Welcome

I would like to warmly welcome you to Bonn, the UN City, for the Third International Conference on Early Warning (EWC III). I am delighted that the United Nations has assumed patronage of this conference.

The many serious natural disasters last year brought home to us all in a dramatic fashion that natural disasters can happen anywhere and anytime and that no country can be certain that it will not be hit. They represent a considerable threat to the whole of humanity.

The world was made aware of the importance of early warning against natural disasters when the tsunami devastated large parts of South and South-East Asia at Christmas 2004. A functioning early warning system would have alerted people and saved countless lives. Germany has long been a strong advocate of early warning and has acquired an excellent international reputation in this field. Consequently, the German Government is supporting, among other things, the development of a tsunami warning system in the Indian Ocean.

However, we can only effectively counter the global threat posed by natural hazards within a multilateral framework and with a long-term strategy. We are cooperating closely with the United Nations and its member states to tackle this enormous challenge together. Germany has already hosted two conferences on early warning. In 1998, scientists met in Potsdam at the invitation of the Federal Foreign Office and the GeoForschungsZentrum. The Second International Conference on Early Warning (EWC II) was held in Bonn in 2003. It focused on translating early warning knowledge and research into actual policy formulation. These conferences have shown that a regular and intensive exchange between scientists and politicians is crucial for effective early warning.

This year's conference aims to build on the experience gained in the past and, at the same time, highlight concrete ways of promoting early warning against natural hazards. Scientists, experts and practitioners in the field of early warning have devised more than 100 projects, which will be

presented at the conference. Guided by the motto "from concept to action", they will discuss them together with policy-makers. The aim is to draw up concrete proposals as to how existing gaps in early warning systems can be closed.

The success of early warning depends heavily on the effective involvement of the media, which therefore has a special responsibility. Without it, it would be impossible to issue a warning rapidly and to provide the largest possible share of the population with information. Moreover, well-grounded media reporting offers a great opportunity to inform the public and policy-makers of the considerable technological possibilities in this field and to make them aware of the necessity of effective early warning.

I am therefore particularly pleased with your interest in this conference. I wish you a stimulating time in Bonn and look forward to your reports and articles.

Frank-Walter Steinmeier
Federal Minister for Foreign Affairs of Germany

Welcome

The tsunami that struck countries around the Indian Ocean at the end of 2004 drew world attention to the devastating effects of natural hazards. Coming only weeks after that tragedy, the January 2005 World Conference on Disaster Reduction (WCDR) in Kobe, Japan was a momentous opportunity for the international community to map out a plan of action for the next decade. The Hyogo Framework for Action has been recognized by governments and international organizations alike as a solid basis to address the complex issues of disaster risk reduction.

Early warning and preparedness are critical in preventing natural hazards from turning into disasters. We welcome and are grateful for the German government's initiative to convene a Third International Conference on Early Warning, coming after the two previous conferences held in Potsdam and Bonn that focused on scientific and policy aspects of early warning. As part of the implementation of the Hyogo Framework, the Third International Conference on Early Warning in Bonn will translate concepts into action: the conference is an opportunity to highlight, through the presentation of projects in the field, the importance of early warning mechanisms, good practice and governance.

The media play an important role in reporting on disasters but also in explaining how they can often be mitigated or prevented. I encourage journalists and correspondents to draw from the debates in this conference material for their own work as part of the early warning chain – and contribute to making the world a safer place for all. I should like to thank you in advance for your commitment to this endeavour.

Jan Egeland
Under-Secretary General for Humanitarian Affairs

Outcomes

Third International Conference on Early Warning: Expected outcomes

Early warning and preparedness are critical elements in preventing natural hazards from turning into disasters. The approach chosen for the EWC III is on translating concepts into action: the Priorities and Projects Forum will highlight, through the presentation of projects in the field, the value of early warning mechanisms and the importance of good practice and good governance.

The outcomes of the Third International Conference on Early Warning are intended to serve as reference for practitioners and for future work in the early warning area, placed in the institutional context of the Platform for the Promotion of Early Warning (PPEW).

One of the key outcomes of the EWC III will be a checklist of good practice or actions to assist countries in developing effective people-centred early warning systems. The document will be a simple checklist of key elements, actions and good practices that national governments or community organizations can refer to when developing new early warning systems, evaluating existing arrangements or simply checking that procedures are in place. Practical examples and case studies, drawn from both the conference and the broader community, will be used throughout the document to further illustrate key points of good practices. The checklist is not intended to be a comprehensive or exhaustive 'how to do' list for the design of early warning systems, but instead will be a practical, non-technical reference tool that will help with the "last mile" notion of ensuring early warning actually delivers safety.

Another outcome of the conference will be the catalogue of early warning projects, a direct result of the call for proposals and of the project-oriented approach chosen for the conference itself. This compendium will include all projects that have been retained by the review group and considered as useful for the development of early warning. It will be circulated at the conference to trigger donor interest for funding purposes, and after the conference will be administered by PPEW, as part of its regular functions. Consideration will be given, in due course, to the establishment and institutionalisation of a permanent, inter-agency Early Warning Project Review Board. This would be a coordination body, quality monitor and caretaker of a structured systematic approach to filling the gaps identified by the Early Warning Survey. In a way, this would be a long-term institutionalisation of the EWC III project selection process.

EWC III will also be the opportunity to launch the Global Early Warning Survey and advertise the results of the survey. This will be used as a basis for the illustration of gap-filling measures.

Overview

Why a Third International Conference on Early Warning?

The EWC III follows two previous conferences hosted by Germany in 1998 and 2003, that firmly established the importance of early warning as a core component of any effective prevention strategy, and prescribed the way ahead for the international community. More recently, at the World Conference on Disaster Reduction in January 2005, top policy makers and experts agreed on the Hyogo Framework for Action 2005-2015 *to build the resilience of nations and communities to disasters*. This task has never seemed more urgent than now, against the backdrop of the Indian Ocean tsunami, hurricane Katrina, the Pakistan earthquake and a string of other dramatic natural events causing disaster in many parts of the world.

True to its motto 'from concept to action,' this Third International Conference on Early Warning aims to serve as a catalyst for the conceptualization, funding and implementation of concrete early warning projects, with a view to putting into practice the Hyogo Framework for Action. This effort is directly related to the UN Secretary-General's call for 'warning systems to cover all countries and all hazards' as well as to recommendations issued by the G8 summit at Gleneagles in July 2005 and the 2005 World Summit in New York.

When and where will the EWC III be held?

The Conference will take place from 27 to 29 March at the International Congress Centre ('Bundeshaus') in Bonn, a modern glass and steel building that housed the former German Federal Parliament. The International Congress Centre is in the heart of the former government quarter of Bonn and in the adjoining historic 'Wasserwerk' building that was the provisional seat of the German Parliament from 1986 to 1992.

Who is responsible for organizing the EWC III?

The Conference will be hosted by the Government of Germany under the auspices of the United Nations. The Federal Foreign Office in Berlin has set up an *EWC III Task Force* to organize the conference with the support of and in co-operation with:

- A *conference secretariat* based in Geneva with the secretariat of the United Nations International Strategy for Disaster Reduction (ISDR), working in tandem with ISDR's Bonn-based PPEW, which manages the conference programme, directs substantive issues and handles organizational matters;
- A *German supporting committee* coordinated by the Bonn-based German Committee for Disaster Reduction (DKKV), that will support the organizational work and logistics, and organize the Scientific and Technical Symposium with guidance from a *technical advisory committee;*

- A *consultative committee* composed of major stakeholders largely drawn from the Inter-Agency Task Force on Disaster Reduction and from the ISDR Support Group, consisting of governments' and agencies' representatives, which provides overall advice and guidance to the conference secretariat. A committee of German scientists and an International Scientific Advisory Board, both under the leadership of the GeoResearch Centre in Potsdam, Germany, are tasked with the organization of the Scientific Symposium, which will run in parallel with the main discussions in the plenary.

Who will be participating in the EWC III?

The expected 600 to 800 participants will comprise high-level representatives of governments, intergovernmental bodies, UN organizations and specialized agencies (including several Heads of agencies) as well as NGOs, academic institutions and the corporate sector. This reflects the organizers' aim to bring together decision-makers, scientists and practitioners for a fruitful and action-oriented discourse.

What will be the format of the EWC III?

The two-and-a-half day discussions will be divided into two streams: a *Priorities and Projects Forum*, taking place in the main plenary, to present and discuss good practices in early warning, and a *Scientific Symposium* in the adjacent 'Wasserwerk.' The objective is to generate maximum interface between the two streams and to encourage participants to move between both venues.

The Forum's format will be interactive: each session covering the main hazard groups (earth, water and air) will be introduced by a series of presentations given by experts who will outline the main characteristics of the projects. A fourth session will address cross-cutting issues associated with building global capabilities in early warning. Steered by an active moderator, open discussions will then take place in which conference participants will be encouraged to engage. The format of the debate will be lively, interactive and issue-focused. It will not take the form of prepared statements. Contradictory positions will be encouraged to stimulate the discussion and enrich the debate. The moderator, with expert support, will draw conclusions for each theme that will contribute to the conference's outcome documents.

The conference format does not allow time for the delivery of formal statements by governments or agencies. Statements will be distributed in paper form.

What are the objectives of the EWC III?

In an effort to promote the implementation of the *Hyogo Framework for Action*, the EWC III aims to:

- Demonstrate 'that early warning works' through the illustration of good practices;
- Equip practitioners and decision-makers with a set of useful tools;
- Promote viable early warning projects vis-à-vis potential donors, with a view to closing the gaps identified in the *Early Warning Survey* (recently issued by the office of the UN Secretary-General).

What will be the main outputs of the EWC III?

- A catalogue of innovative early warning projects, reviewed by independent experts, to be presented to potential funding sources.
- An Early Warning Checklist as a tool for governments and agencies to ensure that they have given due consideration to all key elements of early warning.
- The establishment of a long-term mechanism to monitor and distribute information about gaps and activities pertaining to early warning around the world.

Key projects

Earth

A warning analysis network and site for Iran

The Islamic Republic of Iran is highly prone to earthquakes, flooding, and drought. In order to reduce the vulnerability of the population to these hazards, the government must strengthen its disaster management and emergency response capacity; in particular, its access to, and integration of, natural hazard information from all sources. The aim of this project is to provide disaster management officials with quick and reliable access to hazard information. Project activities will include identifying and addressing gaps in current knowledge, and developing a national early warning network. It is expected that improved access to information will reduce the time needed to make critical decisions in the event of a disaster by up to 30 per cent, and will improve the efficiency of disaster response by up to 60 per cent.

From local action to national cooperation: A national and people - centered early warning system in Tajikistan

Dozens of landslides and hundreds of mudflows and avalanches occur annually in Tajikistan, resulting in severe economic and social losses. The Zerovshan Valley is particularly prone to natural hazards, yet monitoring and assessment of potential risks is sporadic, forecasting is incomplete, communication networks are unreliable, and local capacity to prevent and mitigate natural hazards is limited. The objective of this project is to develop effective early warning systems in Tajikistan at the community level, which are backed by competent national services and adequate communication systems. Three main activities would be undertaken at local, regional, and national levels: natural hazard awareness raising and training; monitoring and forecasting of hazards, such as floods and land-slides; and, strengthening of disaster coordination and communication capacities.

Flooding and landslides early warning systems in the city of La Paz, Bolivia

The city of La Paz is the second largest in Bolivia and has been developed along a narrow valley of the La Paz River. Over 200,000 inhabitants are vulnerable to the impacts of sudden flood and landslides. The main objective of this project is to develop and implement an automatic early warning system for floods and landslides, which will enable people to receive timely warnings of impending danger and adopt appropriate measures to reduce human and material loses. This will be achieved through the installation of technical monitoring equipment for both floods and landslides. The early warning system would become the main element of the La Paz Municipal Hazard

management System and will be incorporated within the municipal organizational structure under the responsibility of the Chief Technical Official of the Municipality of La Paz.

Early warning system towards hazards of the Tungurahua and Cotopaxi volcanoes, Tungurahua province, Ecuador

The Cotopaxi volcano in Ecuador is the highest active volcano in the world. The possibility that this volcano will erupt within the next one hundred years is greater than 50 per cent. The Tungurahua volcano is one of the most active volcanoes in Ecuador, with frequent, medium intensity activity, occasionally resulting in the formation of lava wells. Over 14,000 families are vulnerable to these hazards. This project is intended both to improve understanding of the risks of these volcanoes by installing a remote early warning system and to strengthen capacities of the institutions and population in these regions to prepare for and respond to an eruption. The remote early warning system will focus on mudflow and ash fall from Cotopaxi, and lava and mudflow from Tungurahua.

Water

Towards a multi-hazard early warning and response system in west Africa: A multi-hazard approach to forecasting adverse health impacts in Africa

This project aims develop an effective multi-hazard early warning and response system, which will strengthen the ability of health institutions at all levels to address climate-related disease and health hazards in West Africa. The primary goal of the project is to achieve a 50 per cent reduction in morbidity and mortality, particularly for women and children under the age of five. Project activities will include: building institutional capacity to produce early warning information tailored to the health sector; enhancing the ability of the health sector to understand and respond to early warning messages; and improving the communication of warnings to field staff and vulnerable communities.

Early warning systems for desert locusts – A west Africa pilot project

Desert locust plagues have been recognized as a major threat to agricultural production in Africa for thousands of years. Meteorological information is available through the Internet to assist in the monitoring and forecasting of locust outbreaks, and technological advances have been made since the last major locust plague in 1988-1989. However, this information and these tools are not widely used at the national level. The aim of this project is to develop more effective and efficient tools and more reliable information for countries to use in monitoring and predicting locust development and migration, and to build the capacity of national governments to plan control operations. Target countries for the project are Mauritania and Senegal.

Implementing a real-time flood forecasting system for east Black Sea Region

In 1998, the Western Black Sea Region in Turkey experienced devastating flooding as a result of unusually high levels of rain. The Turkey Emergency Flood and Earthquake Recovery (TEFER) project, a flood warning system that covers four regions (Western Black Sea, Susurluk, Gediz, and Buyuk Menderes) was established following these floods. Results from the TEFER project have been positive, but

additional work is now needed to expand the system. The objective of this project is to implement a real-time forecasting system in the Eastern Black Sea Region, in the Trabzon and Rize areas. This will enable prediction of the frequency, magnitude and timing of floods, and will provide early warning to authorities and the public when flooding is expected.

Early warning systems for natural hazards in the Binational River Basin Catamayo-Chira

The Catamayo-Chira river basin is shared between Ecuador (42 per cent of territory) and Peru (58 per cent of territory). Approximately 585,000 people live in this area, and their economy is largely based on agriculture. The basin is highly vulnerable to extreme climate variations, caused by "El Niño" and "La Niña". The aim of this project is to establish a real-time, hydro-meteorological network and early warning system to improve natural hazard preparedness and response. Project activities will include: zoning of vulnerable areas, updating hydro meteorological databases, designing and implementing a monitoring network for the region, and strengthening institutional and community capacity to understand and prepare for natural hazards. The project also aims to improve water resource management in the region.

Strengthening capacity in dealing with major risks in the Caribbean Basin

Analyses of past catastrophes concluded that alerts failed to help populations-at-risk to properly assess the gravity of approaching dangers. The official triggering of alerts was delayed owing to cumbersome decision-making processes, and response activities were largely based on intuitive assessments and ad hoc requests for assistance. This project aims to set up an effective pre-crisis management system through the establishment of risk rankings according to zones and the identification of exposed population groups. It, furthermore, strives to improve the information chain by using existing communications techniques and specifically established civil society communication channels to disseminate custom-made alerts, security measures and crisis response.

Air

Early warning communications system for kingdom of Tonga

The Kingdom of Tonga in the South Pacific Ocean is highly susceptible to natural hazards. However, disaster managers have limited ability to access and disseminate natural hazard information. The aim of this project is to strengthen early warning and disaster preparedness in the Kingdom by building a reliable natural hazard communications network. This network would both improve the collection of meteorological data from remote monitoring sites, and also facilitate the distribution of this information throughout Tonga, using high frequency radio data circuits, augmented by satellite broadcast information. Similar projects are being implemented throughout the Pacific region through the RANET-Pacific Project.

Enhancing hydroclimate monitoring, early warning and applications for the reduction of climate related risks in the Greater Horn of Africa

The Greater Horn of Africa region is prone to a wide range of climate-related natural hazards, including droughts, floods, dust storms, tropical cyclones, and locust invasions. These hazards have resulted in significant environmental, social and

economic damage in the region, yet prediction and early warning tools remain limited. This project will enhance the capacity of the region to cope with climate-related risks by: developing a regional data base with long-term, high-quality information on natural hazards; improving the dissemination of timely early warning products; increasing the availability of sector-specific early warning information and tools; and, strengthening regional climate modeling, prediction and early warning.

Development of a regional Sand and Dust Storm (SDS) early warning system in north-east Asia

Major dust storms are of increasing concern in North East Asia, as recent storms have caused significant property damage, poor air quality, and even death. As such, interested countries and organizations are collaborating to develop a regional SDS early warning system. The aim of this project is to develop the science and the networks that will serve as the basis for an effective system. Expected results include: the establishment of a regional SDS monitoring network, and upgrading of current monitoring capacity; the improvement of SDS modeling capabilities; the development of methods to assimilate scientific data; and, the strengthening of the SDS forecasting and early warning capacities of participating countries.

Development of an advanced tropicalcyclone early warning system for the Philippines

Each year an average of 20 tropical cyclones enter the Philippines forecast area of responsibility, with an average of nine actually crossing the country. However as yet there is no early warning system based on state-of-the-art technology available in developed countries. The overall aim of the project is to reduce the number of deaths associated with typhoon landings in the Philippines by 20 per cent through the implementation of an advanced tropical cyclone warning system. This will be achieved through technology transfer to provide state-of-the-art numerical predictions of tropical cyclones landfall and hydrological models to predict floods; and training of decision-makers, emergency manager, non-government officials, and education programmes for the public.

Symposium

The scientific and technical symposium

Through the UN International Decade for Natural Disaster Reduction (IDNDR), the International Strategy for Disaster Reduction (ISDR), and also during the World Conference on Disaster Reduction, experts from a multitude of fields and disciplines have identified early warning as one the major disaster reduction tools to save lives and reduce losses. The EWC III, results from the impetus given by Germany and the United Nations to that field in recent years.

The EWC III and its Scientific and Technical Symposium have to be seen in the context of the two preceding early warning conferences. They reflect a paradigm shift in disaster reduction in general and in early warning in particular: the content of the first conference (EWC98, Potsdam, 1998) was characterized by contributions from scientists and experts in various disciplines pertaining to early warning. The conference provided an overview of the state of the art of early warning, with a focus on hazard, its monitoring, forecasting and reduction mainly though technological solutions to early warning. The second conference (EWC II, Bonn, 2003) promoted early warning as a process in which monitoring and forecasting are one of several components. After five years, experts realized that little of the existing knowledge was widely applied and it was important to shift the focus towards *integrating early warning into public policy*. EWC II included practitioners and policy makers, recognized as essential actors to render early warning functional and sustainable.

The scientific and technical symposium of EWC III will demonstrate the continuous progress of early warning. It calls for a move *from policy to action*. The multi-disciplinary scope of the presentations that will report and discuss the latest research results and approaches in early warning worldwide range from technical novelties - e.g. in the field of earth observation – to new approaches with a focus on social sciences and local early warning praxis.

Those contributions will be structured in 3 sessions:

- *Multi-hazard early warning:* This session will underline the importance of multi-hazard early warning systems in the context of their sustainability. Many processes and policies in early warning are the same for different hazards. Therefore, multi-hazard early warning offers valuable synergies that might prove vital for the functionality and sustainability of an early warning system. New research as well as novel and particularly successful approaches will be presented both from the viewpoint of developing countries and of countries with high technology.

- *Mega-events:* This session will discuss the impulses that were triggered by the tsunami in the Indian Ocean in December 2004, and other potential mega-events. Mega-events by definition affect large areas and a large number of people, and are rare. As a consequence, multi-regional, international and even global cooperation and coordination in early warning play a particularly important role for mega-events.
- *People, politics & economics:* This session will address crucial aspects of early warning, such as community involvement, communication, legal and policy issues, cost-benefit, and other issues that make an early warning system successful and sustainable when addressed properly.

The discussions concluding each session are expected to generate important contributions from the participants that will be captured by the conference's outcome documents.

Point of view

Everett M. Ressler
UNICEF

Early warnings: Enhancing effectiveness

Have you noticed that on the sounding of an alarm or siren, some people may take precautionary action while others ignore it?

Human beings don't automatically take action, like a robot, simply because a warning is issued. In fact, initial response to warnings tends to be disbelief or denial. People would generally not alter their behavior or plans and resist doing so unless change is considered absolutely necessary. People may search for clues why the alarm was sounded and look at the reaction of others to decide whether or not to act. They come to their own conclusions and generally act accordingly. If warning systems are to be effective, it is important to understand how people receive and understand warning messages, and the factors that encourage or discourage action. Having a perfect technical system to transmit alerts is not enough.

The value of effective early warning is undisputed, for obviously, if warned, people at risk may be better able to take quick protective action and emergency services may be able to respond rapidly. The tragedy of the 2004 tsunami raised to global attention the importance of effective early warning systems for tsunami but equally for all other threats--cyclones and other storms, floods, earthquakes, global warming, avian flu, environmental degradation, health hazards, and so on. All too often, insufficient attention is given to the social elements of early warning;

"Warning" is used here to mean "a call to action," and differs from "forecasting" which offers predictive information about the occurrence of a threat. In this sense, warning as a call to action aims to elicit appropriate response, not simply inform people of a danger. Simply put, an effective warning generates appropriate action; an ineffective warning fails to generate appropriate action. If appropriate response was not taken, one cannot be content with "we informed them, but they failed to act;" we must strive to understand why the warning did not generate appropriate action and how the warning might have been delivered in a way that would have generated such. Understanding the social processes that facilitate or impede action are essential then to developing an effective early warning system.

Understanding people's response to warnings must always be considered within specific cultural contexts, for language, culture, tradition and life experience influence how human beings define problems and respond to them. This is true not only between countries but between different groups within a country. Still, from cross-cultural observation and disaster research, some social factors governing early warning response appear to be generic, enough so to use them as

a basis for more specific verification. Drawing on such observation, the following are offered as suggestions for a successful early warning system:

People-centered communications – Give highest attention to understanding how people at risk perceive the threats faced, what their questions and uncertainties are, what form of warning, content messages, sources and actions they might suggest are most appropriate. Lip service is often paid to people-centered communications but all too often warning systems begin with fixed answers in a "top-down" approach; questions and dialogue will greatly enhance effectiveness.

One size doesn't fit all – Because different groups within a population are likely to receive warnings, process them and respond differently, the "tailoring" of warning messages to specific audiences is to be expected to elicit the most effective warning response.

Understanding alerts – People are more likely to act if warnings are clear and understood. Communicate warnings in languages and forms used and appreciated by the audience to be warned. Many warnings continue to vague and to use technical language difficult for the general population to translate to local understanding.

The importance of confirmation – On receiving a warning, people typically attempt to "confirm" the warning before taking action. Confirmation behaviour is evidenced by queries such as "is it true" and "how serious is the threat" to sources perceived to be credible -- meteorological, health centres, authorities, local leaders. A successful warning system will anticipate the need for confirmation, seek to understand how and to whom people will seek confirmation from, and help ensure that systems and information to facilitate that verification process are supported.

All sources are not equal – The source of warning messages influences whether or not people take action. As one might expect, the higher the credibility of the source of the warning, the more likely people will take action. Conversely, if the source is not well known, not considered authoritative or not very credible, people are less likely to take the warning seriously. The more successful early warning systems will engage the most credible sources in helping to convey warning messages.

Being warned more than once – People are more likely to act if they hear the warning from multiple sources and repeatedly. In general, the more a threat is talked of the more likely people will take action. However, if past warnings have proven false, then naturally people are less likely to act when they hear the next warning.

Consistence of message – People are more likely to take action if warnings from various sources are similar; they are less likely to act if messages from different sources give differing or contradictory advisories. Effectively conveying consistent messages requires common understanding, collaboration between the entities providing information – varying official sources and agencies, media as well as non-formal information sources.

Personal consequences – Unless forced, people tend not to respond to warnings unless they understand that they are personally at risk or that specific action is required of them.

Specific actions – Appropriate response is more likely to be taken if warnings provide guidance or reminders of actions to be taken.

Experience – Past experience is a complex factor in whether and how people will respond. In general, experience enhances appropriate warning response behavior. If a recent severe emergency was experienced, response to the next warnings is more likely to be quick and effective, but if the emergency did not prove to be severe, people may tend to under-play the next warning, sometimes referred to as "survivor's confidence," which can be both wrong and dangerous. Effective warnings may require information how the present threat is different than the past ones, why particular actions are advised.

In summary, in the face of an acute threat, loss of life and property will only be prevented or reduced if people take appropriate precautionary measures. Effective early warning systems play a critical role in helping at risk populations know what the threat is and when to act, but this requires a sensitivity and commitment to understanding the social factors that influence action. Warning systems will be most effective that are rooted in understanding that people, all over the world, act rationally in the face of danger and will take appropriate action if provided the timely information and tools to do so.

Point of view

Dr Maryam Golnaraghi
World Meteorological Organisation

Working together for a safer world

Every year, disasters caused by a wide range of hazards impact many communities around the world, leading to loss of human lives, destruction of social and economic infrastructure, and degradation of already fragile ecosystems. When disasters happen they significantly set back national priorities such as health, food security, and socio-economic development by years, if not decades. Developing and integrating risk knowledge and early warning systems as a central part of disaster risk management activities can considerably reduce loss of life and socio-economic damage caused by natural hazards.

Over the last decades, while human casualties and economic damage figures have been high, it is important to stress that they would have been even higher without pre-disaster efforts, particularly early warning systems. It is unacceptable that lives, infrastructure and property are lost at a time when the relevant technologies, expertise, capacities and experience are largely available to prevent many different types of natural hazards from turning into natural disasters. A fundamental precondition for national disaster preparedness is the availability of well-functioning "end-to-end early warning systems" that deliver accurate information in a timely manner to the authorities, risk managers and the population at risk. Such systems must rely on:

(1) Commitment, collaboration, coordination, and information sharing at international, regional, national and local levels in relation to hazards and their potential impacts;
(2) Capacities for:
(a) Observing, monitoring, and developing hazard forecasting and warning mechanisms;
(b) Assessing the potential risks and integrating risk information in the warning messages;
(c) Distributing rapidly and reliably, authoritative and understandable warnings to authorities, risk managers and the population at risk;
(d) Preparing for and responding to the warnings at all relevant levels to minimize the potential impacts;
(e) Educating the public and other stakeholders involved to enhance understanding of the potential risks and to enable them to take effective preventive and response actions.

Over the years, specialized agencies of the United Nations have worked extensively with their Members (through the relevant national agencies), to develop technical capacities for monitoring, detecting, and warnings of a wide range of hazards and their impacts. The World Meteorological Organization (WMO), through an internationally coordinated network of the National Meteorological and Hydrological Services (NMHSs) of its 187 Members, 40 Regional Specialized Centres and three World Meteorological Centres (also operated by the NMHSs), has developed the global operational network for observing, monitoring, detecting, forecasting and operationalizing early warnings for weather-, water-, and climate-related hazards such as extreme temperature, severe storms, tropical cyclones, floods, droughts, avalanches, land and mudslides and wildfires. For example, over the past 20 years, WMO's network has proven to be highly effective in issuing tropical cyclone and storm surge warnings in different coastal regions. UNESCO's Intergovernmental Oceanic Commission (IOC) has been coordinating the development of a tsunami warning system in the Pacific since 1968 and is actively working towards the establishment of similar systems in the Indian Ocean and other regions at-risk. The Food and Agriculture Organization (FAO) and the World Health Organization (WHO), have been working to strengthen capacities for food security and health-related warnings respectively. Other UN and international organizations have been focusing on legislative and development issues, vulnerability and risk assessment, national warning mechanisms, emergency preparedness and response planning, and public education. These efforts have led to significant progress with regard to the different aspects of early warning. However, many challenges remain.

It is essential that early warning systems are available for all hazards, while ensuring their operational and cost effectiveness and sustainability over time. Development and sustainability of effective end-to-end early warning systems is costly and resource intensive. A multi-hazard approach builds on and integrates existing early warning systems, thus maximizing impact through the pooling of technical and organizational capacities and the effective linking of the networks and infrastructure of various partners. This integration of warning systems allows for operational synergy at different levels through: i) maximum utilization of the network's observation capacity to monitor all the hazards faced in a particular region, ii) involvement of all regional and national warning centres and their services in multi-disciplinary, multi-hazard modelling and forecasting iii) employment of global telecommunications networks for efficient and effective dissemination of data and information on hazards for far reaching impact1, iv) improvement of national dissemination and response mechanisms through their frequent use, and v) cost-effective and efficient maintenance of these systems.

There remain many challenges with regard to legislative, financial, organizational, technical, operational, training and capacity-building aspects, which need to be addressed in order to ensure that early warning systems are implemented as an integral part of disaster risk reduction strategies within a multi-hazard framework. These challenges need to be defined and prioritized and clear follow-up actions need to be identified and implemented through close strategic partnerships between international, regional and national actors involved in different aspects of early warning systems.

Point of view

Saroj Kumar Jha
Hazard Risk Management Group
The World Bank

Towards effective warning and monitoring systems: A pro-poor risk management perspective

The mission to reduce global poverty is jeopardized by the increasing frequency and severity of natural disasters. The vulnerability of communities to natural hazards is directly linked to prevailing levels of poverty. The poorest segments of society often live in the worst-affected areas with little or no access to information and basic services such as emergency health care or safe shelter. Macroeconomic projections of hazard risks and estimations of changes in real per capita income show that disasters have lasting macroeconomic consequences and tend to slow or stall the reduction of poverty. Apart from affecting the overall number of those living in poverty, natural catastrophes also accentuate the poverty gap (Nicaragua Study, Catastrophes and Development, The World Bank 2002). Therefore, reducing poverty in high-risk countries can only be achieved through pro-poor disaster risk reduction strategies and the implementation of time-bound action plans. The aim must be to reduce vulnerability through improved risk governance and management.

It is well established that good information and communication save lives and assets. An early warning system based on state-of-the-art modeling and forecasting techniques, supported by a fail-safe communication and dissemination system, provides timely, accurate and reliable information to vulnerable populations and governments for emergency preparedness and a speedy response. Effective people-centered early warning and dissemination systems play a major role in reducing the vulnerability of the poor and should therefore form a central element of any poverty reduction strategy in countries threatened by natural hazards.

The protection of its constituent population is the prime function of any state, and strategic risk management is a key element of good governance in high-risk countries. Thanks to scientific and technical advances in hazard forecasting, modeling, and communication systems, it is now possible to provide highly accurate real-time warning with minimum lead-time. Yet, we see large variations in the knowledge and

application of early warning systems in developed and developing countries. In the absence of comprehensive data for government spending on scientific monitoring and forecasts of weather hazards, it is estimated that expenditures vary from hundreds of millions of dollars in developed countries to hundreds of thousands of dollars in developing countries[1]. In other words, the state of a country or region's early warning and monitoring system is also an indicator of its state of development; a fact which must be overcome as a measure of good governance in developing countries.

Public policies in high-risk countries need to identify and address gaps in early warning capabilities through modern instrumentation for hazard observation and data acquisition, advanced scientific research in hazard modeling and forecasting for accurate and reliable warning, and finally, through the establishment of fail-safe risk communication channels to reach people in vulnerable areas. Partnerships with the private sector, academia and civil society organizations can help governments to mobilize resources for research, education, training and dissemination activities. Involving communities and local authorities in early warning is a necessary practice and should be addressed in national risk-reduction strategies. Adequate funding and robust institutional mechanisms supported by an appropriate legal framework will give credence to any people-centered early warning system.

It is therefore imperative that poverty reduction strategies in hazard-prone countries include the evaluation and development of effective early warning systems, as they have the greatest effect on levels of vulnerability, and go a long way in protecting lives and livelihoods.

1 Postnote(May 2005, number 239) on Early warning for Natural Disasters by the Parliamentary Office of Science and Technology(UK)

Point of view

Prof. Dr. Jochen Zschau,
GeoForschungsZentrum Potsdam

Seconds that can save lives

Slowing down high speed trains, switching traffic lights to red, releasing a SCRAM in a nuclear power plant are some of the automated actions an earthquake early warning system can initiate within a few tens of seconds. This can happen in the very short time after the earthquake has occurred and before the seismic waves start their destructive work. Those few seconds can save lives and help to support the emergency response. Such systems can generate automatic warning of the population by radio and television, shutting down critical lifeline systems, highways, railways and industries, closing valves in pipelines and gas lines, or activating control systems for the protection of crucial structures.

The physical basis for earthquake early warning is simple: strong ground shaking is caused by shear and subsequent surface waves that travel at about half the speed of the primary waves and are much slower than electromagnetic signals transmitted by Internet, telephone or radio. Thus, depending on the distance of a strong earthquake from the vulnerable urban area, real-time analysis of the first primary wave may provide warnings of a few seconds or tens of seconds before the arrival of strong ground shaking. About 10 seconds could be available for early warning in Istanbul, 25 seconds in Bucharest and over a minute in Mexico City.

Although the technological means required for earthquake early warning such as seismic instrumentation, computerized systems and telecommunications are in place, their capacity to serve the population and assist disaster management and decision makers has only been marginally exploited. In addition, most of the existing seismological processing methods have not been developed for real-time applications as required for early warning. Therefore, the development of real-time analysis, modelling and simulation methods, their appropriate integration into facilities for data processing, visualization and rapid information and their application to earthquake early warning in conjunction with disaster management, are major challenges of modern seismology.

Some important early steps have been made towards this goal, for instance, in Mexico, the United States, Japan and Taiwan, where earthquake early warning systems are operationally tested. For Europe, similar activities are underway in some of the larger Mediterranean cities such as Istanbul, Bucharest and Naples. The European research consortium, Seismic Early Warning for Europe (SAFER), has recently been formed with the participation of the United States, Japan and Taiwan, to substantially help further develop the earthquake early warning capabilities in Europe and promote the necessary networking between science, technology and disaster management.

Point of view

Reid Basher
ISDR Bonn

The four elements of early warning

Over the past decades, loss of life and property resulting from natural disasters such as storms, floods, droughts, earthquakes, and tsunamis has grown significantly. This is largely due to growing populations and their concentration in urban areas as well as changes in the use and exploitation of land. In the last ten years, some 2.6 billion people were affected by natural disasters. Nearly a million of them died.

Natural hazards need not automatically spell disaster. They do so only if they hit areas and communities with low levels of preparedness and resilience. Torrential rain in the middle of an ocean remains inconsequential. But the same heavy rainfall in a vulnerable location – for example a shantytown on the side of a hillside stripped of trees - may result in landslides and dramatic loss of life.

Countries have long been concerned about the impact of hazardous natural events. In developing countries in particular, natural disasters can seriously hamper progress. They may destroy infrastructure and livelihoods, trigger food shortages and exacerbate conflicts. The level of destruction caused by a hazardous natural event serves as an indicator of the state of development of the affected country and the quality of its policies and practices.

Early warning is a major element of disaster risk reduction. Effective people-centered early warning systems must comprise all four key elements of early warning: risk knowledge, generation of warnings, dissemination of warnings and response capacity.

It is essential to have a solid knowledge of the risks faced by a given community. As risks arise from a combination of the threat of natural hazards and the vulnerability of the community, any good early warning system will monitor patterns and trends with regard to both these factors. A systematic, standardized data collection and assessment process must be in place, complete with maps and trends on hazards and vulnerability.

Secondly, only a scientifically and technologically sound early warning system can generate timely and accurate warnings for the populations at risk.

Once these warnings are available, it is crucial that they be disseminated without delay and in an easily understandable fashion to those at risk. Vertical and horizontal lines of communication reaching all relevant levels of government and society must function smoothly and in parallel. For this, is important that tasks are assigned and responsibilities defined in advance. The warning itself must contain useful information that triggers appropriate responses virtually automatically. Systems need to be developed, which ensure that local, national and regional entities share information and coordinate their activities productively.

The vulnerability of those who are directly threatened can be much reduced by making sure they know about and are prepared for what they are likely to face. People at risk need to understand the threat and respect the warnings they receive. The more the community can be involved and educated, the more effective early warning and disaster management plans will be.

Neglecting any one of these four elements means rendering the entire system ineffective. Strong national platforms for coordinating early warning and disaster risk reduction activities at all levels are therefore crucial for the successful implementation of the concept of people-centered early warning. The major players concerned need to meet regularly to ensure they understand and cover all the segments.

Furthermore, the system needs to be built on solid political support, an appropriate legal framework as well as well-developed institutional capacity. And perhaps most importantly, it requires the training of people.

Early warning, coupled with better preparedness and response mechanisms, has been shown to be highly effective in reducing disasters. On the other hand, the 2004 tsunami demonstrated what happens when warning systems are lacking or incomplete. Had an effective system been in place in the region, many thousands of lives could have been saved. The disaster served as a powerful wake up call for the international community.

Audio visual materials

People-centered flood warning system in Central Mozambique

Produced by: Foundation Munich Re and GTZ (PRODER).
Duration: 10 min., 5 min., and 1 min.
Year: 2006.
Subject: Example of a tailor-made early warning system for people at risk which does not need complex computing, flood modeling or Internet systems.
Contact: The Munich Re Foundation
e-mail: tloster@munichre-foundation.org

When disaster strikes: The story of Samiyarpettai

Produced by: UNDP India
Duration: 15 minutes
Year: 2006
Subject: Example of how a community in India approaches early warning systems.
Contact: UNDP New Delhi,
e-mail: webadmin.in@undp.org

"Town watching" in Japan

Produced by: ISDR
Duration: 3 minutes
Year: 2006
Subject: How to improve community awareness and preparedness on disaster risk reduction mapping cities and villages.
Contact: ISDR
e-mail: leonib@un.org

Cyclone shelters in Bangladesh

Produced by: WMO
Duration: 15 minutes
Year: 2006
Subject: How cyclone shelters makes a huge difference when floods occur.
Contact: WMO Geneva,
e-mail: CVanMaele@wmo.int,

The avalanche warning systems in the Alps

Produced by: Bayerischer Rundfunk
Duration: 2-3 minutes
Year: 2006
Subject: Avalanche early warning and risk management.
Contact: DKKV
e-mail: zum.kley@dkkv.org

Contacts

Early warning and disaster risk reduction
Reid Basher
Platform for the Promotion of Early Warning,
Bonn, Germany.
Tel: +49 228 249 8810
e-mail: reid.basher@un.org

Saroj Kumar Jha
Hazard Risk Management Group, The World Bank
Tel: +1 202 458 2726
e-mail: sjha1@worldbank.org

Everett Ressler
Preparedness / Early Warning
UNICEF - Emergency Operations
Geneva, Switzerland
Tel: +41 22 909 5643
e-mail: eressler@unicef.org

Early warning and earthquakes
Prof. Dr. Jochen Zschau
GeoForschungsZentrum Potsdam
German Committee for Disaster Reduction (DKKV)
Tel: +49 331 288 1200
e-mail: zschau@gfz-potsdam.de

Prof. Dr. Friedemann Wenzel
Universität Karlsruhe
German Committee for Disaster Reduction (DKKV)
Tel: +49 721 608 4431
e-mail: friedemann.wenzel@gpi.uni-karlsruhe.de

Early warning systems
Dr. Horst Letz
IFRC, Disaster Preparedness and Response Department
Geneva 19, Switzerland
Tel: +41 22 730 4488
e-mail: horst.letz@ifrc.org

Patricio Bernal
Intergovernmental Oceanographic Commission UNESCO
Paris, France
Tel: + 33 1 45 68 39 83
e-mail: p.bernal@unesco.org, r.herve@unesco.org

Early warning and storms
Prof. Dr. Gerd Tetzlaff
Universität Leipzig
German Committee for Disaster Reduction (DKKV)
Tel: +49 341 973 2850
e-mail: tetzlaff@uni-leipzig.de

Early warning and floods
Prof. Dr. Erich Plate
German Committee for Disaster Reduction (DKKV)
Tel: +49 721 468 752
e-mail: erich.plate@iwk.uka.de

Early warning and human security
Prof. Janos Bogardi
United Nations University (UNU-EHS)
Institute for Environment and Human Security
Tel: +49 228 4228 5501
e-mail:bogardi@ehs.unu.edu

Early warning and technology
Dr. Maryam Golnaraghi
World Meteorological Organization
Geneva, Switzerland
Tel: +41 22 730 8006
e-mail: mgolnaraghi@wmo.int