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2009 GLOBAL ASSESSMENT REPORT ON DISASTER REDUCTION

Thematic Progress Review Sub-Component on Early Warning Systems

Compiled and Drafted by the World Meteorological Organization as a Contribution to the 2009 Global Assessment Report on Disaster Reduction

Final Report

January 2009

Compiled and Drafted by: Dr. Maryam Golnaraghi
Chief of Disaster Risk Reduction Programme
World Meteorological Organization
7 bis, Avenue de la Paix
P.O. Box 2300
CH-1211 Geneva, 2, Switzerland
Tel: (+41 – 22) 730 – 8006
Fax: (+41 – 22) 730 – 8128

The materials presented in this report are based on surveys, information, technical comments and review provided by international agencies including the Food and Agriculture Organisation (FAO), the Global Fire Monitoring Centre (GFMC), the International Federation of Red Cross and Red Crescent Societies (IFRC), the Platform for the Promotion of Early Warning of the International Strategy for Disaster Reduction (ISDR-PPEW), the International Telecommunication Union (ITU), the United Nations Office for the Coordination of Humanitarian Affairs (OCHA), the United Nations University (UNU), the United Nations Development Programme (UNDP), the United Nations Environment Programme (UNEP), the Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organisation (UNESCO-IOC), the United Nations Children's Fund (UNICEF), the United Nations Office for Outer Space Affairs (UNOOSA), the United Nations Operational Satellite Applications Programme (UNOSAT) of UNITAR, the World Bank, the World Food Programme (WFP), the World Health Organisation (WHO) and the World Meteorological Organisation (WMO). This report was reviewed by all participating agencies.

Acknowledgements: WMO is grateful to the above-mentioned agencies and their staff for their contributions in providing input and reviewing this document.

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1. Background

Early warning systems should be an integral component of any nation's disaster risk reduction strategy, enabling the governments at national to local levels and the communities to take appropriate measures for saving of lives and livelihoods in anticipation of a disaster.

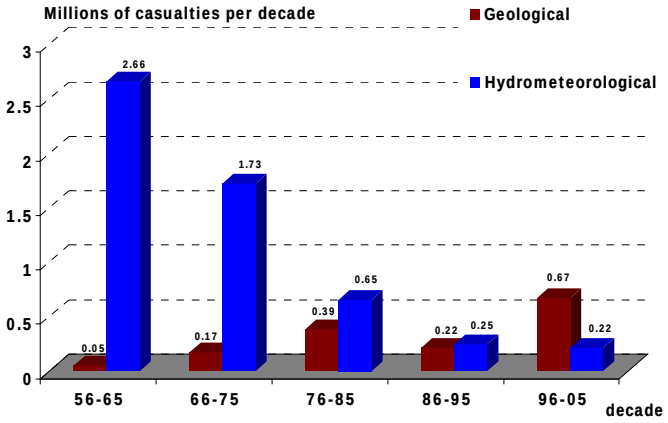

Figure 1: Trends in disaster-related loss of life over the five last decades (Source: EM-DAT, OFDA/CRED International Disaster Database)

Over the last 50 years, while the recorded number of disasters, caused by natural hazards, and their associated economic losses have increased by nearly 10-fold and 50-fold, respectively, loss of life associated with hydro-meteorological hazards has decreased 10-fold, as illustrated in Figure 1. This has been associated with the development of early warning systems and emergency preparedness and planning at national to local levels.

Early warning systems have received significant international attention over the past ten years. First International Early Warning Conference (EWC-I)[1] (1998) stressed the critical value of early warning systems as an essential element of disaster risk reduction strategies, while the Second International Early Warning Conference (EWC-II)[2] (2003) defined four components of early warning systems, as illustrated in Figure 2, including:

i. Observing, detecting and developing hazard forecasts and warnings;
ii. Assessing the potential risks and integrating risk information in the warning messages;
iii. Distributing, rapidly and reliably, understandable warnings to authorities, risk managers and the population at risk;
iv. Emergency preparedness and response to warnings at all relevant levels to minimize the potential impacts

EWC-II also discussed the need for an International Early Warning Programme (IEWP) that would strengthen national early warning capacities, with five pillars for action including: (i) better integration of early warning into development processes and public policies; (ii) improved data availability for investigating, forecasting/predicting and managing risks on different time scales; (iii) improved capacities and strengthened early warning systems, particularly in developing countries; (iv) development of people-centred warning systems; and, (v) mechanisms for sustaining the early warning dialogue and supporting the development and implementation of a programme.

[1] http://www.geomuseum.com/ewc98/

[2] http://www.ewc2.org/

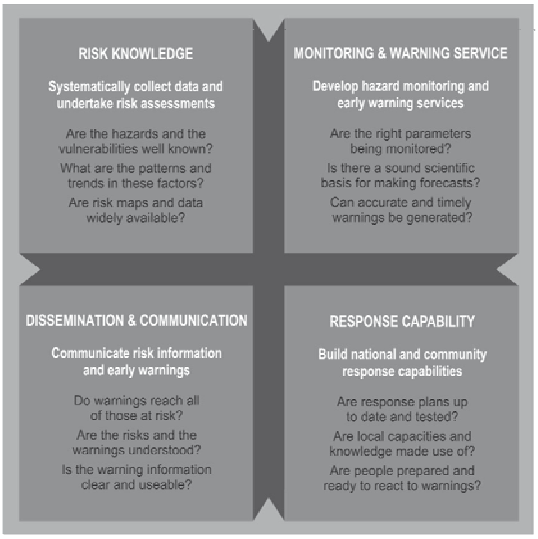

Figure 2: Four components of people-centred early warning systems (Source: Platform for Promotion of Early Warnings – PPEW, Bonn, Germany)

During the World Conference on Disaster Reduction[3] (Kobe, Japan, January 2005), 168 countries adopted the Hyogo Framework for Action[4], which dedicates special attention to early warning systems, under its second priority area. In March 2006, the Third International Early Warning Conference[5] was held, with two major outputs: (i) The Checklist for Developing Early Warning Systems[6], to assist countries and communities in developing effective, people-centred early warning systems and (ii) the Global Survey of Early Warning Systems[7], which identified capacities and gaps in early warning systems.

Following the EWC-III, in May 2006, the First International Experts' Symposium on Early Warning Systems with Multi-Hazard Approach[8] identified criteria for good practices in early warning systems, and examples of such good practices including France, China (Shanghai), Cuba, and Bangladesh. The Symposium identified a clear need for the four technical components to be supported by strong planning, enforceable legislation, standard concept of operations defining roles and responsibilities of different agencies at national to local levels as well as financial resources to ensure sustainability of early warning systems over time.[9] Additionally, it formulated clear recommendations for strengthened coordination and collaboration among agencies across the four components of early warning systems.

[3] http://www.unisdr.org/wcdr/

[4] http://www.unisdr.org/eng/hfa/docs/Hyogo-framework-for-action-english.pdf

[5] http://www.ewc3.org/

[6] http://www.ewc3.org/upload/downloads/checklist.final_pdf.pdf

[7] http://www.unisdr.org/ppew/info-resources/ewc3/Global-Survey-of-Early-Warning-Systems.pdf

[8] http://www.wmo.int/pages/prog/drr/events/ews_symposium_2006/index_en.html

[9] Concept of Operations (CONOPS) - Concept of Operations documents can be developed in many different ways, but usually share the same properties. In general, a CONOPS will include the following:

- Statement of the goals and objectives of the system
- Strategies, tactics, policies, and constraints affecting the system
- Organizations, activities, and interactions among participants and stakeholders
- Clear statement of responsibilities and authorities delegated
- Specific operational processes for fielding the system

The Symposium further stressed that,

i. Development and sustainability of EWS would require political commitment and dedicated investments;

ii. EWS should be an integral part of national and local disaster risk management plans and budgets;

iii. Enforceable legislation must explicitly define the roles and responsibilities of various authorities and agencies from national to local levels;

iv. Implementation of EWS requires clear concept of operations enabling effective coordination among agencies across all components of EWS, at national and local levels;

v. Systematic feedback and evaluation at all levels are needed, to ensure improvements of the system over time.

Both the Johannesburg Plan of Implementation (2002)[10] and the Hyogo Framework for Action (2005) called for an "integrated and multi-hazard approach" to disaster risk reduction. In the framework of early warning systems, implementation of some of the components requires a high level of specialisation. However, several pilot projects are underway to demonstrate ways in which a multi-hazard approach built on existing institutional capacities and strengthened cooperation among the various agencies could result in enhanced operational and system effectiveness, and improved sustainability within the different components of early warning systems, through:

i. Utilization and development of available infrastructures and capacities for forecasting, detecting and monitoring of multiple hazards and risks, when technically appropriate;

ii. Utilising operational warning centres and dissemination services more frequently and systematically;

iii. Improving emergency preparedness and response mechanisms on an ongoing basis, with consideration for characteristics of different hazards (e.g., slow versus fast onset, with local versus large spatial impacts

In many countries, some of these elements are in place. However, without an integrated approach, supported by standard operational procedures defining roles and linkages of different agencies at national to local levels, the system as a whole could fail. Effective cooperation and collaborations across these four technical components, and across hazard-specific capacities, would require support through strong governance, coordination mechanisms, dedicated infrastructure, planning, enforceable legislation, standard concept of operations and financial resources to ensure sustainability of early warning systems over time.

This report provides:

- An assessment of national capacities and gaps in early warning systems;
- Regional and international cooperation in support of development and strengthening of early warning systems at the national level;
- Recommendations for strengthening early warning systems as an integral part of disaster risk management.

Processes for initiating, developing, maintaining, and retiring the system. A CONOPS should relate a narrative of the process to be followed in implementing the system. It should define the roles of the stakeholders involved throughout the process. Ideally it offers clear methodology to realize the goals and objectives for the system, while not intending to be an implementation or transition plan itself. (Ref: Carnegie Mellon University 2008).

[10] http://www.un.org/esa/sustdev/documents/WSSD_POI_PD/English/WSSD_PlanImpl.pdf

2. Data Sources

This report has been developed based on the following primary sources of information:

1) As a follow-up to a recommendation of the Global Survey, and as part of the development of World Meteorological Organization's (WMO) Disaster Risk Reduction Programme (DRR), in 2006-2007, WMO conducted a major Survey of National Capacities for Meteorological, Hydrological and Climate-Related Forecasting and Warning Systems[11] in which 139 countries participated.
2) In 2008, the ISDR Platform for Promotion of Early Warning (PPEW) and the UNU Environmental and Human Security Institute (UNU-EHS), conducted the Joint Early Warning Questionnaire (hereafter referred to as PPEW-UNU Joint Questionnaire), in which 51 countries have participated. The questionnaire template used for this survey is provided in Annex 1.
3) Response of international agencies that support the development of early warning systems, to a questionnaire prepared and coordinated by WMO in 2008. The questionnaire template is provided in Annex 2. The questionnaire was sent to 19 key international agencies[12], and responses were received from 14 agencies[13]).
4) Some interviews and other publicly available information

3. National Early Warning Capacities

The following section provides an analysis of capacities of national stakeholders to support the components of early warning systems, as well national context to support coordination and collaboration across these elements with a multi-hazard approach.

3.1. Governance and organisational coordination

The results of the PPEW-UNU Joint Questionnaire indicate that of the 51 countries that responded to the survey, national legislation or policies are in place in 40 countries for the implementation of EWS. While 34 have established in law the authority for issuing warning, only in a few cases are the functions, roles and responsibilities of each actor in the warning dissemination process specified in legislation or government policy. In majority of countries, authorities have been empowered to disseminate early warning messages, and more than half indicated that local authorities are not aware of which organizations are responsible for which warnings. Only in few cases the warning dissemination chain is enforced through government policy or legislation. While coordinating mechanisms from national to local levels and legislation in support of early warning systems are available in most countries surveyed (34/51), a vast majority of the countries indicated the need for development of comprehensive early warning system programmes, including identification of roles and responsibilities of each agency (only available in 21/51), and a clear concept of operations to drive collaborations and cooperation among these agencies.

[11] http://www.wmo.int/pages/prog/drr/natRegCap_en.html

[12] The questionnaire was sent to FAO, GFMC, GEO, IFRC, ISDR-PPEW, ITU, OCHA, UN Habitat, UNU, UNDP, UNEP, UNESCO-IOC, UNICEF, UNOOSA, UNOSAT, World Bank, WFP, WHO, WMO.

[13] FAO, GFMC, ISDR-PPEW, OCHA, UNU, UNDP, UNEP, UNESCO-IOC, UNICEF, UNOOSA, UNOSAT, World Bank, WFP, WMO responded to the questionnaire.

Similar results were also reflected in the WMO 2006 country-level survey in which 139 countries participated, suggesting that in majority of countries, national plans, coordination mechanisms and legislation may need to be re-evaluated and further strengthened to ensure designation and enforcement of the leadership (line of command), coordination and clarity of roles and responsibilities of various agencies, and availability of standard operational procedures for development and issuance of the earning messages linking to emergency preparedness and response mechanisms on the ground. Furthermore, the need for dedicated adequate budget and resource allocation to agencies according to there role in supporting early warning systems have been identified as a key element for sustainable development of early warning capacities. In general, most countries indicated a need for a systematic feedback mechanism, learning from previous warning activations to improve the system as a whole across all components and at national to local levels.

3.2. Capacities for forecasting, detection and monitoring of hazards

Every country is potentially threatened by a variety of hazards, characterised by their intensity (e.g. cyclone categories), frequency (e.g. period of return), geographic extend (from a single point for a lightening to vast regions for a drought or sea-level rise), onset (from seconds for an earthquake to decades for desertification), and origin (e.g., meteorological, hydrological, geological, climate-related) are included in the scope of this study).

Development of early warnings requires, (i) systematic and consistent real-time monitoring and detection of the natural hazards, (ii) maintenance and management of historical databases of environmental parameters for hazard analysis and mapping, and (iii) operational forecasting capacities of hazards, on a 24/7 basis. In many countries, availability of hazard data is impeded by insufficient operational observational infrastructures, lack of data management systems for handling large databases and inadequate resources for maintaining 24/7 operational forecasting capacities (e.g., financial and technical including hardware, software and technical capacities of the forecasters).

The lead time and accuracy related to forecasting of hazards such as tropical cyclones, tornadoes, floods (including flash flood), droughts, heat and cold waves, has more than doubled over the last ten years. However, these capacities remain under-developed or nonexistent in many developing and least developed countries. Furthermore, national capacities for detecting and forecasting hazards could also be further improved through enhanced inter-agency cooperation and collaboration, within and across countries. Both WMO and PPEW-UNU survey results confirm that there is need for development of standards for the operations of early warning systems not only at the national level, but also with neighbouring countries and at the regional level.

Observing, monitoring, detecting, and forecasting of hazards are resource-intensive and since hazards have no boundaries, national capacity developments have traditionally relied on strong international and regional cooperation.

Figure 3 provides the number of countries in which some level of hazard warnings are available, for the listed natural hazards. In many countries, National Meteorological and Hydrological Services are among the few authoritative agencies operating on a 24/7 basis and have been mandated to issue warnings for both hydrometeorological and in some cases for geological hazards. However, despite the high figures for issuance of warnings for some hazards, only few countries have in place an effective system that would ensure appropriate utilisation of the warning to assist emergency response and preparedness at the community level. It was also confirmed through the PPEW-UNU Joint Questionnaire, that warning systems are operated to a lesser degree in the case of epidemics, tsunamis, land-degradation and desertification, avalanches, locust, and volcanic activity.

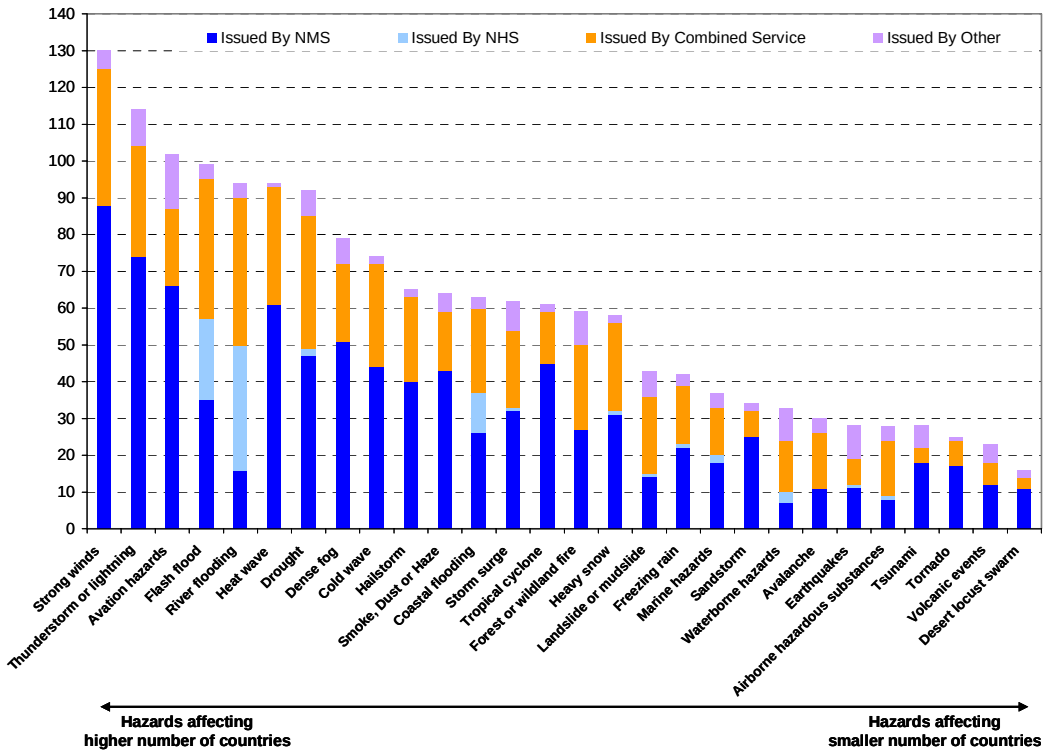

Figure 3: Availability and source of authoritative warnings for different hazards in 139 countries (Source: WMO 2006 country-level survey)

3.3. Capacities to incorporate risk information in warning messages

A first step to any good disaster risk reduction plan is the identification of different potential risks in different parts of a country. Traditionally warning messages have been focusing on communicating hazard information. However, in order to ensure that the warnings trigger the appropriate responses, warning messages should also provide information about related risks, and recommendations on measures people and authorities can undertake to reduce those risks.

In a majority of countries, technical agencies are mandated to collect historical databases on hazards. Figure 4(a) indicates hazards and the number of countries they impact. As illustrated in Figure 4(b), National Meteorological and Hydrological Services collect, archive and update information on meteorological, hydrological and climate-related hazards and in some occasions, geological hazards such as earthquakes and tsunamis. However, the WMO 2006 country-level survey indicated that these hazard databases are not compiled on the basis of same standards (e.g., variables, formats, etc) and in many cases may have gaps and quality issues (such as large gaps in the data) linked to lack of capacities for observing and managing large databases. Of the 139 countries that responded to the WMO 2006 country-level survey, 54% indicated limited ability to archive and update historical hazard databases, 60% indicated the need for data rescue programmes, 57% indicated the need for technical staff and improved quality assurance methodologies of the data, 92% indicated the need for guidelines for development standards for hazard datasets, metadata and hazards analysis and mapping tools to support risk mapping and warning systems.

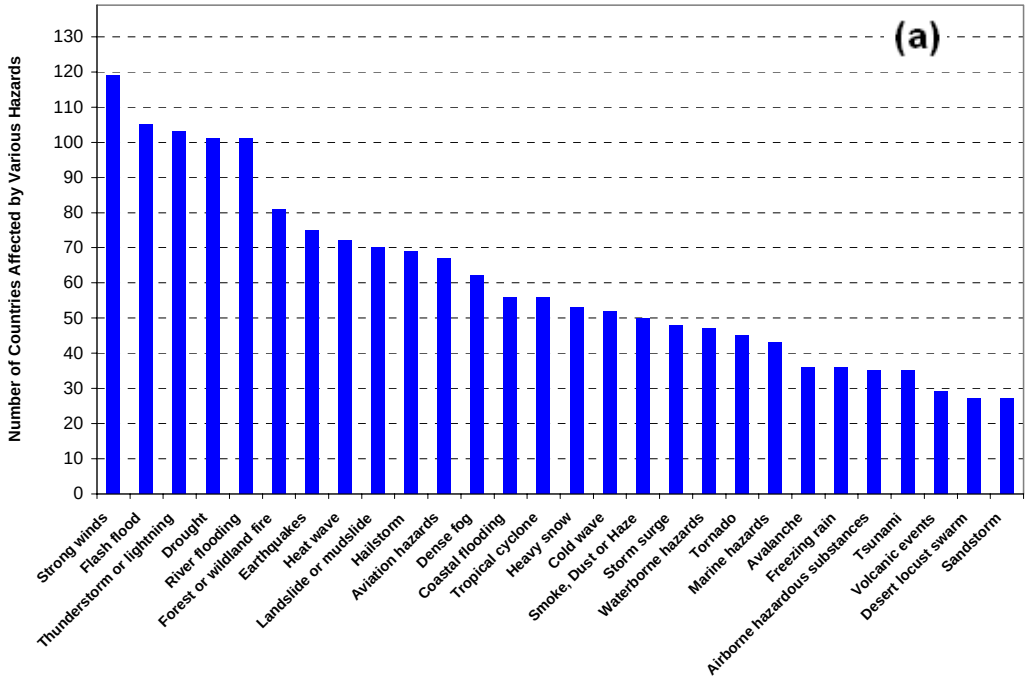

Figure 4(a): Number of responding countries who identified themselves as being affected by the specified hazards. (Source: WMO 2006 country-level survey)

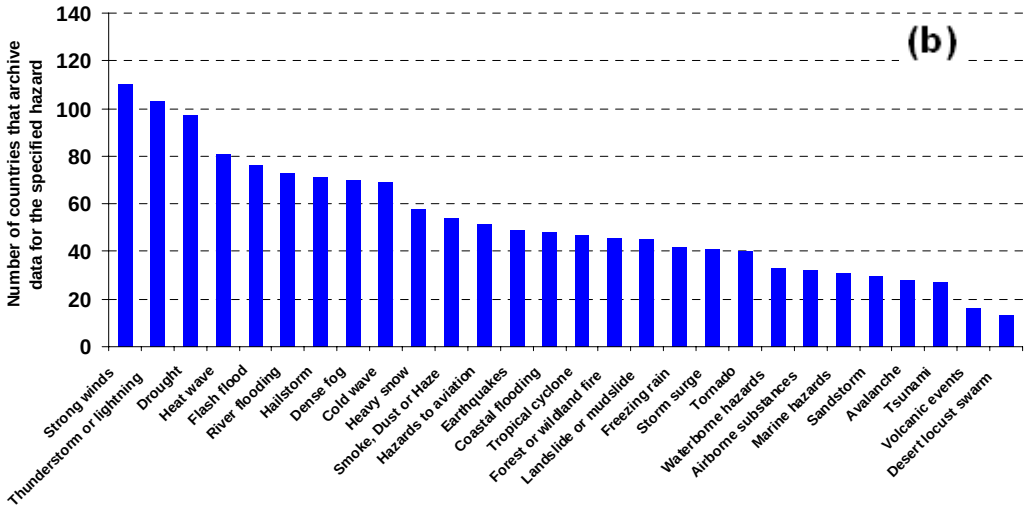

Figure 4(b): Collection, analysis and archiving of standard hazard data by National Meteorological and Hydrological Services (Source: WMO 2006 country-level survey)

Risk assessments (covering both hazard and vulnerability) have been conducted in some cases, but efforts are needed, particularly in the context of vulnerability assessment. While national hazard mapping has been conducted mostly in case of earthquakes, volcanic activity, lahars, and floods, these analyses are not complemented with vulnerability assessments. According to the PPEW-UNU analysis, these maps (hazard, vulnerability, and risk) have found their use in early warning systems of volcanic activity and lahars, and to a lesser degree for flash and riverine floods, avalanches, tsunamis, tropical cyclones, storm surges and other sever storms. These results lead to the conclusion that it is important to strengthen the capacities of institutions to conduct risk assessments in the context of early warning.

3.4. International, regional and national dissemination and communication capacities

Issuance of warnings and dissemination to the authorities and the general public are national responsibilities. Effective dissemination mechanisms should be available 24 hours a day, every day of the year ensuring that:

- Messages should be readily identifiable as authentic and authoritative;
- Messages should reach authorities responsible for emergency preparedness and response at national to community levels;
- Dissemination mechanisms need to be sustainable, reliable and redundant, and should combine different means;
- Dissemination mechanisms should allow for updates and cancellation of false alarms.

As an example, Figure 5 provides an analysis of dissemination mechanisms used by National Metrological and Hydrological Services to issue warnings to authorities, emergency responders, media and communities at risk. While these dissemination mechanisms are used in parallel, the traditional fax and webpage posting are still used extensively for dissemination channels at the national levels.

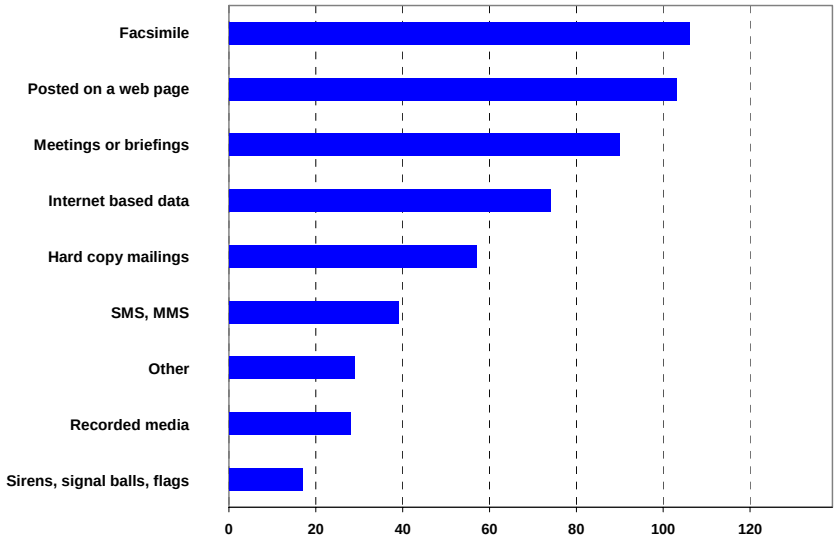

Figure 5: Warning dissemination and communication mechanisms fused by the National Meteorological Agencies to authorities and local communities (Source: WMO 2006 country-level survey)

According to the PPEW-UNU Joint Questionnaire, 46 of the 51 countries responding to the surveys have reported that recognized authorities are empowered to disseminate warnings; however, in only 27 of the countries warning dissemination chain is enforced through government policy or legislation. Nearly 39 countries indicated that the communication and dissemination systems are tailored to the needs of the individual communities; only ten of the 51 indicated a two-way communication system to verify whether local authorities and communities at-risk have received the warning. In some cases communication and dissemination systems have been tailored to the needs of some individual communities. While in some countries warning dissemination is centralized through a national warning centre, mass media, folk or alternative media are also used to disseminate the information to the public. The WMO 2006 country-level survey indicated that overall dissemination of the warnings from national level to local communities remain a challenge, particularly in the remote rural areas in both, developing and even in some developed countries.

3.5. Capacities for linking warnings to emergency preparedness and response mechanisms at national to community levels

The overall purpose of the first three components of the early warning systems is to enable timely and proactive activation of appropriate emergency preparedness and response measures to avoid or limit impacts of disasters. Therefore, a good understanding of the line of authority, and decision processes from the community to the national level is critical in reducing potential impacts on lives and livelihoods. While effective emergency preparedness and response must be anchored at the local level, in many cases communities do not have the adequate resources to take appropriate measure, thus, community emergency preparedness and response mechanisms must be supported by capacities and resources at provincial and national (and in some cases international) levels, where necessary. Emergency protocols and procedures should clearly identify responsibilities of each local agency for different risk levels.

The WMO 2006 country-level survey reveals that one of the major challenges for most countries, particularly those with fewer resources, is the capacity for effective utilization of warnings in emergency preparedness and response mechanisms at national to community levels. In most countries, this is primarily caused by the (i) need for emergency preparedness and response plans developed utilizing hazard and vulnerability maps, (ii) need for warning readiness mechanisms that link the level of risk to concrete actions on the ground, (iii) lack of trust in or understanding of the local authorities and emergency responders in “hazard” warnings issued by the national agencies, (iv) need for drills and, (v) improved public education related to the activation of the emergency plans. In some cases, better preparedness at the community level, is directly linked to the frequent community experience with occurrence of certain hazards. The PPEW-UNU Joint Questionnaire indicates that of the 51 countries, 43 reported that disaster preparedness and response plans were empowered by law and 34 indicated that the plans were adapted to the individual needs of the vulnerable communities, but only 14 noted that hazard and vulnerability maps were utilized to develop emergency preparedness and response plans, confirming similar results obtained through WMO 2006 country-level survey. Furthermore, need for strengthened education and training on how to respond to a warning message has also been highlighted in both surveys. While PPEW-UNU Joint Questionnaire indicated that in 31 of the 51 responding countries, feedback from warning activation (real or drills) are analysed on an ongoing basis to identify need for improvement and capacity building opportunities, WMO 2006 country-level survey has indicated that feedback mechanisms from emergency preparedness and response agencies for the improvement of warnings issued by technical agencies are underdeveloped. Overall, early warning drills are not conducted regularly in many countries. In addition, only in a few cases systems are established to verify that warnings have reached the intended recipients. These facts suggest that some of these systems may not be people-centred, but more institutionally centred and efforts are required to complement existing systems with people-centred strategies.

4. International and regional cooperation in support of strengthening national early warning systems

Strengthened cooperation at international and regional levels is leading to development of more comprehensive early warning system capacities at the national level.

4.1. Governance and organisational coordination

ISDR Secretariat has been promoting the establishment of National Platforms for Disaster Reduction, A National platform for Disaster Risk Reduction is a nationally owned and led forum or committee of multi-stakeholders working in disaster risk reduction. It advocates for disaster risk reduction at different levels and across sectors, providing coordination, analysis and advice on priority areas of action. It should be built on existing national coordination mechanisms and contribute to the establishment of a comprehensive national disaster risk reduction system for the country. At present, 45 countries have already launched National Platforms for Disaster Risk Reduction, of which 20 are in Africa, five in Asia-Pacific, nine in the Americas and 10 in Europe.[14] Such strengthening coordination at the national level would be instrumental to the strengthening and or establishment of early warning systems programmes over time.

UNDP supports over 60 high disaster risk countries in the development of disaster risk reduction frameworks, strategies and legislation at the national and sub-national level, thereby ensuring that early warning systems are an integral component of comprehensive risk management strategy. As part of support to national efforts on building disaster risk reduction capacities at the local level, UNDP primarily works on strengthening the 'last mile' of early warning systems through community-based approaches. Following the Indian Ocean tsunami, UNDP has been working closely with UNESCO-IOC in developing Standard Operating Procedures (with particular emphasis on actions that need to be take at the 'last mile') for tsunami early warning and related capacity building efforts in the tsunami-affected countries. In the LAC region, UNDP has helped document best practices on EWS with particular emphasis on local level issues. UNDP's ongoing programmes in a number of countries -- Liberia, Seychelles, Mauritania, Malawi, Maldives, Indonesia, Sri Lanka, Bangladesh Namibia, Swaziland, Ethiopia, Kenya, Mozambique, Zimbabwe, Uruguay, Guatemala, Maldives and Moldova -- include components on strengthening local level elements of EWS.

4.2. Developments with hazard-specific early warning systems

4.2.1. Forest and wildland fire

A globally coordinated wildland fire early warning system is being developed through cooperation of the Global Fire Monitoring Centre (GFMC), with a number of technical partners (Canadian Forest Service, US National Oceanic and Atmospheric Administration, Centre for Australian Weather and Climate Research, University of Maryland, United Nations University). The system would be comprised of three components: a fire danger rating system, a fire risk assessment, and a fuels assessment. A prototype will be demonstrated operationally, in sub-Saharan and West Africa. Guidelines for fire weather agrometeorology will be developed by 2009, to guide expansion of the prototype to other regions. In addition, this program aims at providing a basis to develop international resource-sharing agreements that can be implemented during times of wildland fire disaster.[15]

[14] Officially declared National Platforms for Disaster Risk Reduction can be found at the following website: http://www.preventionweb.net/english/hyogo/national/list/?pid:23&pih:2.

[15] Global Wildland Fire Early Warning Portal: http://www.fire.uni-freiburg.de/fwf/fwf.htm. The envisaged system is also GEO Task DI-06-13.

The envisaged Global Wildland Fire Early Warning System will have a major component in local capacity building of the final end user – the local fire management agencies. Specifically, this involves technology transfer and training in the practical application of early warning information in daily fire management decision-making. This is something that would happen at all system levels. For instance, at the global level, early warning information can be used for international resource-sharing decisions that are made before disaster fires occur; at the local (community) level, early warning can be used for the most basic decisions involving fire prevention, detection, and suppression activities in advance of critical burning conditions. It is envisaged to promote the development of local fire early warning systems in the frame of the concept of Community-Based Fire Management (CBFiM).

4.2.2. Hydrometeorological and climate-related hazards

Early warning systems for meteorological, hydrological and climate-related hazards such as sever storms, floods, droughts, heat and cold waves, tropical cyclones and storm surges, sand and dust storms, is enabled through a WMO coordinated international network operated by the National Meteorological and Hydrological Services (NMHS). This operational network includes WMO Integrated Global Observing Network (WIGOS), WMO Global Telecommunication System (GTS) which is evolving to WMO Information System (WIS), and WMO Global Data Processing and Forecasting System (GDPFS) comprised of three world meteorological centres, 40 Regional Specialized Meteorological Centres (RSMCs), to provide at-risk countries with hazard analysis, forecasts, bulletins and watches (Figure 6). For example, there are six designated RSMC providing tropical cyclone and storm surge analysis, watches and bulletins to countries at risk. This system is being further strengthened and expanded to support other hazards such as sand and dust storms, flash floods.

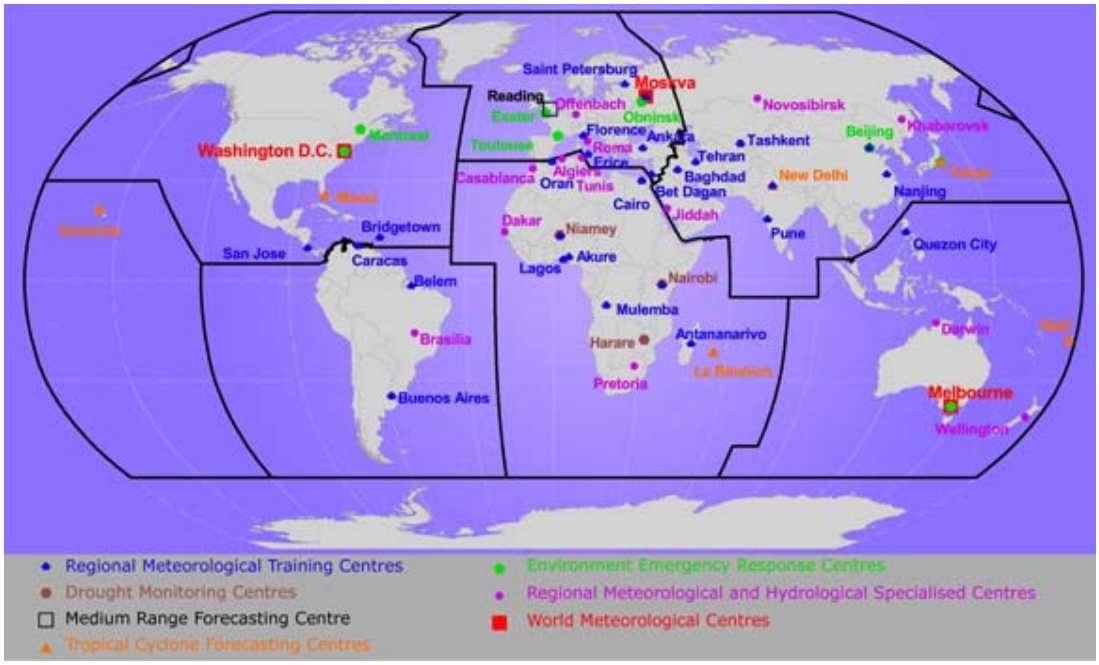

Figure 6: Schematic of Regional Specialized Centres Coordinated by WMO.

Over the past two years, WMO in collaboration with several partners and NMHS has coordinated regional and national projects targeted at strengthening technical capacities of the NMHS for issuance of national warnings for a number of hazards, including[16]:

i. Severe weather forecasting, which has been implemented in 5 countries in Southern Africa and being extended to all SADC countries, the Pacific and South America;

[16] For more information on WMO activities see: http://www.wmo.int/disasters.

ii. Sand and dust storm, including establishment of Sand and Dust Storm Regional Centres that would provide technically support countries at risk

iii. Flood Risk Management Programme, including flood forecasting which has been implemented in 10 countries in Africa, Central Europe and Latin America. This Programme is being extended in Kenya by the World Bank and Japan International Cooperation Agency (JICA), in India through the national disaster management programme, in Uruguay through the Inter-American Development Agency (IADB).

iv. Flash flood guidance system, which is being implemented together with the United States National Oceanic and Atmospheric Administration's National Weather Service (NOAA-NWS), United Stated Office of Foreign Disaster Assistance (US OFDA) and the Hydrologic Research Centres (HRC). The system has been implemented in Central America, and is being extended to Southern Africa and South East Asia.

v. WMO facilitated the establishment of the drought monitoring centre, in Southern Africa (Gaborone, Botswana formally located in Harare, Zimbabwe) and the Drought Monitoring Centre for Eastern Africa, (Nairobi, Kenya), which are now integrated as part of the respective regional economic communities, namely The Southern African Development Community (SADC) and Inter-Governmental Authority on Development (IGAD). WMO has been collaborating with the United Nations Convention to Combat Drought and Desertification (UNCCD) in the establishment of a drought management centre for south-eastern Europe in Slovenia, and also with the Organization for Security and Cooperation in Europe (OSCE) for the establishment of a drought management centre in Central Asia.

vi. Improved storm surge watches, to be provided through the six WMO tropical cyclone specialised centres to all countries at risk.

vii. Heat/Health warning system guidelines are being developed through a WMO/WHO collaboration, to be demonstrated in several countries.

Furthermore, WMO, in cooperation with the International Federation of the Red Cross (IFRC), ISDR Secretariat, UNDP, the World Bank's Global Facility for Disaster Reduction and Recovery (GFDRR) and various regional agencies, is initiating projects to assist with the development of operational early warning systems that link national warnings of NMHS to national to community level emergency preparedness planning and response mechanisms including the establishment of Concept of Operations based on Standard Operating Procedures (SOP). WMO together with China (Shanghai) initiated the first multi-hazard early warning system project in 2007. Other demonstration projects are being launched in three countries Central America (Costa Rica, Nicaragua and El Salvador) with plans to expand to Southern Africa, and South East Europe, and south and Southeast Asia in 2009-2011 timeframe.

4.2.3. Tsunami

The Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS) (formerly ITSU), was established as a subsidiary body of the United Nations Educational, Scientific, and Cultural Organization's Intergovernmental Oceanographic Commission (UNESCO-IOC). The Pacific Tsunami Warning System has been in operation since 1965, and is currently comprised of more than 30 Pacific Member States. In addition, following the tragic Indian Ocean tsunami in 2004, UNESCO-IOC received the mandate from the international community to coordinate assistance for tsunami early warning systems for all countries at risk, including tsunami advisory information services, tsunami hazard risk assessment, tsunami warning and emergency response and preparedness. Currently, the Pacific Tsunami Warning Centre in Hawaii (USA) and the Japanese Meteorological Agency provide interim tsunami information advisory services to all countries at risk. The UN General Assembly confirmed this mandate in 2006 and 2007 by Resolutions. Other dedicated centres have been established in the Indian Ocean in 2008, to be followed by other regions.

With the objective to expand tsunami early warning capacities to other regions at risk, in 2005, UNESCO-IOC General Assembly formally established three Intergovernmental Coordination Groups (ICG) to coordinate the development of tsunami early new warning systems, as follows:

i. The Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWS)

ii. The Intergovernmental Co-ordination Group for the Tsunami and other Coastal Hazards Warning System for the Caribbean Sea and Adjacent Regions (ICG/ CARIBE EWS)

iii. The Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North Eastern Atlantic, the Mediterranean and Connected Seas (ICG/NEAM).

The regional coverage of these "Tsunami Warning Systems" (TWS) is schematically shown in Figure 7.

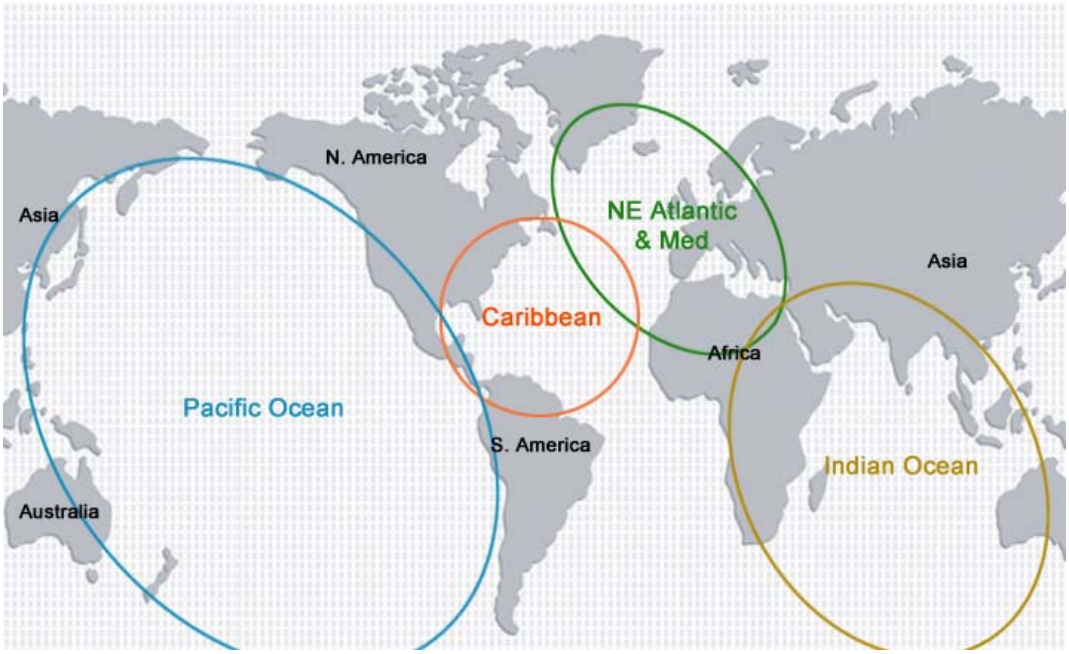

Figure 7: Regional coverage of the Tsunami Warning Systems and the responsible Intergovernmental Coordination Groups for Tsunami Early Warning Systems established by UNESCO-IOC (Source: UNESCO-IOC, November 2008 http://www.ioc-tsunami.org,)

In the Indian Ocean, UNESCO-IOC, ISDR and WMO conducted assessment missions in 16 countries in 2005-2006 timeframe. . Through the Global Sea Level Observing System (GLOSS) programme the UNESCO-IOC has directly installed/upgraded 23 real-time sea level stations, and more than 50 stations part of the GLOSS Core Network in the Indian Ocean have been installed/upgraded with multilateral, bi-lateral or national funding. The Pacific Tsunami Warning Centre (PTWC) from the USA and the Japan Meteorological Agency (JMA) from Japan, as of 1 April 2005, are serving as interim tsunami watch providers. WMO has coordinated the upgrade and training of the staff for the Global Telecommunication System (GTS), which is the primary telecommunication network linking all countries and the regional watch centres for exchange of tsunami related information and warnings. As of December 2007, GTS was upgraded in Kenya, Tanzania, Madagascar, Sri Lanka, Maldives, Bangladesh, Pakistan and Myanmar, to ensure that all countries can receive tsunami information from regional centres within 5 minutes' minutes. A programme of training workshops on development of Standard Operating Procedures (SOP) for tsunami warning by IOC has commenced in the region, funded by the UNESCAP administered Multi-Donor Trust Fund. UNESCO/IOC, UN/ISDR, the U.S. Geological Survey and OCHA supported training of trainers, schoolteachers, children and emergency management staff. On the basis of the country assessments, the UN Special Envoy for Tsunami Recovery, former President Clinton, launched the initiative for Strengthening National Capacities for Tsunami Early Warning and Response Systems in the Indian Ocean in March

2006. This initiative brought together eight international agencies (IFRC, ISDR, OCHA, UNDP, UNESCO-IOC, UNEP, WMO, and the World Bank) to support the development of operational set up for tsunami early warning systems in all countries of the Indian Ocean rim. The implementation of agreed national programmes is underway, depending on available funding and pledges. OCHA, in collaboration with implementing partners, supported projects for a total amount of 920'000 USD in preparedness and contingency planning, evacuation exercises, risk mapping, awareness raising programmes and capacity development of national disaster management authorities in 10 countries in the Indian Ocean (Sri Lanka, the Maldives, Thailand, Comoros, Madagascar, Seychelles, Tanzania, Kenya, Somalia, Yemen).

For the Caribbean and Adjacent Seas Tsunami Warning System, the Pacific Tsunami Warning Centre has been providing interim tsunami advisory services for the region since 2005 and since June 2007, the West Coast and Alaska Tsunami Warning Centre is responsible for issuing tsunami warnings also for Puerto Rico and the Virgin Islands. The ICG/ CARIBE EWS has designed the CARIBE-EWS in detail, and is aiming for the establishment of a regional Caribbean Tsunami Warning Centre in the region by 2010.

In the Northeast Atlantic and the Mediterranean region, ICG/NEAMTWS has established a Task Team to develop the best architecture of the various, partially existing components of the regional tsunami early warning system. Various proposals for the implementation of national tsunami warning and regional tsunami watch centres as well as instrumentation networks are currently developed by Member States and the ICG/NEAMTWS Working Groups. An Implementation Plan has been adopted to guide the establishment and operation national tsunami warning centres and regional tsunami watch centres, the implementation and status of all components such as the seismic and sea level networks is constantly under review by the ICG/NEAMTWS

UNESCO-IOC also coordinates the designation of National Focal Points (NFP) representing member states on tsunami matters in the IOC, and National Tsunami Warning Point (NTWP) for receiving and distributing tsunami warning and advisory information. The UNESCO-IOC website makes available all relevant information and documents of the various ICG meetings. The following is a summary of the designation of National Tsunami Focal Points in the four regions, as of June 2008:

i. All countries in the Pacific have identified official national tsunami focal points

ii. Of all countries in the Indian Ocean rim, two countries remain to confirm their official focal point and one had not nominated a focal point

iii. 23 out of 29 countries in the Caribbean and Adjacent Regions had made either complete (19) or partial (4) formal focal point nominations.

iv. In the Northeast Atlantic and the Mediterranean region, most countries are yet to designate their national tsunami focal points.

4.2.4. Health epidemics and pandemic alerts

Epidemics and pandemics can place sudden and intense demands on health systems. They expose existing weaknesses in these systems and, in addition to their morbidity and mortality can disrupt economic activity and development. The world requires a global system that can rapidly identify and contain public health emergencies and reduce unneeded panic and disruption of trade, travel and society in general. The revised International Health Regulations, IHR (2005) provide a global framework to address these needs through a collective approach to the prevention, detection, and timely response to any public health emergency of international concern.

The WHO through its Epidemic and Pandemic Alert and Response Programme, is addressing six core functions[17]:

[17] For the Epidemic and Pandemic Alert and Response Department of WHO see: http://www.who.int/csr/en/.

i. Support Member States for the implementation of national capacities for epidemic preparedness and response in the context of the IHR(2005), including laboratory capacities and early warning alert and response systems;

ii. Support national and international training programmes for epidemic preparedness and response;

iii. Coordinate and support Member States for pandemic and seasonal influenza preparedness and response;

iv. Develop standardized approaches for readiness and response to major epidemic-prone diseases (e.g. meningitis, yellow fever, plague);

v. Strengthen biosafety, biosecurity and readiness for outbreaks of dangerous and emerging pathogens outbreaks (e.g. SARS, viral haemorrhagic fevers);

vi. Maintain and further develop a global operational platform to support outbreak response and support regional offices in implementation at regional level.

4.3. Integration of risk information in warning messages

UNDP, through its Global Risk Information Programme (GRIP) supports development of sectoral risk information at the national level, through the development of standard loss databases and capacities to carry risk analysis for priority hazards. Risk assessment and climate risk assessment projects are a critical support for integration of risk information in warning messages.

In the domain of food security, WFP is developing remote sensing, satellite imagery and GIS tools for risk analysis and improved contingency planning, through the "Information Technology for Humanitarian Assistance, Cooperation and Action," thus, assisting the humanitarian community to anticipate and respond more practically and effectively to such humanitarian crises. In addition, FAO has conducted food production and food security assessments in 22 countries during 2007-2008, and is planning to conduct similar ones in 25 countries in 2009-2010. These assessments enable governments to assess and formulate food assistance needs and enhance food security.

Regarding environmental degradation, UNEP is developing information at the global scale in relation with slow onset disaster risk such as biodiversity loss and land degradation. These phenomena are not only aggravated by the occurrence of natural hazards, they also reduce capacities of communities to cope with natural hazards.

Humanitarian agencies, such as UNICEF, HCR and IFRC, also assist countries in the development and maintenance of sectoral risk information in relation with targeted communities and risks (e.g. women and children, refugees, water and sanitation).

4.4. Telecommunication, dissemination and information management

Since the early 1960's, the WMO Global Telecommunication System (GTS), which connects 188 countries around the world, has enabled sharing of various observations, forecasts, bulletins, watches and related information for meteorological and other hazards among regional specialized meteorological centres and the National Meteorological and Hydrological Services to issue the official national warnings. GTS is also the primary telecommunication system for exchange of tsunami related warnings and information. Starting in 2009, through the WMO Information System (WIS), information available through GTS will be increasingly opened to other designated national and regional centres contributing to protection of lives, livelihoods and property.

Currently, and in 2009, technologies available for warning dissemination are all being updated to use the Common Alerting Protocol (CAP), a kind of universal adaptor for alert messages. CAP messages include elements that describe the event and give instructions to the targeted receivers. It allows for a warning message to be disseminated consistently over different media (e.g. sirens, SMS, radio, telephone, TV, web services, news wires, dedicated warning networks). It also enables flexible geographic targeting, phased and delayed dissemination, as well as updates and cancellation features for warning messages. ITU and WMO are promoting the utilisation of CAP for public warnings.

UNOOSA, through the UN-SPIDER initiative, has continuously supported use of space technology and high-resolution radar imagery for emergency response in disaster situations. Needs of different users were assessed. The UN-SPIDER Knowledge Portal for the exchange of information on space-based technologies for disaster management, including detection and forecasting of hazards, is planned to be launched in 2009-2010. UNOSAT has continued to support implementation of GDACS, thus enabling international, regional, national and sub-national actors to receive early information and early warnings through use of RSS feeds.

Humanitarian agencies, through the IASC Sub-Working Group on Preparedness and Contingency Planning[18], IASC "Early Warning – Early Action Report", and the dedicated websites such as GDACS and Hewsweb[19], share a large amount of early information, as a decision support for preparedness, contingency planning, and coordination for supporting communities at risk.

4.5. Community Preparedness and response activities:

In most Early Warning Systems, as the two surveys in this report highlight, the bulk of effort and expense is put into transmitting information to decision-makers and government emergency management services. Far less effort and funding go to feeding community local hazard warning knowledge into government systems or to ensuring that understandable messages reach communities or households to help them to make sensible decisions about how to respond.

To overcome this anomaly, IFRC has since mid 1970's invested in community-based preparedness and early warning systems to save lives, protect property, and reduce economic losses. One of these investments, the volunteer-based Bangladesh cyclone preparedness program that has successfully warned, evacuated, and sheltered millions of people since the 1970s is very well known[20]. Less well known is the investment that 185 other Red Cross/Red Crescent members of the IFRC make each year in educating and preparing communities for their local disaster risk. In 2008, alone more than 150 national Red Cross/Red Crescent members world wide were engaged in community level preparedness activities that included, public awareness on disaster risk and community organisation for response using local volunteers.

For example, in the countries affected by 2005 Tsunami the Red Cross/Red Crescent societies have undertaken a commitment to build appropriate Community based early warning systems (CBEWS) in more than 6,500 communities[21]. In addition, one of its members, American Red Cross has launched a project (2008-2010) that facilitates the integration of tsunami warning in Sri Lanka, Vietnam, Indonesia and the Philippines by strengthening their multi-hazard national warning systems. The project will establish/strengthen early warning national forums in the target countries, build the capacity of national Red Cross societies to translate hazard information into response options and to communicate these options to at risk communities, and facilitate a system audit in order to test the functionality and reliability of these early warning systems.

[18] http://www.humanitarianinfo.org/iasc/pageloader.aspx?page=content-subsidi-swg_preparedness-default&bodyID=14&publish=0

[19] http://www.hewsweb.org/home_page/default.asp

[20] World Disaster Report 1995, Surviving Cyclones in Bangladesh

[21] http://www.ifrc.org/what/disasters/response/tsunamis/index.asp

Similarly to expand its community based disaster risk reduction actions, IFRC launched in September 2007 a "Global Alliance on Disaster Risk Reduction". The alliance which initially focuses on twenty countries[22] has developed a global framework for "Building Safer and Resilient Communities" communities and includes five key components:

i. Risk assessment and identification and the establishment of community-based early warning and prediction

ii. Community-based disaster preparedness.

iii. Advocacy, education and awareness-raising.

iv. A strong auxiliary relationship with local and national governments.

v. Partnerships with international, governmental, non-governmental and community based organizations.

CBEWS have always been a vital part of disaster preparedness for the Red Cross/Red Crescent[23] but it has increased its importance in an era of new and increasing disaster risks. The ability of communities for example to adapt to climate change also is affected by their access to early warning information on weather-related risks[24].

A recent example of the pre-emptive use of CBEWS comes from West and Central Africa, where IFRC has partnered with regional climate forecasting professionals and in 2008, following predictions of above average rains, an appeal[25] for regional flood preparedness was launched – the first of its kind. National Red Cross/Red Crescent societies in the region were supported to take early action on seasonal forecasts, including the organising community volunteers and positioning of relief stocks in strategic locations.

5. Summary and Recommendations

In summary, while there has been some progress in strengthening early warning systems capacities, there is need for strengthened commitment to addressing the development of these capacities. Specifically, a number of issued are highlighted below:

1) Existing national and local emergency preparedness and response plans need to be re-evaluated, based on hazard and vulnerability mapping, and must be supported by enforceable legislation. These plans need to clearly indicate the line of command, roles and responsibilities of different agencies engaged in different components of early warning systems, must be aligned across community, provincial, and national levels, ensuring that financial and operational resources are routed to the communities for improving preparedness and response operations on the ground.

2) There is need for further strengthening of monitoring and forecasting infrastructure and skills of the staff of technical agencies (e.g. National Meteorological and Hydrological Services, geological services, ocean services, etc) that are responsible for monitoring and forecasting of hazards. This needs to be further complemented with strengthened cooperation, coordination and knowledge sharing among the technical agencies and with their disaster risk management counterparts for provision of improved warnings.

[22] The number of countries in alliance will increase from 2010. Current plans include an expansion of 10 countries each year.

[23] Red Cross Red Crescent good practices in early warning
http://www.ifrc.org/Docs/pubs/disasters/resources/preparing-disasters/cs-earlywarning.pdf

[24] Red Cross/Red Crescent Climate Guide:
http://www.climatecentre.org/downloads/File/reports/RCRC_climateguide.pdf

[25] http://www.ifrc.org/docs/appeals/08/MDR61003PrelEA.pdf

3) National technical agencies could benefit from strengthened regional cooperation for access to data and latest tools and technologies for monitoring and forecasting of hazards, as has been demonstrated through a number of existing regional cooperation mechanisms such as the Pacific and the Indian Ocean Tsunami Warning Systems (coordinated by UNESCO-IOC) and the WMO global tropical cyclone programme, which facilitates tropical cyclone and storm surge forecasts and bulletins through six regional specialized centres to all countries at risk. Furthermore, there is need for strengthened cooperation among neighbouring countries for establishment of standards, procedures and protocols for warnings on trans-boundary issues.

4) There is need for establishment of standardized hazard and impact databases, as well as national technical capacity development for utilization of hazard and risk mapping tools to support emergency response and preparedness planning and integration of risk information in warning messages.

5) In most countries, dissemination channels that link national warning systems to the communities need to be strengthened significantly, taking into consideration cultural and communities' needs as well as sustainability issues on the basis of resources available. Feedback mechanisms to verify that warnings have reached the authorities and at-risk communities must be established. Furthermore, there is need for training programmes targeted at the authorities, emergency response staff and the pubic for understanding the source of the warnings, content of the warning messages and linking this information to concrete actions on the ground based on the risk levels (e.g. establishment of risk readiness levels, etc).

6) Emergency preparedness and response plans need to be developed utilizing hazard and vulnerability maps. There is need for increased drills and public awareness and training programmes at the community level, particularly when the community does not experience hazards frequently.

7) There is need for development of Concept of Operations and Standard Operational Procedures for early warning systems of different hazards enabling effective coordination and cooperation across various components of the early warning systems from national to local levels.

8) Early warning system programmes should be complemented with an effective regional-national-local, multi-agency operational evaluation and feedback mechanism to improve the systems over time.

9) Strengthened cooperation, coordination and strategic planning among international agencies could lead to a more effective approach for the development of the national EWS programmes

10) A comprehensive coordinated survey of all components of EWS at the national level, built on the national networks of the international agencies working in this area, could lead to a more detailed and improved global assessment of the status of EWS.

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Annex 1: Questionnaire Template for the PPEW-UNU Survey

1. Is there on-going consultation with international agencies on early warning?	yes ☐	no ☐	*If yes, please indicate:* ☐ FAO ☐ WMO ☐ WHO ☐ WFP ☐ ITU ☐ UNEP ☐ UNDP ☐ OCHA ☐ UN/ISDR ☐ World Bank ☐ UNESCO/IOC ☐ UNICEF ☐ UNOOSA ☐ UNU ☐ USGS ☐ SOPAC ☐ IFRC ☐ NOAA ☐ ADRC ☐ Others: ____	
2. Has national legislation or policy been developed for implementing early warning systems?	yes ☐	no ☐	*If yes, please indicate:* **(a)** Has the authority and political responsibility for issuing warnings been established in law?	yes ☐ no ☐
			(b) Are the chains of command for the dissemination of warnings related to natural hazards established?	yes ☐ no ☐
			(c) Are warning system partners, including local authorities, aware of which organizations are responsible for warnings?	yes ☐ no ☐
3. Have national standards been developed for the operation of early warning systems?	yes ☐	no ☐	*If yes, please indicate:* **(a)** Are these standardized with neighboring countries or regional authorities?	yes ☐ some ☐ no ☐
			(b) Do standards differ from hazard to hazard?	yes ☐ no ☐
4. Are recognized authorities empowered to disseminate warning messages (e.g. meteorological services, health authorities)?	yes ☐	no ☐	*If yes, please indicate:* **(a)** Is the warning dissemination chain enforced through government policy or legislation (e.g. message passed from government to emergency managers and communities etc)?	yes ☐ some ☐ no ☐
			(b) Are the functions, roles and responsibilities of each actor in the warning dissemination process specified in legislation or government policy (e.g. national meteorological and hydrological services, media, NGOs)?	yes ☐ some ☐ no ☐
5. Are communication and dissemination systems tailored to the needs of individual communities (e.g. radio or television for those with access; and sirens, warning flags or messenger runners for remote communities)?	yes ☐	no ☐	*If yes, please indicate:* **(a)** Is the communication system two-way and interactive to allow for verification that warnings have been received?	yes ☐ some ☐ no ☐
			(b) Are mechanisms in place to inform the community when the threat has ended?	yes ☐ some ☐ no ☐
			(c) Are warning messages issued in a language understandable to those at risk?	yes ☐ no ☐
6. Are disaster preparedness and response plans empowered by law?	yes ☐	no ☐	*If yes, please indicate:* **(a)** Are disaster preparedness and response plans adapted to the individual needs of vulnerable communities?	yes ☐ no ☐
			(b) Are hazard and vulnerability maps utilized to develop emergency preparedness and response plans?	yes ☐ some ☐ no ☐
7. Has the community's ability to respond effectively to early warnings been assessed?	yes ☐	no ☐	*If yes, please indicate:* **(a)** Has response to previous disasters been analyzed and lessons learnt been incorporated into future capacity building strategies?	yes ☐ no ☐
			(b) Have community-focused organizations been engaged to assist with capacity building for preparedness?	yes ☐ some ☐ no ☐
8. Has simple information on hazards, vulnerabilities and risks been disseminated to vulnerable communities and decision-makers?	yes ☐	no ☐	*If yes, please indicate:* **(a)** Has the community been educated on how warnings will be disseminated and how to respond to hazards after an early warning message is received?	yes ☐ some ☐ no ☐
			(b) Have mass media, indigenous knowledge, folk or alternative media been utilized for public warnings?	yes ☐ no ☐

Characteristics of natural hazards and related maps							Early warning systems in operation in the country						
Hazard Analysis			*If yes, please indicate:*										
Characteristics of natural hazards (e.g. intensity, frequency and probability) analyzed at the national level. *Indicate existing hazards:*			Hazard maps have been developed	Vulnerability assessments have been conducted	Risk assessments and risk maps developed at national or local level	Maps were used for developing EWS in vulnerable areas	Years of operation of the system	System based on legislation	Annual funding allocated	Data processed in real or near real time	Preformated messages to issue public warnings	Standard Operating Procedure (SOPs) in place	Post-event evaluation used to improve the EWS
Natural hazard	**yes**	**no**	**yes**	**yes**	**yes**	**yes**		**yes**	**yes**	**yes**	**yes**	**yes**	**yes**
Volcanic activity	☐	☐	☐	☐	☐	☐	____	☐	☐	☐	☐	☐	☐
Lahars	☐	☐	☐	☐	☐	☐	____	☐	☐	☐	☐	☐	☐
Earthquakes	☐	☐	☐	☐	☐	☐	____	☐	☐	☐	☐	☐	☐
Tsunami	☐	☐	☐	☐	☐	☐	____	☐	☐	☐	☐	☐	☐
Landslides	☐	☐	☐	☐	☐	☐	____	☐	☐	☐	☐	☐	☐
Tropical cyclones	☐	☐	☐	☐	☐	☐	____	☐	☐	☐	☐	☐	☐
Floods	☐	☐	☐	☐	☐	☐	____	☐	☐	☐	☐	☐	☐
Severe storms	☐	☐	☐	☐	☐	☐	____	☐	☐	☐	☐	☐	☐
Drought	☐	☐	☐	☐	☐	☐	____	☐	☐	☐	☐	☐	☐
Extreme temperature	☐	☐	☐	☐	☐	☐	____	☐	☐	☐	☐	☐	☐
Dust and sand storms	☐	☐	☐	☐	☐	☐	____	☐	☐	☐	☐	☐	☐
Avalanches	☐	☐	☐	☐	☐	☐	____	☐	☐	☐	☐	☐	☐
Famine/food insecurity	☐	☐	☐	☐	☐	☐	____	☐	☐	☐	☐	☐	☐
Epidemics	☐	☐	☐	☐	☐	☐	____	☐	☐	☐	☐	☐	☐
Locusts	☐	☐	☐	☐	☐	☐	____	☐	☐	☐	☐	☐	☐
Wildland fire	☐	☐	☐	☐	☐	☐	____	☐	☐	☐	☐	☐	☐
Land degradation and desertification	☐	☐	☐	☐	☐	☐	____	☐	☐	☐	☐	☐	☐
____*	☐	☐	☐	☐	☐	☐	____	☐	☐	☐	☐	☐	☐
____*	☐	☐	☐	☐	☐	☐	____	☐	☐	☐	☐	☐	☐
____*	☐	☐	☐	☐	☐	☐	____	☐	☐	☐	☐	☐	☐

Has an integrated risk map been developed to assess the interaction of multiple natural hazards? yes ☐ no ☐	*Which hazard(s) are included?* ____

Early warning systems in operation in the country																
	Are measurement parameters and specifications documented for each hazard?	Is technical equipment in place and the personnel trained in its use and maintenance?		Are data and analysis from regional networks adjacent territories and international sources accessible?	Is data received, processed and available in meaningful formats in real time, or near-real time?	Are data analysis, prediction and warning generation based on accepted scientific and technical methodologies?		Are data and warning products issued according to standards and protocols?	Are warnings generated and disseminated in an efficient and timely manner and in a format suited to user needs?		Is the authority to issue warnings operational at all times and mandated by law with roles and responsibilities defined?	Are protocols in place to define communication responsibilities and channels for technical warning services?		Is a system established to verify that warnings have reached the intended recipients?	Are warning centers staffed at all times?	Are early warning drills conducted regularly in communities at risk to improve preparedness and response plans?
	yes	**yes**	**some**	**yes**	**yes**	**yes**	**some**	**yes**	**yes**	**some**	**yes**	**yes**	**some**	**yes**	**yes**	**yes**
Volcanic activity	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Lahars	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Earthquakes	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Tsunami	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Landslides	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Tropical cyclones	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Floods	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Severe storms	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Drought	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Extreme temperature	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Dust and sand storms	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Avalanches	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Famine/food insecurity	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Epidemics	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Locusts	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Wildland fire	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Land degradation and desertification	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
_____*	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
_____*	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
_____*	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

* Add relevant hazard

Annex 2: Questionnaire Template developed and distributed by WMO to survey the activities of the International Agencies

Section I: Your Agency's Mandate and Contributions for Hazard-Specific Warnings

In this survey, early warning systems are considered as end-to-end systems, and include five components, namely:

1. Governance and Organisational Coordination;
2. Detection, and Forecasting of Hazards;
3. Incorporating Risk Knowledge in Warning Messages;
4. Telecommunication and Dissemination of warnings at the national level;
5. Emergency Preparedness and Response.

		Governance and Organisational Coordination		*Detection, and Forecasting of Hazards*		*Incorporating Risk Knowledge in Warning Messages*		*Telecommunication and Dissemination (national level)*		*Emergency Preparedness and Response*	
		Full mandate	Support	Full mandate	Support	Full mandate	Support	Full mandate	Support	Full mandate	Support
METEOROLOGICAL	Aviation hazards (i.e., turbulence, icing)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Cold and heat waves	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Drought	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Hailstorms and freezing rain	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Heavy snow and avalanches	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Sand and dust storms	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Severe storms	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Thunderstorms or lightning	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Tornados	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Tropical cyclones	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
HYDROLOGICAL	Coastal flooding	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Flash flood	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	River flooding	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
GEOLOGICAL	Earthquakes	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Volcanoes	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Tsunamis	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
MARINE	Extreme waves	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Storm and storm surges	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Sea fog	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Sea ice and icebergs	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
OTHER	Desert locust swarm	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Health epidemics	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Air pollution, smoke, dust or haze	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Airborne hazardous substances (i.e., nuclear, biological, chemical, etc.)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Waterborne hazards (i.e., nuclear, biological, chemical, oil spills, etc.)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Desertification and environmental degradations	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Forest or wildland fire	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Landslides, mudslides, mudflows	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Section II: Your Agency's Contribution to Strengthening National Early Warning Capacities

Please tick below the major 5-15 countries where your agency is engaged in projects and initiatives that specifically contribute to strengthening of early warning systems' **national** capacities. Please also indicate whether your agency supports early warning systems though regional and global activities. Specific initiatives would be further described in Section III to VIII.

☐ Global programme / activities (please name):	☐ Regional activities (please name):	
☐ Afghanistan	☐ Ghana	☐ Nigeria
☐ Albania	☐ Greece	☐ Norway
☐ Algeria	☐ Grenada	☐ Oman
☐ Andorra	☐ Guatemala	☐ Pakistan
☐ Angola	☐ Guinea	☐ Palau
☐ Antigua and Barbuda	☐ Guinea-Bissau	☐ Panama
☐ Argentina	☐ Guyana	☐ Papua New Guinea
☐ Armenia	☐ Haiti	☐ Paraguay
☐ Australia	☐ Honduras	☐ Peru
☐ Austria	☐ Hungary	☐ Philippines
☐ Azerbaijan	☐ Iceland	☐ Poland
☐ Bahamas	☐ India	☐ Portugal
☐ Bahrain	☐ Indonesia	☐ Qatar
☐ Bangladesh	☐ Iran, Islamic Republic of	☐ Romania
☐ Barbados	☐ Iraq	☐ Russian Federation
☐ Belarus	☐ Ireland	☐ Rwanda
☐ Belgium	☐ Israel	☐ Saint Kitts and Nevis
☐ Belize	☐ Italy	☐ Saint Lucia
☐ Benin	☐ Jamaica	☐ Saint Vincent and the Grenadines
☐ Bhutan	☐ Japan	☐ Samoa
☐ Bolivia	☐ Jordan	☐ San Marino
☐ Bosnia and Herzegovina	☐ Kazakhstan	☐ Sao Tome and Principe
☐ Botswana	☐ Kenya	☐ Saudi Arabia
☐ Brazil	☐ Kiribati	☐ Senegal
☐ Brunei Darussalam	☐ Democratic People's Republic of Korea	☐ Serbia
☐ Bulgaria	☐ Republic of Korea	☐ Seychelles
☐ Burkina Faso	☐ Kuwait	☐ Sierra Leone
☐ Burundi	☐ Kyrgyzstan	☐ Singapore
☐ Cambodia	☐ Lao People's Democratic Republic	☐ Slovakia
☐ Cameroon	☐ Latvia	☐ Slovenia
☐ Canada	☐ Lebanon	☐ Solomon Islands
☐ Cape Verde	☐ Lesotho	☐ Somalia
☐ Central African Republic	☐ Liberia	☐ South Africa
☐ Chad	☐ Libyan Arab Jamahiriya	☐ Spain
☐ Chile	☐ Liechtenstein	☐ Sri Lanka
☐ China	☐ Lithuania	☐ Sudan
☐ Colombia	☐ Luxembourg	☐ Suriname
☐ Comoros	☐ Macedonia, the former Yugoslav Republic of	☐ Swaziland
☐ Democratic Republic of the Congo	☐ Madagascar	☐ Sweden
☐ Congo, Republic of the	☐ Malawi	☐ Switzerland
☐ Costa Rica	☐ Malaysia	☐ Syrian Arab Republic
☐ Côte d'Ivoire	☐ Maldives	☐ Tajikistan
☐ Croatia	☐ Mali	☐ United Republic of Tanzania
☐ Cuba	☐ Malta	☐ Thailand
☐ Cyprus	☐ Marshall Islands	☐ Timor-Leste
☐ Czech Republic	☐ Mauritania	☐ Togo
☐ Denmark	☐ Mauritius	☐ Tonga
☐ Djibouti	☐ Mexico	☐ Trinidad and Tobago
☐ Dominica	☐ Micronesia, Federated States of	☐ Tunisia
☐ Dominican Republic	☐ Moldova	☐ Turkey
☐ Ecuador	☐ Monaco	☐ Turkmenistan
☐ Egypt	☐ Mongolia	☐ Tuvalu
☐ El Salvador	☐ Montenegro	☐ Uganda
☐ Equatorial Guinea	☐ Morocco	☐ Ukraine
☐ Eritrea	☐ Mozambique	☐ United Arab Emirates
☐ Estonia	☐ Myanmar	☐ United Kingdom of Great Britain
☐ Ethiopia	☐ Namibia	☐ United States of America
☐ Fiji	☐ Nauru	☐ Uruguay
☐ Finland	☐ Nepal	☐ Uzbekistan
☐ France	☐ Netherlands	☐ Vanuatu
☐ Gabon	☐ New Zealand	☐ Venezuela, Bolivarian Republic of
☐ Gambia	☐ Nicaragua	☐ Viet Nam
☐ Georgia	☐ Niger	☐ Yemen
☐ Germany		☐ Zambia
		☐ Zimbabwe

Section III: Governance and Organisational Coordination in Support of Early Warning Systems

If initiatives of your agency have influenced plans or political and financial commitments to early warning systems in 2007 – 2008, please describe them briefly, explain the process through which commitment has been raised, and clarify the outcomes.

Examples: agreements on authoritative warnings and response plans, legislation defining roles and responsibilities of different agencies, legal frameworks for data sharing between relevant services, standards, etc.;

Please indicate plans for 2009 – 2010 (for all or some hazards as listed in Section I, please specify).

For warning with regard to those hazards for which your agency plays a role, as identified in Section I, please highlight the major operational coordination arrangements of your agency with other agencies in the context of early warning systems. Please indicate if this coordination takes place at international, regional and/or national levels.

Examples: operational coordination for hazard detection and forecasting, risk assessment, dissemination of warnings, and emergency response, or between these components, that would involve either different ministries, technical agencies, public-private partnerships, etc..

Section IV: Progress with Capacities for Detection, and Forecasting of Hazards

If applicable, please indicate developments in 2007 – 2008 through your agency or its national counterparts, which have improved capacities for detection and forecasting (for all or some hazards as listed in Section I, please specify).

Examples: Development of earth observation systems, identification of specific users' requirements for early warning systems, provision of advisories across borders for development of national warnings, multi-hazard approach to utilisation of observing systems (even beyond their initial purpose).

Please indicate plans for 2009 – 2010 (for all or some hazards as listed in Section I, please specify).

Section V: Progress with Capacities to Incorporate Risk Knowledge in Warning Messages

If applicable, please indicate developments in 2007 – 2008 through your agency or its national counterparts, which have facilitated transition from hazard warning to risk warnings, and enhanced utilisation of risk information for decision making (e.g., landuse and sectoral planning, emergency preparedness and response) (for all or some hazards as listed in Section I, please specify).

Examples: Assessment of potential impacts and associated probabilities, utilisation of communities' skills, feedbacks and lessons learned for enhancing early warning systems, enhancing accessibility of risk information, assessment of impacts of climate change on risk, etc.

Please indicate plans for 2009 – 2010 (for all or some hazards as listed in Section I, please specify).

If applicable, please indicate national case studies where warning messages have evolved from hazard warnings to risk warnings through enhanced coordination and utilisation of capacities available through different agencies (for all or some hazards as listed in Section I, please specify).

Examples: Heat-health warning through coordination between health and meteorological services, coastal risk warnings or tsunami warnings through coordination between marine and meteorological services, etc.

Section VI: Progress with Strengthening International, Regional and National Telecommunication Mechanisms

If applicable, please indicate developments in 2007 – 2008 through your agency or its national counterparts, which have strengthened international, regional and/or national telecommunication mechanisms for early warning systems (for all or some hazards as listed in Section I, please specify).

Examples: Redundancy and quality assurance of emergency telecommunication mechanisms, utilising combination of traditional and modern technologies, cross-training between technical agencies developing warnings and agencies involved in dissemination of information to public, public education, simulation exercises and emergency drills, utilisation of media to educate the public, development of credibility, authoritativeness and legitimacy of the sources of warnings, utilisation of warning-specific communication tools for other purposes in order to generate and maintain public awareness, etc.

Please indicate plans for 2009 – 2010 (for all or some hazards as listed in Section I, please specify).

Section VII: Progress with Linking Warning Systems to Emergency Preparedness and Response Mechanisms at National to Community Levels

If applicable, please indicate developments in 2007 – 2008 through your agency or its national counterparts, which have strengthened the link between warning systems and emergency preparedness and response mechanisms at national to community levels (for all or some hazards as listed in Section I, please specify).

Examples: Development or updating of emergency preparedness and response plans, linking warning levels to actions at relevant levels, joint training between agencies responsible for developments and issuance of warnings and emergency operators, awareness and educational programmes targeted at public, setting of partnerships (including public-private and regional cooperation) for enhanced response capacities, etc.

Please indicate plans for 2009 – 2010 (for all or some hazards as listed in Section I, please specify).

Section VIII: Progress with Assessing Benefits of Early Warning Systems

If applicable, please indicate progress in 2007 – 2008 through your agency or its national counterparts, for assessment of benefits of early warning systems (for all or some hazards as listed in Section I, please specify).

Examples: Assessment of the added value of coordination and collaborations, of effectiveness of a multi-hazard approach to early warning systems, demonstration of benefits of early warning systems compared with alternative actions, national developments that have been triggered / enabled by the warning systems, etc.

Please indicate plans for 2009 – 2010 (for all or some hazards as listed in Section I, please specify).

If applicable, please detail, through examples where warning systems have clearly saved lives or properties, the operational processes that led to such savings (for all or some hazards as listed in Section I, please specify).

Annex 3: International stakeholders providing support to national early warning systems

Agency	Natural Hazards (blank for all)	Lead Role for...				
		Governance and Organisational Coordination	*Detection, and Forecasting of Hazards*	*Incorporating Risk Knowledge in Warning Messages*	*Telecommunication and Dissemination*	*Emergency Preparedness and Response*
FAO	• Drought • Desert locust swarm • Desertification and environmental degradations • Forest or wildland fire			**X**		**X**
GFMC	• Forest or wildland fire		**X**			
GEO						
IFRC		**X**		**X**	**X**	**X**
ISDR		**X**				
ITU					**X**	
OCHA		**X**		**X**	**X**	**X**
ProVention		**X**				
UNU				**X**		
UNDP		**X**		**X**		**X**
UNEP	• Desertification and slow onset environmental degradations	**X**	**X**	**X**		
UNESCO and its IOC	• Earthquakes • Volcanoes • Landslides, mudslides, mudflows • Tsunamis • Extreme waves • Storm and storm surges • Sea fog • Sea ice and icebergs		**X**			
UNICEF				**X**		**X**

Agency	Natural Hazards (blank for all)	Lead Role for...				
		Governance and Organisational Coordination	*Detection, and Forecasting of Hazards*	*Incorporating Risk Knowledge in Warning Messages*	*Telecommunication and Dissemination*	*Emergency Preparedness and Response*
UNOOSA			X		X	
UNOSAT				X	X	
WFP	• Hazards related to agriculture and food security	X	X	X		X
WHO	• Health epidemics • Cold and heat waves		X	X		X
World Bank		X		X		
WMO	• Aviation hazards • Cold and heat wave • Drought • Hailstorms and freezing rain • Heavy snow and avalanches • Sand and dust storms • Severe storms • Thunderstorms or lightning • Tornados • Tropical cyclones • Coastal flooding • Flash flood • River flooding • Tsunami (warning dissemination only) • Extreme waves • Storm and storm surges • Sea fog • Sea ice and icebergs • Desert locust swarm • Health epidemics • Air pollution, smoke, dust or haze • Airborne hazardous substances • Waterborne hazards • Desertification and environmental degradations • Landslides, mudslides, mudflows • Forest or wildland fire		X	X	X	