



Information and communications technology for disaster risk reduction

Extreme weather conditions and natural disasters are taking an increasing toll, in both human and economic terms. The international community, having realized the gravity of this ominous trend early on, adopted the Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters. In the Framework, countries agreed on actions to reduce the loss of life and the socio-economic and environmental impacts of disasters, including identifying, assessing and monitoring disaster risks and enhancing early warning, as well as strengthening disaster preparedness. Globally, 2008 was the third most expensive year on record in regard to disaster-related economic damage. In the Asia and the Pacific region, 2008 was marred by Cyclone Nargis, which devastated the Irrawaddy Delta in Myanmar and killed an estimated 130,000 people, and the earthquake that struck Sichuan Province in China, which affected millions and left more than 85,000 dead. In terms of deaths, Cyclone Nargis ranks among the worst five cyclones, and the Sichuan earthquake among the worst 10 earthquakes, since 1900.

It is widely recognized that information and communications technology (ICT), including space-based technology, plays an important role in establishing effective early warning systems and successfully

conducting emergency preparedness and response activities. Aimed at policy- and decision-makers from developing countries working on disaster risk reduction in the Asia and the Pacific region, this policy brief discusses useful infrastructure and applications and recommends actions on how to mainstream and enhance their use in disaster risk reduction efforts, in particular with respect to early warning systems.

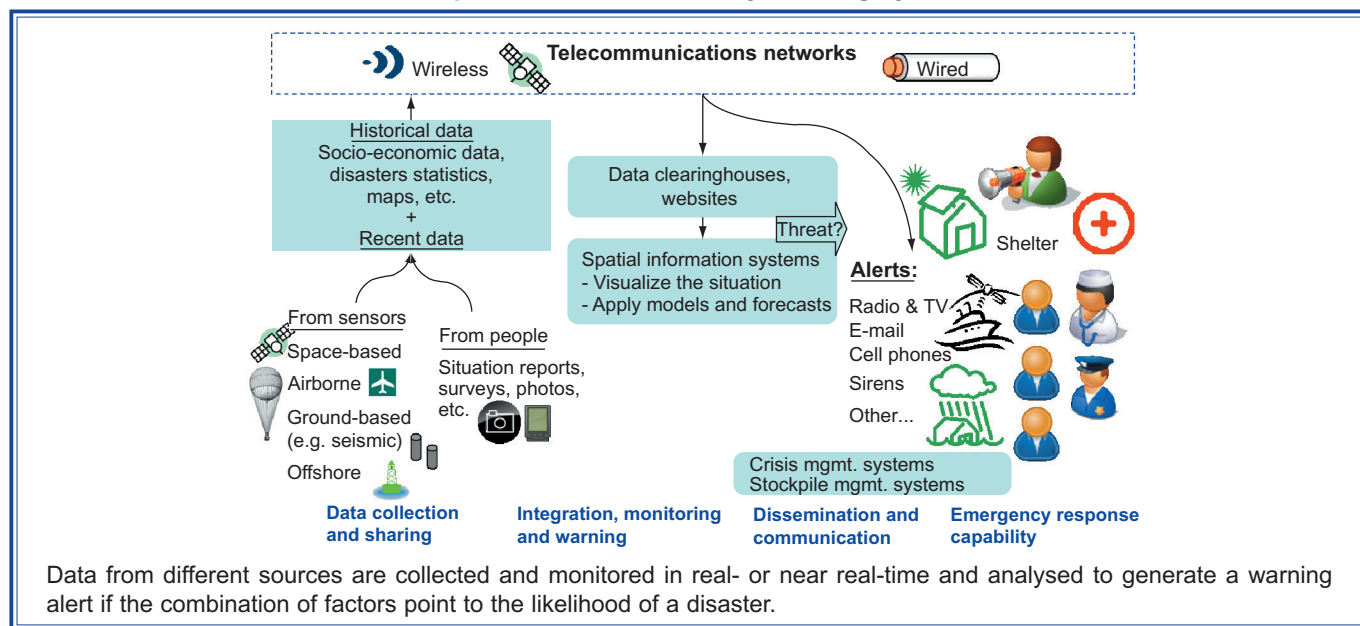
ICT tools for early warning systems, emergency preparedness and response

The main functions supported by the tools presented in the present policy brief include the following:

- Information collection and sharing
- Decision support systems, through the integration of geo-spatial data
- Communication and dissemination
- Emergency preparedness and response

A simplified model of an early warning system is provided in the figure.

Simplified model of an early warning system



Information collection and sharing

A number of ICT tools are available to help systematically collect data and undertake risk assessments so that the behaviour of hazards and the socio-economic vulnerabilities of communities can be better understood. These tools can be offshore (tsunami buoys), ground-based (automated hydro-meteorological observing systems, broadband seismometers, portable digital cameras and electronic handheld devices), airborne (lidar) or space-based (optical and radar satellite remote sensing, global positioning systems); all are used to acquire data for various types of hazard monitoring and at different stages of disaster risk management. For example, the World Meteorological Organization collects data through more than 20,000 manned and automatic weather stations in order to monitor hazards. Processed satellite images of affected areas for damage assessment and disaster response can be provided by other global and regional initiatives, such as the International Charter on Space and Major Disasters and Sentinel Asia, in the event of major impending disasters and upon the request of countries.

Stakeholders in disaster risk reduction began collaborating with each other through national and regional multisectoral mechanisms, with the objective of sharing knowledge and tools for improving access to information and implementing measures of disaster risk reduction. This is increasingly done through the Internet, using data clearinghouses, informational websites, document depositories, discussions forums and communities of practice (for example, PreventionWeb). It is important to establish international standards for describing data (metadata) to enable the practical usage of the data that are made available.

Decision support systems

Promoting synergies in hazard monitoring and risk identification through the functional integration of scientific and technical organizations working in meteorology, geology and geophysics, oceanography and environmental management, among other fields, has been identified as a key action towards reducing disaster risks. It is equally important to reflect socio-economic perspectives in the process. Relevant organizations should have the capability to integrate hazard and risk information, as well as to identify and monitor the parameters influencing the hazards, and should have access to decision support tools.

Decision support tools include spatial information systems designed to assist in integrating and analysing vast amounts of historical and real-time data and in displaying the data in user-friendly ways. Geographic information systems can superpose multiple layers of spatial

information derived from the processing and interpretation of remotely sensed data (such as land use and geomorphology) with other geographical and cartographic information (such as elevation and slope). This information can be linked to statistical databases (for example, those with figures on population density), resulting in maps on which high-risk areas can be matched with the socio-economic features of the society.

Countries in the Indian Ocean receive international tsunami warnings from the Pacific Tsunami Warning Center and the Japan Meteorological Agency, which use decision support systems to forecast whether an earthquake may cause a tsunami. These tools are also useful to policy- and decision-makers addressing issues such as unplanned and poorly managed urban growth, rural poverty and vulnerability, and declining ecosystems, which together have been identified as the drivers underlying the increase in disaster risk.

Communication and dissemination

Voice and data communication continue to be of crucial importance in the context of disaster management. Some tools, such as traditional radio and television, are ideal for one-way mass communication, as they have high penetration rates in most countries. Other types of radio tools, such as community, amateur, shortwave and satellite broadcasting, are also suitable for transmitting information for universal coverage. The Internet, e-mail and mobile telephones are becoming increasingly important broadcasting tools. Cellular phones provide mobility, two-way communication, location-based services and privacy. As more poor people in many developing countries of Asia and the Pacific obtain access to such phones, special attention must be given to making new content and early warning alerts suitable for these devices.

Emergency preparedness and response

National and community disaster preparedness and response capabilities should be developed by all levels of government as well as by communities. In addition to planning for adequate evacuation routes, emergency shelters, and emergency stockpiles of food, water and medicines, efforts must be made to ensure redundant and reliable communication systems, as well as efficient operating procedures in and reports originating from disaster-affected areas. Such critical infrastructure, facilities and communication systems can be developed using ICT tools, including those that are space-based.

Risk assessment maps, generated by geographic information systems, play a critical role in determining

safe locations for emergency shelters and evacuation routes. Disaster management systems and field reporting mechanisms are key tools for understanding and managing relief and recovery activities, including the relocation of people and the management of the logistics for food, fuel, water, medicines and other critical assets. This logistical information should also be linked to spatial information systems, enabling disaster managers to visualize on a map the correlation of disaster damage and casualties together with the available and needed facilities and supplies.

Another essential tool for disaster response is emergency communication. Emergency communication operating procedures and equipment must be established and made available to various actors involved in disaster response. In an emergency situation, these actors must have reliable and redundant communication channels, as some forms of telecommunications infrastructure may be damaged by extreme disasters. Emergency communication should consider such requirements as: (a) enabling the relevant actors to continuously report from within the disaster areas; and (b) maintaining their access to information sources, such as meteorological reports, at all times. Pre-established crisis situation centres should be equipped with crisis management systems to handle the command and control of rescue teams.

Challenges in the use of ICT for disaster risk reduction

Lack of data and information sharing. The data and information needed for disaster risk reduction come from a wide variety of sources which often are not shared or integrated in a way that facilitates timely and accurate decision-making in a disaster situation. This is further complicated due to the differences in standards used for data collection and classification within national boundaries, as well as between neighbouring countries in the case of trans-boundary disasters, creating difficulties when users attempt to access and analyse data. Some countries lack historical records about 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 (metadata), which makes it difficult to compare data among regions.

Insufficient human and institutional capacity. Policymakers working on disaster risk reduction may be aware of the potential that ICT tools may hold for their work; however, there may be a lack of skilled staff to analyse and interpret data for evidence-based policy- and decision-making. Also, national disaster risk reduction entities may lack the institutional arrangements that would enable them to mobilize sufficient human and material resources to benefit from ICT, or to obtain such resources from other countries or institutions in the region through cooperation or assistance mechanisms.

Lack of connectivity and unreliability of telecommunication networks. The flow of information in an early warning system often originates from global or regional sources (for example, meteorological and seismic data), and needs to reach, through a national centre, local authorities and ultimately people in their communities. Therefore, it is critical that all the stakeholders in an early warning system have access to communication tools that enable them to fulfil their role in a timely and cost-effective way.

In the event of severe disasters, connectivity in many countries fails. Moreover, developing countries, particularly the least developed countries and small island developing States, have frequent power outages and possess unreliable telecommunications networks that offer only low connection speeds, both nationally and internationally. Outdated or insufficient equipment supporting the telecommunications backbone as well as the user terminals, such as television, radio and personal computers, contribute to this problem. These conditions may result in average citizens and emergency response teams being incapable of receiving early warnings or achieving their objectives, if the communication infrastructure on which they depend is affected or rendered unavailable by a natural hazard or other reasons.

Policy recommendations

The successful implementation of ICT applications, including those that are space-based, for disaster risk reduction requires an enabling environment which fosters the development of ICT infrastructure, capacities and institutional arrangements. Despite the increasing awareness and availability of resources for disaster risk reduction, and the affordability and reach of ICT to previously unconnected communities, it would be unrealistic to expect everything to be put in place soon. In the meantime, it is important for developing countries to leverage the available ICT resources and services, while prioritizing and planning the mainstreaming of ICT in plans, efforts and initiatives related to disaster risk reduction.

The ESCAP secretariat recommends the following areas of policy intervention pertaining to the issues and challenges raised above.

Information collection and sharing. National data collection, standardization and sharing procedures and guidelines should be established for collecting environmental and social 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. To obtain urgent space-based information for response and early relief activities,

countries could seek support from global and regional initiatives, such as the International Charter on Space and Major Disasters, and the Sentinel Asia project.

Capacity-building. Countries should develop human resources and strengthen the capacities of institutions to integrate and make use of ICT applications, including those that are space-based, for effective disaster risk reduction and disaster management. Countries should seek to leverage available ICT resources and services that are available regionally and globally by joining cooperative mechanisms and capacity-building programmes for disaster risk management, such as: (a) the ESCAP Regional Space Applications Programme for Sustainable Development; (b) the Asian and Pacific Training Centre for Information and Communication Technology for Development, an ESCAP regional institution; and (c) the United Nations Platform for Space-based Information for Disaster Management and Emergency Response, executed by the United Nations Office for Outer Space Affairs. Tsunami-prone countries can seek support from sources such as the Tsunami Regional Trust Fund in order to strengthen their multi-hazard early warning capacities, as part of the efforts towards a regional early warning system for tsunami and other hazards.

Additionally, countries should establish or strengthen agreements with other countries and institutions in their subregion to provide institutional support and share ICT resources (such as equipment, including the expertise required to use the equipment), which may be too costly for a single developing country to acquire and maintain.

Reliable connectivity. Governments should implement policies and regulations to provide universal access to ICT services, reaching users located in un- and underserved areas. Policymakers should identify the hazard-prone areas that are home to the highest numbers of unconnected people (lacking radio, television, telephones and/or Internet), and take immediate action to provide these areas with at least the minimum service required to communicate awareness campaigns, early warnings, and emergency response information. In particular, policymakers may consider encouraging investment in wireless voice and data networks, as they offer opportunities for poor rural areas to achieve connectivity rapidly and cost-effectively, as can be demonstrated by the continuous growth in the adoption of mobile telephones.

In the immediate term, policy- and decision-makers should maximize the use of the most widespread technologies in their country, such as radio, television,

satellite television and mobile phones, and establish partnerships with the operators of those networks in the private sector, as well as with civil society and mass media, to ensure that they cooperate fully with government in all disaster risk reduction and disaster management activities.

As emergency response teams and early warning systems rely on telecommunication networks, such networks should be designed to be available at all times and should have a backup service in case of failure. They should be tested frequently and treated as critical national infrastructure. However, funding the large investments required by such activities can be difficult, particularly so in the midst of the current economic crisis, given competing development priorities. Insufficient investment in early warning capacities is a significant challenge. As recommended by the Global Platform for Disaster Risk Reduction at its second session, Governments should implement policies which enable the mobilization of national development funds to risk reduction measures. This could help to: (a) extend the reach of communication networks to underserved areas; (b) ensure the reliability of such networks; and (c) reduce the price of telecommunications equipment and user terminals, such as computers and cellular phones. Such policies may include establishing Universal Service Obligation Funds, providing tax waivers for the import of equipment, and promoting the use of free and open-source software. Policymakers should also support the implementation of stand-by systems for regional and subregional emergency communications, which can be shared among participating countries during emergencies.

For further reading

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