed in information, they blogged, they linked, they commented, they wikied, they copied, pasted and sorted data, they put

148. http://groups.google.com/group/TsunamiHelp
149. http://groups.yahoo.com/group/seaeatvolunteers/
150. Comment spam includes machine-generated spam crammed with links to commercial sites. Many popular blogs are plagued by this.
151. For the depth and detail of just one aspect of Megha Murthy's redesign of SEA-EAT, see http://www.meghalomania.com/expand-collapse-script-for-blogger-blogs/
152. A wiki is a website that allows the easy creation and editing of any number of interlinked web pages via a web browse
153. For details, see http://balaspot.blogspot.com/2005/12/how-my-life-changed.html
154. Yahoo!Messenger lets multiple users text-chat simultaneously. We used this like a conference room, staying logged in, but also chatting one-on-one in private windows. http://messenger.yahoo.com/
155. Flickr is a photo-hosting site (then comparatively new) that permitted tagging of pictures, group pools and a degree of social networking. http://www.flickr.com/
156. For the workgroup page, see http://www.socialtext.net/tsunamihelp/index.cgi?who_s_doing_what

their lives on hold and put out their hands to do what they could. Miraculously, each time we needed something done, someone stepped up with the knowledge and expertise, and just did it. Solutions were improvised - like the sub-blogs and the Flickr page - and somehow, it all worked.

Over multiple chat windows we kept each other motivated, encouraging - nay, ordering - one another to get some sleep, some food, some relaxation, while ignoring similar exhortations directed at ourselves.

But it wasn't all good vibrations. With the frenetic levels of activity and stress, there was bound to be some friction.

There were frayed tempers, misunderstandings, and a couple of blow-ups. A potentially interesting offshoot, ARC (Alert Retrieval Cache),[156] which posted SMS text messages to a web page, unfortunately sustained collateral damage in one of the two major interpersonal conflagrations that hit the group. The other flare-up happened because the group was being harried by one person's needless barrage of e-mail. Instant decisions had to be taken, and certain steps were made, which resulted in some unpleasantness that still hasn't quite gone away. In a more amicable parting of ways, a few bloggers separated to run a blog that followed the same model but also included political comment and opinion.[157] Overall, it was difficult to know where to draw the line between gently reining in over-enthusiasm and curbing efforts by some members to promote their own agendas. I'll wager we erred on the wrong side of that line as often as not.

And resentments, yes. In the midst of a related initiative, long after January, Dina and I discovered that some people thought we were hogging media attention to further our own consultancies. For the record, Dina is a researcher and ethnographer, I'm essentially a writer for hire. Neither of us consult on blogs, and most of the people we consult for still haven't a clue what a blog is. What's important, however, is that these resentments didn't surface at that point. Work continued uninterrupted, quality kept getting better. What kept us going was the knowledge that in some small way, we were helping. Many of us were spending all our waking hours online, and getting very little sleep when we did take a break. The baton was passed from hand to hand across countries, continents and time zones.

No single person was indispensable - willing hands took up the slack whenever someone had to leave. I remember blogging until my taxi arrived at the door, packing my laptop, bandaging a bleeding thumb en route (I had sliced it on a razor while I was cramming things into a haversack) and getting to my Delhi train just in time. By the time I next logged on 18 hours later, in the home of my friends Devangshu, (DD) and Nilanjana, so many developments had taken place that I never really caught up or caught on. One just assumed that things had been taken care of. In the inbox of the e-mail address I used for the group, some 300 unread messages from the mailing list still stare accusingly at me. And that's after clearing out roughly 400 in several instalments.

Food? Ignored. Sleep was a dispensable luxury. People turned party invitations down without a qualm (it didn't seem right for me, I know, to celebrate the New Year; I'm sure others felt the same). People apologised profusely for the time it took to move from a work PC to a home PC. Work itself was neglected: for those of us who worked on our own, as freelancers and entrepreneurs, it meant non-working (i.e., unpaid) time. For the ones holding down jobs, it meant juggling everyday tasks with the SEA-EAT effort. I remember InstantMessaging our designer about the blog not showing up properly on one browser. "Give me a minute," she said, "I just have to tell someone to go away." An hour of painstaking tweaking (on her part) and wailing (on mine) later, we had sorted it out. "Who was that you shooed away?" I asked her. "My boss," she typed back, adding a smiley. Another member excused himself briefly as midnight came around on 31 December. He was back in a very short while. He'd just popped up to raise a toast to the New Year with the folks in his apartment, and was back at his computer in minutes. One member quietly and calmly took over the tech coordination when others burned out. Another spent huge amounts of time online though she had to make crucial preparations for on upcoming wedding - her own! Another didn't sleep for several days, fuelled only by rice, coffee and adrenaline.

I can't speak for the offline support other people got. I know I got plenty. DD and Nilanjana kept thrusting plates of food and mugs of coffee into my hand, letting me hog their broadband connection while they shared the other PC and the dial-up. Quiet calming encouragement from them and from Annie. Their toleration of my whining and angst when things were getting tense. Nilanjana telling me about explaining the blog to her grandmother in Calcutta: the lady looked at the screen in silence for a few minutes, then got on the phone to all her friends, telling them, "We can't let these youngsters do everything!" Those elderly ladies then organized collection drives, doing the grande dame thing with hapless club managers and the like to get donations. Nilanjana and DD again, calling up their friends in the Indian media - with a few honourable exceptions, most had no clue that this thing was going on in their backyard, so to speak - to clue them in, then helping me condense this new, rather exotic concept into media-friendly morsels. Friends sent supportive SMSes, mailed in links. These things stayed with me.

4. The Chien(ne)s Sans Frontières Effort

Side by side, another enormous effort was taking place. Some of the bloggers of Chiens Sans Frontieres Effort, CSF, the blogs-across-borders week forgotten, were blogging, mailing and SMSing from the frontline. Dilip D. Souza was mailing in practical advice from Tamil Nadu: don't send clothes, they're lying in piles on the roadsides. Four young men in Sri Lanka,

156. ARC's current status can be checked at http://www.socialtext.net/tsunamihelp/index.cgi?arc
157. Progressive Tsunami Help: http://progressivetsunamihelp.blogspot.com/

three in their teens, one barely out of them, were witnessing what no human being should have to - devastation, morgues, identifying corpses, burials in graves they helped dig. They spoke passionately of aid not getting to where it was needed, of corruption and inefficiency. One of them, Morquendi (an online handle, since I haven't been able to get his permission to use his real name) and I chatted online for hours one night, the matter-of-fact text of his IMs detailing the political games that were being played, the risks he and his young friends were taking, the things they were seeing. He was worried about them. They're so young, he said. How old are you, Morq, I typed. 23, he wrote back. I brushed away tears several times that night, not for the first time in those weeks.

5. Hindsight

Did we do any good? Did we meet our own expectations?

Frankly, we didn't have a formal agenda when we started. We just did the best we could, as we saw it then. Some people donate money. Others send clothing, food, medicines. Some go to the affected areas and volunteer. We had web expertise, we knew how to look for information, how to make it user-friendly, we had networks. That's what we could give, and we did. My friend Nilanjana Roy put it into words for me. She said, "It was your way of putting a candle in your window to show that you cared."

Did we change the world? Did we make a significant difference? In small ways, I do believe we did. Looking back, we know we were able to help. From the emails, the traffic counter, from the links to us from global news organisations and blogs, we infer that we were able to provide valuable information at a time when it counted. Together, we created a little bit of Net history, created a model for online collaboration that did the job. A model that we, or others, can refine (and have done so) and make more effective.

6. Going On from There

Some of the TsunamiHelp team continued to stay in touch, to build friendships on the strength of that month of working together. We debated the creation of a formal organization, of documenting processes, but for most of us, we'd neglected the rest of our lives for too long, and the process of catching up meant that these thoughts fizzled out.

I had begun to think that SEA-EAT was a one-off, but I was relieved to see that when there were a couple of subsequent earthquake scares in the region, many of the team, alerted by the newsgroup, immediately got back in touch and began updating the blog and wiki.

Then, on 26 July 2005, north Bombay was hit by 944 mm of rain in one day; what the weather people called a 'cloudburst'. Much of the suburbs stayed flooded for days. People were stranded in offices or on the roads. Residents of ground-floor flats found themselves with almost all their possessions unsalvageable. Many lived through days of water logging, no electricity, no phones, but plenty of anxiety. In the aftermath, a group of city bloggers, with a bunch of friends from other parts of the world, began to put together two blogs. Mumbai Help focused on creating a resource that would be useful not just in the immediate situation but for future reference as well. Cloudburst Mumbai was more specific, concentrating on information about the flooding, news reports, aid efforts and the like. Both blogs got respectable readership, though nothing close to the SEA-EAT figures. Out of these efforts, some of us, plus a few other like-minded folk, started up an initiative called ThinkMumbai, to look at some of the city's deep-rooted problems, and to provide some aids for future difficult times. That effort went into a long hiatus, but a few of us are in the process of reviving it this year.

In late August 2005, Hurricane Katrina smashed its way through New Orleans. Several days before that, as it became clear that Katrina was very likely to hit the coast, some members of the SEA-EAT team had swung into action. There was a blog, but it was incidental. Based on the SEA-EAT experience, the team made the wiki the focus of their efforts. And that wiki logged a million visitors in two days. Of course that's largely due to the fact that internet penetration in the US is of a completely different order of magnitude, and this disaster was happening in their own backyard. The team used the database methods earlier put to use to match volunteers and NGOs to assist in projects, such as a People Finder and a Shelter Finder. They also came up with fresh ideas, such as creating and using a local Skype[158] number as a call centre, manned by shifts of volunteers in three continents.

In October 2005, an earthquake near the India-Pakistan border in Kashmir resulted in major losses of life and property. Again, many members of the SEA-EAT and CSF teams, plus others from the MumbaiHelp effort, got together to try and help out. With the remoteness of the area, and the consequent paucity of information, the team went back to a blog as the centre of the effort. An attempt to create a system where SMSes could be sent direct to a blog didn't work out.

In December 2005, Bala Pitchandi and Angelo Embuldeniya came up with the idea of a memorial week that would try and bring the world's attention back to the victims and survivors of the year's disasters, a campaign that got a lot of support across the web. Around the same time, the group decided that starting a new blog or wiki each time something bad happened wasn't the best way to approach this. That meant establishing credibility and search engine rankings each time. We decided to bring it all under one umbrella, and we now call ourselves the World Wide Help (WWH) group. The methods we follow are to post alerts and warnings to the WWH blog (and by now, with our links to NGOs, world bodies and relief agencies, we're able to keep tabs on potential crises pretty efficiently); and if a situation looks like becoming a major disaster, we then look at creating a focused resource.

158. Skype is a Voice Over Internet Protocol provider. The service lets you make calls not just from Skype user to Skype user, but also to and from landlines. http://www.skype.com

We used the WWH blog during the floods in Suriname in May 2006, with a combination of news reports, translation efforts, on-the-ground reporting, and information from relief organisations.

This July, around the time I was revising my draft of this essay, seven bombs planted by terrorists went off in Mumbai local trains during the evening rush hour, killing 181 commuters and injuring another 890. The city was in chaos; suburban trains on the Western Railway line were obviously not running. But road traffic was jammed too, at a standstill. Phone lines were jammed - as rumours and panic spread, everybody seemed to be trying to call everyone else at the same time. Networks couldn't take that load, naturally, so huge numbers of people got no information whatsoever, which only fuelled the confusion. Family and friends in other parts of the world frantically trying to make sure their loved ones were safe only added to it. Some of us turned to the web for answers, and MumbaiHelp came back to life, with a flurry of e-mails, first-person reports on road conditions, hospital numbers, and more.

And, just in case I had begun to think I was becoming a bit of a guru on this online relief thing, my collaborators taught me something new. One post, titled "How can we help you?" got a few hundred comments that night. It became a de facto forum, with people leaving names and phone numbers of their relatives, and others popping up to make calls, send SMSes and confirm that yes, your brother, your friend, your aunt, was indeed safe.

7. And So We're the Best Thing That Happened to the Web, Right?

I've heard talk about how SEA-EAT and subsequent efforts have outdone big media. I don't believe a word of that. It is a fact that we did get a lot of attention, and that, ironically, was thanks to media coverage of some of the things we did. Did we supplant big media, do their jobs? Heavens, no. Our biggest successes in terms of traffic were SEA-EAT, which got a million viewers in about eight days, and the Katrina wiki, which got that much in a day. For the big media sites, those figures are peanuts. None of them is trembling in fear of bloggers yet, I'll wager. Citizen journalism, even the segment that WWH specialises in, online relief aid, only supplements the efforts of the media, of formal relief agencies, of government bodies.

But here's the thing. There was a week on the cusp of 2004-2005 when 1 million people didn't find what they wanted anywhere else. When Katrina hit, a million others couldn't find the information they needed elsewhere that day. When the bombs went off in the Mumbai local trains, 40-50,000 people didn't find what they were looking for in the media. We were able to reach out a hand to them, in our small way. We lit our candle, and showed we cared.

Author's Note

I earn my living as a writer and communicator, and I can get pretty evangelistic about blogs, but for the longest time, I was unable to write about SEA-EAT. I talked about it a lot to friends, answered e-mails from researchers and students, was even interviewed about it several times. But I was never able to write about it. I really don't know why. Until a friend/fellow blogger and journalist/contributor to SEA-EAT, Jai Arjun Singh, who was writing an article for a national newsmagazine, mailed me a few queries as part of his research. As I sat down to reply to him, suddenly the words broke free. I spent the next few hours hammering away at the keyboard, referring back frequently to archived e-mails I had written to journalists who'd asked questions.

Acknowledgement

Nilanjana S. Roy kept pushing me to write this text, despite my natural laziness. Jai Arjun Singh provided the trigger I needed, with his incisive questions. I referred to posts by Dina Mehta and Bala Pitchandi to check on my recollection of the sequence of events. Dina and Bala, Megha Murthy, Neha Vishwanathan, Nilanjana S. Roy and Devangshu Datta critiqued this account for me at various times and gave me their opinions, invaluable in fine-tuning it from the first disjointed scribbles. Shuddhabrata Sengupta gave me the extra impetus to actually complete this by giving me the opportunity to write for this year's Sarai Reader. And every member of all the collaborations I've been part of helped me understand the process a little better, while we helped each other refine, modify and make more useful, often on the fly, a very raw, untried concept.