Capacity Assessment of National Meteorological and Hydrological Services in Support of Disaster Risk Reduction

Analysis of the 2006 WMO Disaster Risk Reduction Country-level Survey

World Meteorological Organization

Weather • Climate • Water

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CHAPTER 1
Introduction

1 INTRODUCTION AND GENERAL BACKGROUND

1.1 Overview of hazards and vulnerability

Every year natural hazards cause significant loss of life, and set back economic and social development by years if not decades. From 1980 to 2005, weather-, water- and climate-related hazards and conditions accounted for 90% of total number of disasters, 72% of the two million casualties, and 75% of total economic loss (Figure 1). Furthermore, the risk associated with the potential of increasing severity and frequency of hydro-meteorological hazards linked to climate variability within a changing climate, as reported in the fourth assessment report of the Intergovernmental Panel on Climate Change, appears to be on the rise.

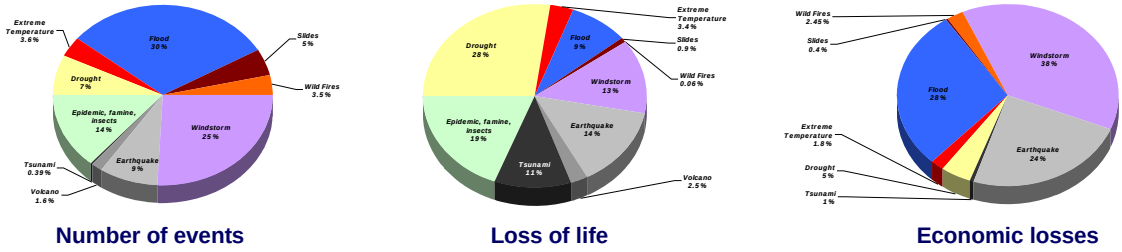


Figure 1. 90% of disaster events, 70% of loss of life and 75% of economic losses are related to hydro-meteorological hazards *(source: EM-DAT: The OFDA/CRED International Disaster Database)*

While on the global scale the number of disasters and related economic losses from weather-, climate- and water-related hazards have increased over the 1956-2005 period (respectively nearly 10-fold and 50-fold), the reported loss of life has decreased from 2.66 millions over 1956-1965 decade to 0.22 million over 1996-2005 decade, as illustrated in Figure 2. The reduction in loss of life is the result of enhanced disaster risk reduction policies and tools, including contingency planning and early warning systems.

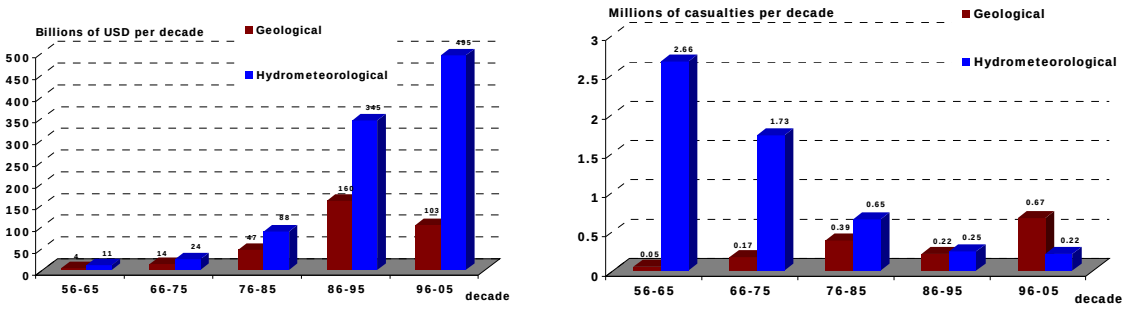


Figure 2. Decadal loss of life and economic losses related to geological versus hydrometeorological hazards *(source: EM-DAT: The OFDA/CRED International Disaster Database)*

In terms of human life, between 1980 and 2005, nearly 7500 natural disasters worldwide have taken the lives of over 2 million people. Least developed countries, accounting for 10% of the world's population, recorded 41% of the global losses of life. Furthermore, over the same period, small island developing states (SIDS) that correspond to 0.8% of the planet recorded 5% of disaster events that happened around the world. Thus, disaster risk reduction should be considered as a priority, and specifically in SIDS, developing and least developed countries.

1.2 Hyogo Framework

Traditionally in disaster management, attention has been focused almost exclusively on actions taken immediately before, during and shortly after a disaster, in what can be called "crisis management" approach.

Today, it is recognized that attention needs to be given to preparedness and prevention strategies. For this to be true, a paradigm shift was called for, which requires a move from “crisis management” to a much more proactive, holistic and systematic approach.

The need for a strategic approach to improving the effectiveness and efficiency of disaster management and disaster risk reduction resulted in the Hyogo Framework for Action 2005-2015 (HFA): Building the Resilience of Nations and Communities to Disasters; a resolve of 168 Governments for action, adopted at the Second World Conference on Disaster Reduction, held in Hyogo, Kobe, Japan in January 2005. HFA is the primary international agreement for disaster risk reduction as it identifies the main actors, the guiding principles, priorities and key activities for achieving disaster risk reduction from the international to the community-level. HFA is a global blueprint for disaster risk reduction efforts during the decade 2005 – 2015.

HFA recognises the inextricable link between natural disasters, poverty, development and environmental issues. It emphasises that disaster risk reduction should be part of every day decision making, as each decision one takes can make us either more vulnerable or more resilient to disasters. It also stresses the need for strong collaboration and cooperation among various agencies. Therefore, efforts to reduce disaster risk require the mainstreaming of disaster risk reduction, through a systematic approach, into development policies, strategies and plans and underpinned by appropriate governance and organizational mechanisms and supported by bilateral, regional and international cooperation, including partnerships. Effective disaster risk management often marks the difference between a natural hazard and a disaster.

Within HFA, the State is considered as primarily responsible for taking measures to reduce disaster risks. However, due to limited capacities, particularly of developing and least developed countries, regional and international cooperation is required to assist high-risk and low-capacity countries, so as to stimulate efforts towards building the resilience of countries and communities concerned.

1.3 Disaster Risk Management

A systematic approach to disaster risk management, as derived from HFA, encompasses risk identification, risk reduction and risk transfer, underpinned by effective governance and organizational coordination mechanisms and effective sharing of knowledge as shown in Figure 3 below.

Figure 3. Conceptual framework of disaster risk management

1.3.1 Governance

The success of disaster risk management efforts is critically dependent on good governance. Good governance includes the adoption and promotion of robust and sound policies, legislation, coordination mechanisms, regulatory frameworks and the creation of an enabling environment that is characterized by

appropriate decision making processes to allow effective participation of stakeholders, including the general population, and assisted by appropriate allocation of resources. Other features of good governance include the rule of law, transparency, equity, efficiency, effectiveness, responsiveness, consensus orientation, accountability and a strategic vision that is based upon sound data and information.

1.3.2 DRR Coordination Mechanisms

Many governments, in response to the HFA first Priority for action "*ensure that disaster risk reduction is a national and a local priority with a strong institutional basis for implementation*", have been and are setting up several types of multi-stakeholder coordination mechanisms within their countries. Some examples include:

- Governmental Inter-Ministerial Coordination Mechanisms, usually under the head of the government, to coordinate activities of various ministries related to disaster risk reduction;
- National Platforms for Disaster Risk Reduction involving different stakeholders (government institutions, private sector, NGO, academic and research institutions, communities, etc.);
- The role of the Office of the UN Resident Coordinator for the coordination of disaster risk reduction activities among UN agencies and with governments.

1.3.3 Risk identification and Assessment

Risk identification involves quantification of risk through understanding hazard, vulnerabilities and exposure patterns. This knowledge is essential for development of strategies and measures for reducing the risks.

Risk identification provides the first essential step for development of sound risk management strategies. A fundamental requirement is the availability of historical and real-time, systematic and consistent, observations of hydro-meteorological parameters, complemented with other forecast products providing information on expected patterns of hazards from the next hour to longer time frames. This must be complemented with vulnerability and exposure information, tools and methodologies for hazard analysis, mapping as well as sectoral risk assessment and modelling.

Hazard events are characterized by magnitude, duration, location and timing. Calculating the probability of occurrence of hazard events in terms of these characteristics is the key in understanding fully the hazard component of disaster impacts. These defining characteristics provide a basis for extracting information on hazard frequency and severity from observational datasets. The fundamental requirement is the availability of, and access to, high quality historical meteorological and hydrological data that is provided by the NMHSs. This requires:

- Ongoing, systematic and consistent observations of hazard-relevant hydro-meteorological parameters;
- Quality assurance and proper archiving of the data into temporally and geographically referenced, and consistently catalogued, observational datasets; and
- Ensuring that the data can be located and retrieved by users.

1.3.4 Risk Reduction

Risk reduction involves actions taken to reduce the overall risks associated with disasters. Such actions would include early warning systems, emergency preparedness mechanisms and short-, medium- and long-term sectoral planning.

1.3.4.1 Early Warning Systems

The second priority for action of the Hyogo Framework for Action, stresses the need for "identifying, assessing and monitoring disaster risk and enhancing early warnings" as pre-conditions for natural disaster risk reduction. Availability of well-functioning early warning systems with an integrated multi-hazard approach that deliver accurate, reliable and understandable warnings, in a timely fashion to authorities, operational managers and the population at risk, is essential to enable early actions to prevent and reduce the impacts of potential disasters.

Effective early warning systems involve four components, including:

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

1.3.4.2 Emergency planning and preparedness

Emergency planning and preparedness includes actions and activities that are taken before a disaster happens, which reduce or mitigate its effects on the population's lives and livelihoods and enable them to more effectively respond and cope. These actions and activities can include:

- Establishment of national to local emergency response policies, standards, organizational linkages between emergency response stakeholders, and operational plans to be followed after a disaster
- Education and training of officials and the population at risk
- Operational education and training for emergency responders
- Development and regular testing of warning systems, response and evacuation plans, etc

The goal of these preparedness activities is to ensure that the government and the population at risk are ready and able to respond quickly and effectively in the event of an emergency.

1.3.4.3 Sectoral planning

The economic and social impacts of weather, climate and water continue to grow year to year. Today, up to 30% of developed country's GDP is sensitive to meteorological, hydrological and climate conditions, while the sensitivity is even higher in developing and least developed countries,

With the increasing risks associated with climate variability and change (as indicated by IPCC's 4th Assessment Report), the socio-economic system for food, water, shelter, energy, etc could be significantly disrupted. Meteorological, hydrological and climate information underpins better informed decision making and planning for the protection of lives and livelihoods.

For example, NMHSs have the potential capacity to provide, and in some cases do, provide, hazard information such as frequency, magnitude and trends that are required for the development of policy and legislation pertaining to disaster risk reduction such as mainstreaming of hydrometeorological risk assessment infrastructure and urban planning, costal zoning and land use planning.

NMHSs are the primary authoritative source of hydrometeorological data, products and services that provide the basis for informed sectoral planning that insures community resilience to weather climate and water hazards.

1.3.5 Risk Transfer

Financial risk transfer mechanisms enable distribution of the (i) risks associated with extreme events (e.g. floods, droughts, earthquakes and tropical cyclones) and (ii) accumulated risks linked to deviation of meteorological conditions from "normal" (e.g. late on-set, warmer or cooler than normal seasons). These markets have primarily focused on developed countries, involving a wide range of standardized and customized financial products targeted at various sectors through catastrophic insurance, catastrophic bonds, and weather risk management products. However, under the new paradigm of disaster risk management, a number of international agencies including the World Bank, World Food Programme (WFP), WMO and the reinsurance sector are joining forces to facilitate the development of these markets in the developing and least developed countries.

1.3.6 Knowledge Sharing and Training

Knowledge sharing and training in disaster risk reduction, involves a wide range of actors and disciplines with a view to improve people's understanding of how they can best protect themselves, their property and livelihoods. It is carried out through formal education and training at schools and universities, specific training

activities carried out by specialized institutions and informal education structures such as social networks, interest groups and others.

Effective NMHSs promote training of their stakeholders on aspects related to hydrometeorological hazards and early warning systems. In particular, these NMHSs play an important role in training users to understand risks associated with hydrometeorological hazards and the benefits of hydrometeorological products and services to support disaster risk reduction and socio-economic development.

1.3.7 Climate change

The 4th Assessment Report of the IPCC (established by WMO and the United Nations Environmental Programme in 1988), provides the latest scientific consensus on the implication of climate variability and change on expected trends and characteristics of meteorological, hydrological and climate –related hazards such as tropical cyclones, floods, droughts, etc. Such changes would result in new vulnerabilities and new patterns of risk.

Disaster risk management is a critical component of climate adaptation strategies. Emergence of capacities for forecasting the changing trends and characteristics of extreme events under climate variability and change scenarios provides critical information to supplement risk assessment capacities on the basis of statistical analysis of historical data.

1.4 Role of NMHSs in DRR

A fundamental mission of National Meteorological and Hydrological Services[1] (NMHSs) and the World Meteorological Organization (WMO) is to contribute to the protection of the lives and livelihoods of people by providing early warnings of meteorological and hydrological hazards and related information to reduce risks. WMO and the NMHSs have vital contributions to make to disaster prevention and preparedness, mitigation of the impacts of disasters, emergency response, recovery and reconstruction**.** Some examples of these contributions include:

- Monitoring and providing early warnings of meteorological and hydrological hazards ranging from tropical cyclones, tornadoes, flash floods and storm surges, and other short duration extreme events, to heat waves, cold spells and climate-related phenomena such as droughts;
- Providing operational support services to civil protection agencies involved in emergency response and recovery (e.g. weather, stream flow and storm surge forecasts, oil spill trajectory predictions, toxic plume dispersion forecasts and technical briefings);
- Supplying hydrometeorological data, statistics and analyses to support sectoral planning underpin structural design (e.g. buildings and structures), land use planning (e.g. designation of flood-prone areas), water resources planning (e.g. for water supply or hydro-electric power generation), operational planning (e.g. suitable seasonal “weather windows” for offshore oil drilling, delicate towing operations at sea, or the opening of fishing seasons) and for emergency preparedness;
- Conducting outreach activities to increase public awareness of hazards, understanding of warnings and other products and knowledge of measures that can be taken to avoid injury and losses;
- Participating in post-event analyses to identify weaknesses, recommend and implement improvements in warning systems and products, public awareness campaigns and in contingency planning for enhanced disaster prevention and preparedness.

1.5 WMO and the DRR Programme

The WMO, through its Disaster Risk Reduction (DRR) Programme, has a strategic work plan built upon strengthened cooperation and collaboration among its ten scientific and technical programmes, 8 technical commissions, six regional associations, 40 regional specialized meteorological centres, 30 regional meteorological training centres, 188 Members’ National Meteorological and Hydrological Services (NMHSs), and various partners to leverage capacities for improved disaster risk management decision-making at

[1] The term NMHS has been used rather loosely as a collective one that applies to the operations of National Meteorological and Hydrological Services without necessarily implying that the two Services are, in fact, combined in a single organization. Where it has been necessary to clarify the specific organizational situation, this has been handled by exception.

national to international levels. WMO's strategic goals in Disaster Risk Reduction are derived from Hyogo Framework for Action, and address those high priority areas that fall under the mandate of WMO and NMHSs.

The WMO disaster risk reduction strategy is focused on strengthening:

- NMHSs operational capacities in early warning systems with a multi-hazard approach;
- Hydro-meteorological hazard databases, hazard analysis and mapping and risk assessment tools;
- NMHS capacities to provide customer-driven products and services targeted at sectoral decision making
- Capacity development and enhancing public awareness.
- NMHSs' cooperation with civil protection authorities and other economic sectors;

This strategy is being implemented through concrete operational national and regional projects. These efforts are supplemented with initiatives at political and institutional level to (i) promote effective governance, legislation and legal framework for national to local disaster risk management planning, (ii) raise awareness to the benefits of hydro-meteorological services and role of the NMHS in disaster risk management decision processes and (iii) facilitate participation of NMHS in related regional and national coordination mechanisms.

CHAPTER 2
THE SURVEY AND THE REPORT OBJECTIVES

2 The WMO Disaster Risk Reduction Country-level Survey

As a first step in implementing the WMO disaster risk reduction strategy, the WMO distributed a survey questionnaire, in March 2006, to its 187 Members[2] to determine their respective capacities and involvement in disaster risk reduction.

2.1 The Structure of the Survey

The WMO Disaster Risk Reduction Country-level Survey (Annex 1) was structured into four main components that sought to identify:

- Hydrological and meteorological hazards affecting the country and the existence and status of national databases for hazards and their impacts
- National legislation, organizational structure and the role of the National Meteorological and Hydrological Service related to disaster risk reduction
- National Meteorological and Hydrological Service capacity and products and services to support different phases of Disaster Risk Reduction
- Areas that are reducing the potential contribution of the NMHS to disaster risk reduction

2.2 Survey Response

The WMO Disaster Risk Reduction Country-level Survey was circulated to 187 WMO Members in March 2007 and a total of 139 National Meteorological and Hydrological Services (NMHSs) contributed detailed inputs in response to it (See Table 1 and Figure 4 below).

Scope	Number of surveys received	Total number of countries	% Response
Global (WMO Members)	139	187	**74%**
Developing countries	85	137	**62%**
Least Developed countries	25	50	**50%**
Africa (RA I)	28	52	**54%**
Asia (RA II)	25	34	**74%**
South America (RA III)	10	12	**83%**
Central and North America (RA IV)	18	22	**82%**
South-West Pacific (RA V)	14	19	**74%**
Europe (RA VI)	44	48	**92%**

Table 1. The distribution of responses to the WMO Disaster Risk Reduction Country-level Survey[3].

[2] At the time of the Survey distribution, the WMO had 187 Members. The WMO member "Serbia and Montenegro" participated in the survey and then on 6 December 2006 Montenegro was added a separate member, thus the total current WMO Members total 188. This report reflects the combined survey submission by Serbia and Montenegro as prior to 6 December 2006.

[3] Developing Countries, Least Developed Countries or Small Island Developing States have been identified from official United Nations lists (Annex 2).

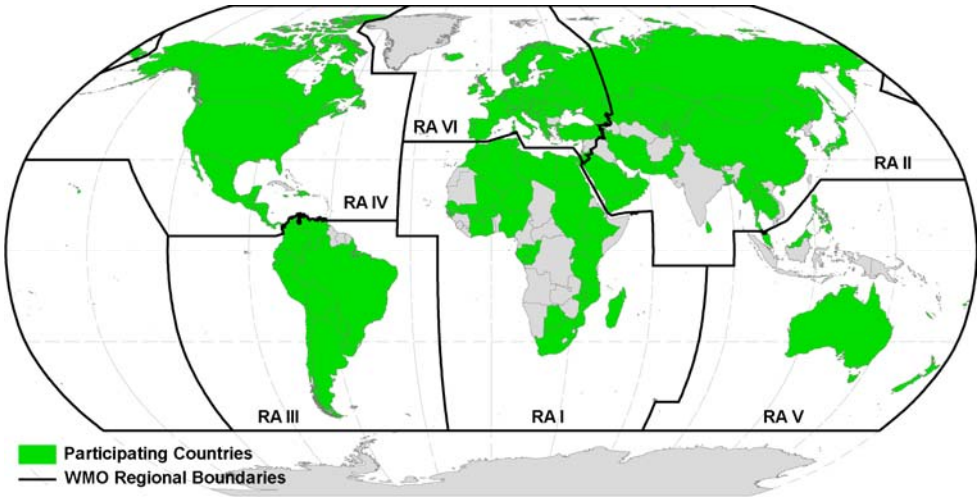


Figure 4. The global/regional distribution of responses to the WMO Disaster Risk Reduction country-level survey.

2.3 Approach to analysis and the survey database

2.3.1 Approach to analysis

The analysis approach of the survey responses was as follows:

- Examine all NMHS contributions and develop a global-level overview of the information contained in them.
- Analyze survey contributions from each Regional Association, Developing Countries, Least Developed Countries (LDCs) and Small Island Developing States (SIDS) and those responses related to sub-regional groupings requested by the Chairs of the WMO Regional Associations' Working Groups on Disaster Risk Reduction;
- Synthesize the results of the preceding work, identify significant gaps, deficiencies and anomalies in NMHS' capabilities and capacities; and
- Conclude with commentary on significant anomalies, regional differences and other matters requiring discussion.

2.3.2 Survey Database

To facilitate the analysis a comprehensive database was developed for identification of capabilities, gaps and needs based on statistical analysis for any grouping of counties (economic, project based, etc.) desired in support of project identification and prioritization.

2.4 Report Objectives

The objectives of this report are to document the capabilities of National Meteorological and Hydrological Services in relation to their provision of meteorological and hydrological support to disaster risk reduction, identify any gaps in those capabilities, and draw attention to related needs for remedial or enhancement actions. This report presents a synthesis of the information contained in NMHSs responses to the WMO disaster risk reduction country-level survey mentioned above, representing a benchmark against which future progress in enhancing support to disaster risk reduction can be measured. At the same time, it aims to provide feedback to national, regional and global disaster risk reduction organizations to assist them in targeting and implementing improvements in their approaches to addressing that priority. Such improvements could, for example, include expanded coordination and tighter partnerships with relevant governmental and non-governmental agencies and institutions and more effective utilization of early warnings and other products of National Meteorological and Hydrological Services.

2.5 Report Structure

For reasons of efficiency, and to provide some predictability for the reader, a consistent "template" (Figure 5) approach has been applied to the synthesis and assessment of the survey responses for each of the six WMO Regional Associations and for other country and sub-regional groupings that were identified by the Chairs and members of the WMO Regional Associations' Working Groups on Disaster Risk Reduction.

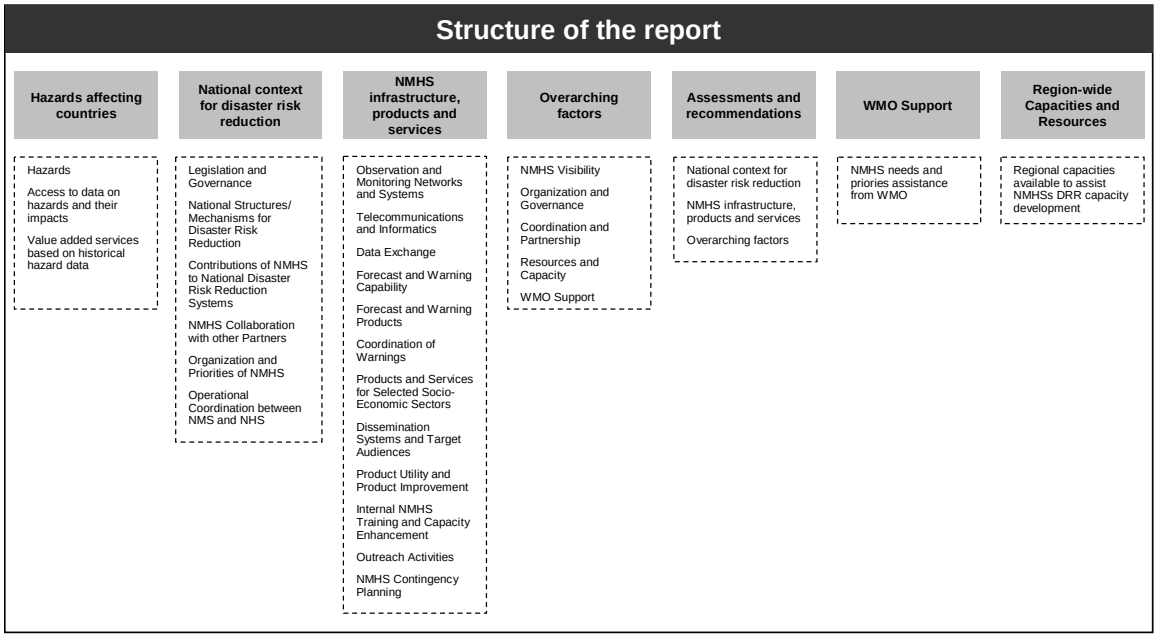


Figure 5. Report Structure

The internal structure of the synthesis chapters is as follows:

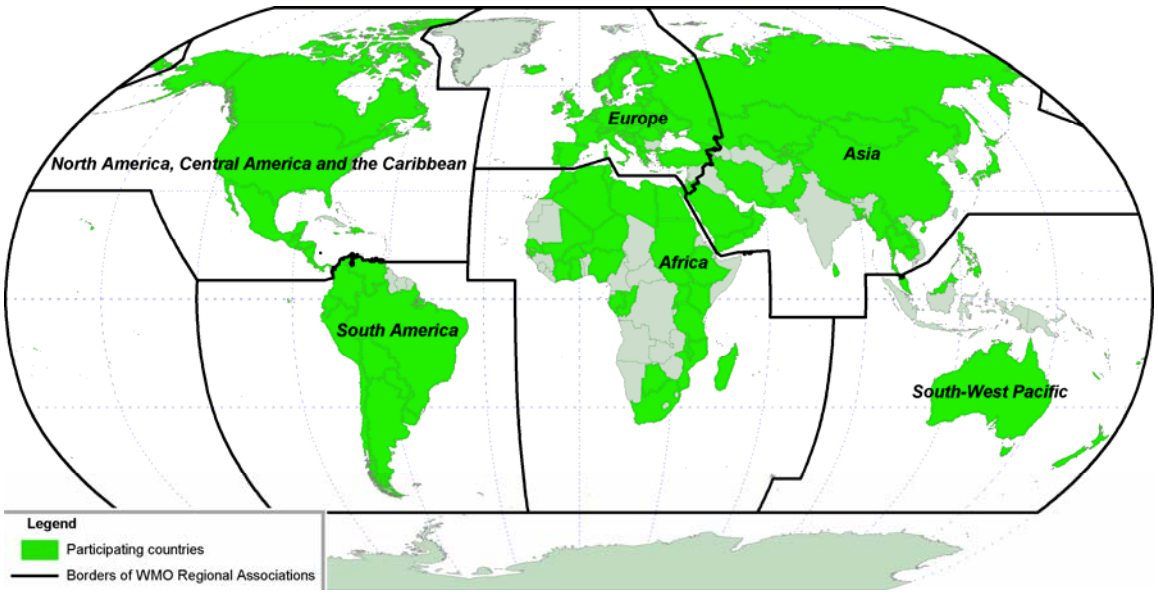
- Chapter Titles are, in each instance, followed an Abstract that provides a condensed overview of the main results and recommendations relating to the chapter.
- Each chapter begins with an indication of the level of response to the survey questionnaire within the group of countries in question, follows with an overview of the hazards that affect the area, comments on the status of archiving for hazard and impacts data and examines the extent of value-added services for disaster risk reduction that are provided by NMHSs, based on these data sets.
- The national context for disaster risk reduction within each group of countries is then reviewed, including legislative and governance aspects, the existence of national coordination committees, and the involvement and contributions of NMHSs within their national disaster risk reduction structures.
- An overview of the internal organization of NMHSs in the region or country grouping, a brief discussion of the influence of their parent ministries or departments on their orientation and priorities, and an examination of collaboration and partnership with the disaster risk reduction community.
- A detailed examination of NMHSs' infrastructure, capacities, products and services, as reflected by the survey responses. This focuses on indicators of the internal capabilities of NMHSs to support disaster risk reduction, such as their observational networks and programmes, telecommunications and informatics systems, warning, forecast and other product generation capacities, coordination mechanisms and product dissemination systems, internal training, capacity building and external outreach programmes and other relevant aspects. A status of contingency plans to maintain NMHSs' services in the event of emergencies is also briefly addressed.
- Comments on overarching factors that influence NMHSs' contributions to disaster risk reduction, such as visibility, organizational, governance and partnership aspects, resources and internal capacity, each synthesis chapter presents a roll-up summary of collective needs for support from WMO, as reflected in the survey response from countries within the region or group being addressed.
- The chapters also incorporate a series of assessments and recommendations relating to its various sub-sections including national context for disaster risk reduction, NMHS infrastructure, products and services and the overarching factors.

- Finally, the chapters conclude with drawing attention to region-wide resources that can be accessed by individual NMHSs to reinforce their own internal capacities, drawing on information from regional assessments prepared by the WMO Regional Associations' Working Groups on Disaster Risk Reduction.

Note: The subsequent chapters of this report present the results obtained by applying the above approach. It is important to note that all percentage figures quoted in the report have been calculated by dividing the number of "yes" responses to individual questions by the total number of responses to the same question. As will be evident in reading the document, the total number of responses to individual questions varied considerably.

Additionally, it should also be noted that the WMO country-level survey was limited in its extent in that it did not include questions relating to air quality or climate change and their implications for disaster risk reduction. Consequently these hazards are not discussed in detail in this report. High air pollution episodes can represent serious health emergencies, particularly for the young and for elderly citizens, with many deaths each year being attributed to poor urban air quality in cities around the world. Moreover, air pollution is a rapidly growing problem in expanding economies in Asia and elsewhere. Equally, global climate change may disrupt temperature and rainfall patterns, increase sea levels and result in other impacts that could cause disruption of populations, economies and ecosystems. The conduct of an assessment of the implications of urban air pollution and climate change/global warming for disaster risk reduction would, therefore, represent a logical extension of the present analysis.

CHAPTER 3



Global Assessment

3 Global Analysis

A global-level assessment of the contributions from the 139 WMO Members who responded to the WMO Disaster Risk Reduction country-level survey identified the following:

3.1 The National Context

- In most countries, national planning is focussed on post disaster response and NMHSs' contributions to disaster risk reduction are not well understood at senior government levels. The fact that only 39% of NMHSs provided services in support of development and housing and 45% in support of land-use planning illustrates that hydrometeorological risk assessment is often not incorporated into development planning.
- Less than one half of the responding countries (52 out of 139) reported that they had a combined National Meteorological and Hydrological Service. In 44 other countries, the (separate) National Meteorological Service (NMS) and the National Hydrological Service (NHS) maintained some degree of collaboration, particularly in relation to hazard warnings.
- Depending on the hazard and country in question, hazard warnings were issued either by the NMS, the NHS or a combined NMHS. Most responding countries with separate NMS and NHS (74) cited requirements for strengthened coordination and collaboration between the two agencies, particularly with respect to issuance of warnings.
- Over 80% of respondents (106 of 126) considered that the effectiveness of the integration of their hazard warnings into emergency preparedness and response operations was limited by the absence of nationally accepted "readiness levels" that required specific actions on receipt of a warning.

3.2 Hazards and Hazard Databases

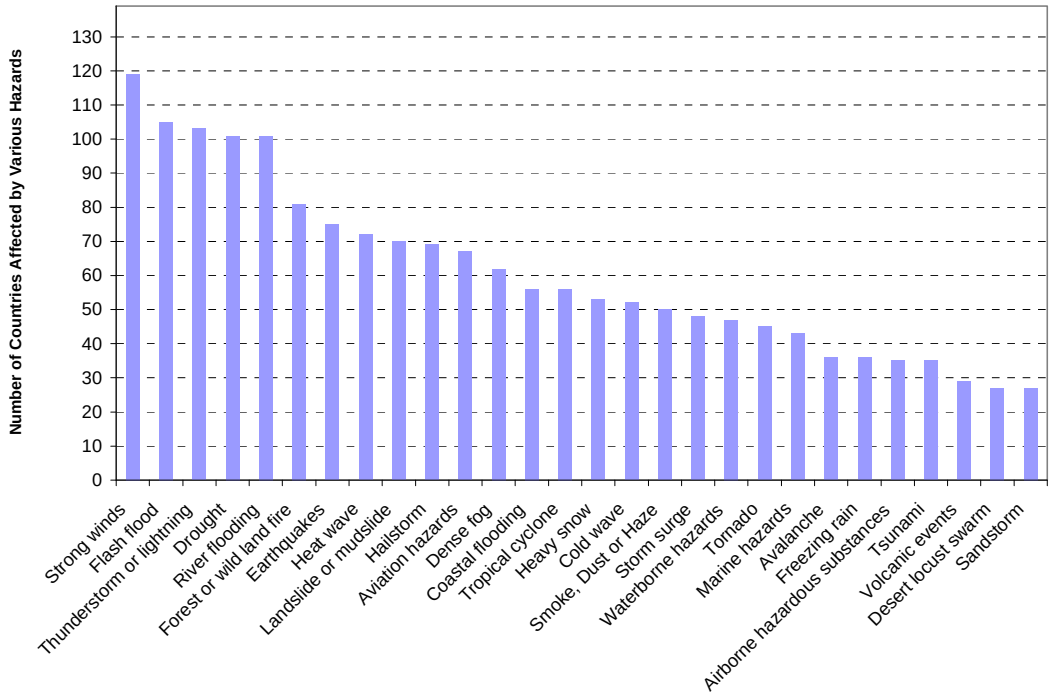


Figure 6. Number of responding countries who identified themselves as being affected by specified hazards.

- As illustrated in Figure 6, strong winds, flash and river floods, thunderstorms and lightning, drought, forest and wild land fires, earthquakes, heat waves, landslides and mudslides, hailstorms and aviation hazards were identified as among the top ten hazards across all regions.
- Many NMHSs reported that they maintained hazard databases: - 92 out of 110 respondents maintained databases for strong winds, 85 out of 103 for thunderstorms and lightning, 88 out of 97 for drought, 68 out of 81 for heat waves and the corresponding numbers for hailstorms were 60 out of 70 and for floods 65 out of 77. Significantly fewer countries, however, maintained such databases in a standardized format that includes metadata and a large majority of responding NMHSs (over 90%) identified the need to strengthen their capacities to maintain standardized hazard databases and to provide hazard mapping and analysis
- Fewer than 10% of NMHSs maintained an official database of disaster loss information (i.e. lives lost, economic losses). Nearly 75% of respondents indicated that another agency was responsible for such information.

3.3 The Internal Capacities of NMHSs

- Almost 130 respondents (includes 80 developing countries and 22 LDCs) stated that the lack of appropriate observing networks, the inability to maintain them, and the lack of capacity to maintain databases limited their contributions to disaster risk reduction.
- Most respondents (119 of 128) identified the need to strengthen their operational forecasting and warning capabilities and half of them cited the need for strengthened partnerships with agencies involved in disaster risk reduction.
- Nearly three quarters of respondents (100 of 130 including 71 of 81 developing countries and 22 of 24 LDCs) stated needs for strengthened collaboration and coordination with WMO Regional Specialized Meteorological Centres (RSMCs).
- Overall, nearly 56% of respondents (72% of developing countries and 96% of LDCs) stated that forecasters' training was a limiting factor on their ability to support disaster risk reduction.
- Most respondents (87% including 92% of developing countries and 92% of LDCs) identified the absence of joint educational and training programmes between NMHSs and stakeholders as a further limiting factor.
- Most respondents (83% including 87% of developing countries and 96% of LDCs) indicated that the lack of public awareness and understanding limited their contributions to disaster risk reduction.

3.4 Identified Needs for Support from WMO

- Most respondents identified that their top requirements for WMO assistance were for technology transfer, capacity building, technical guidelines, specifications and training.
- As their second highest priority areas for WMO assistance, South American responses identified the development of disaster risk reduction plans and European responses identified education, training and outreach programmes.
- Developing Countries and Least Developed countries shared the majority viewpoint with respect to their top requirements for WMO assistance but also identified assistance with development of natural disaster risk reduction plans as their third highest priority.

3.5 Common Gap Areas of NMHS in Relation to Disaster Risk Reduction

A global analysis of the country-level survey responses resulted in the identification of Common Gap Areas of WMO Members in relation to their ability to provide near optimal support to disaster risk reduction. These represent areas where WMO Members need assistance to strengthen their NMHSs' contributions to the protection of lives, livelihoods and property. The Common Gap Areas can be grouped under governance, organizational, technical, and training and capacity development categories, as illustrated below.

Governance:

- Understanding, at the ministerial level, of the benefits of NMHSs in support of national risk reduction planning and related operations.

Organisational:

- Coordination and partnerships among NMHSs and other national agencies involved in disaster risk reduction.

Technical:

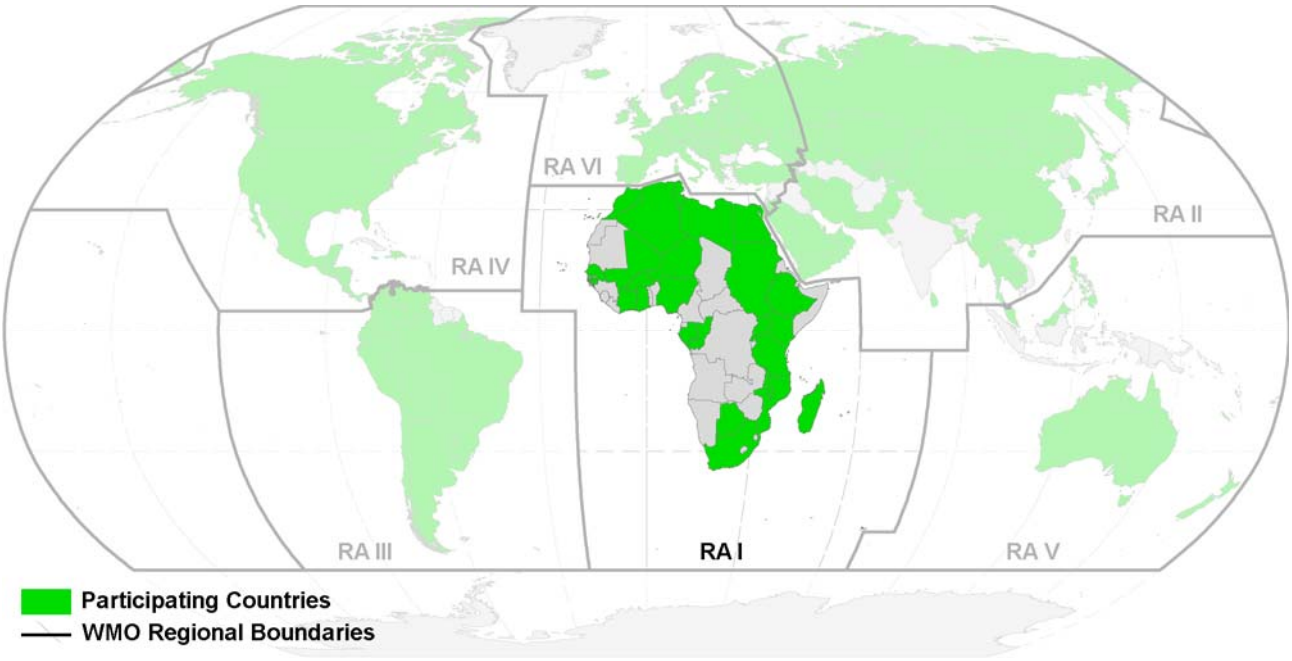
- Standardized hazard data products and methodologies for statistical analysis of hazard characteristics and mapping.
- Capacities for hazard early detection and warning, and integration of warnings and other specialised forecasting services in support of emergency preparedness, response and relief operations.

Training and Capacity Development:

- Technical training and capacity development of NMHS management and operational staff.
- Multi-disciplinary training programmes targeted at strengthening operational linkages between NMHSs and other national agencies involved in disaster risk reduction.
- Public outreach programmes.

The global analysis of survey responses draws attention to the existence of critical deficiencies in the infrastructure and scientific and technical capacities of NMHSs especially in Developing and Least Developed Countries and Small Island Developing States that indicated significant limitations in their ability to contribute effectively to disaster risk reduction. The responses underline the need for major investments in infrastructure and continuing capacity building efforts in NMHSs in these highly vulnerable countries. **Improving the capacities of NMHS in Developing and Least Developed Countries and Small Island Developing States would represent a highly effective approach to reducing economic losses and losses of life resulting from hydrological and meteorological hazards.**

CHAPTER 4



AFRICA

WMO REGIONAL ASSOCIATION I

4 AFRICA (WMO Regional Association I)

4.1 Abstract

Survey responses from 28 African National Meteorological and Hydrological Services (NMHSs) indicate that there are widespread deficiencies in hydrometeorological observing networks, telecommunications and informatics systems in Africa and very limited NMHS capacities in data management and product customization. NMHSs' hazard warning capacities are uneven, even non-existent in some countries, while warning programmes often do not address all significant meteorological and hydrological hazards. Fewer than half of African NMHSs have emergency contingency plans. These weaknesses are often compounded by poor operational coordination between National Meteorological Services (NMSs) and National Hydrological Services (NHSs) and with Regional Specialized Meteorological Centers (RSMCs) and neighbouring NMHSs, and by inadequate linkages with other stakeholders. Needs are widely expressed for expansion of public and stakeholder outreach programmes and for joint training with disaster authorities. Inadequate financial and maintenance resources and shortages of trained professional staff also affect virtually all African NMHSs. Moreover, a significant minority suggest that their national coordinating structures for disaster risk reduction need to be improved, with many feeling constrained by a lack of clarity regarding their roles. The preceding deficiencies are most strongly evident in the Least Developed African Countries. These survey results underpin the following conclusions and recommendations aimed at enhancing the contributions of African NMHSs to disaster risk reduction:

- All African NMHSs should be integrated into their national disaster risk reduction systems and, if not already members, should seek membership in their national coordinating committees for disaster risk management. All of them should press for clear direction regarding their roles and responsibilities and also pursue strengthened partnerships with other involved agencies and organizations.
- Most African NMHSs need to improve their archiving systems for hazard and impact data. This generates associated requirements for capacity development related to data rescue, quality assurance and data management and archiving.
- Most African NMHSs require capacity development and training in disaster risk applications such as hazard and impact analysis, hazard mapping, risk zone analysis and product customization.
- Every effort should be made to establish and maintain adequate hydrometeorological observation and telecommunications networks across Africa. Priority should be given to the very weak infrastructures and capacities of Least Developed (LDCs) and Developing Countries (DCs) and Small Island Developing States (SIDS).
- African NMHSs' hazard warning capacities need to be strengthened, particularly those in DCs, LDCs and SIDS. Warning programmes should be expanded to address all hydrometeorological hazards with disaster-causing potential and warnings routed to all important stakeholders.
- Official warnings of hydrometeorological hazards should emanate from a single competent issuing authority, ideally the NMHS. In some circumstances, however, they may benefit from assessment and interpretation by civil defence authorities before being widely disseminated.
- Verification programmes for hydrometeorological hazard warnings should be implemented by all African NMHSs to monitor warning accuracy and timeliness, assess improvements in skill, and demonstrate NMHSs' warning capabilities to stakeholders.
- Those African NMHSs who have not already done so should establish contingency arrangements to maintain hazard warnings and other services in emergency situations, perhaps through partnership agreements with neighbouring NMHS.
- NMHSs should encourage the establishment of national readiness systems within their countries.
- Operational coordination between African NMSs and NHSs and with neighbouring NMHSs and RSMCs should be improved. In some countries, this may require policy direction or partnership

agreements between the NMSs and NHSs to clarify their respective responsibilities in disaster risk reduction, particularly in relation to issue of early warnings.

- Most African NMHSs should increase emphasis on the provision of products and services to sensitive economic sectors such as land-use planning, housing and development and water resources. This will contribute significantly to disaster risk reduction.
- Most African NMHSs should increase emphasis on education and outreach directed at key stakeholders and the public at large.
- Many African NMHSs indicated the need for support from WMO in capacity building, infrastructure development and resource mobilization. Capacity development is particularly needed in hazard mapping, inputs to risk assessment tools and the development of national disaster risk reduction plans**.**

This chapter centres on the assessment of the survey responses from African NMHSs (WMO RA I). Its internal structure follows the sequence outlined earlier in section 2.5

4.2 Response to the Survey in Africa

The 28 African NMHSs who contributed responses to the WMO country-level survey are listed in Annex 2.

4.3 Hazards affecting Countries in Africa

Figure 7 below presents the number of responding countries in Africa (WMO RA I) who identified themselves as being affected by the specified hazards.

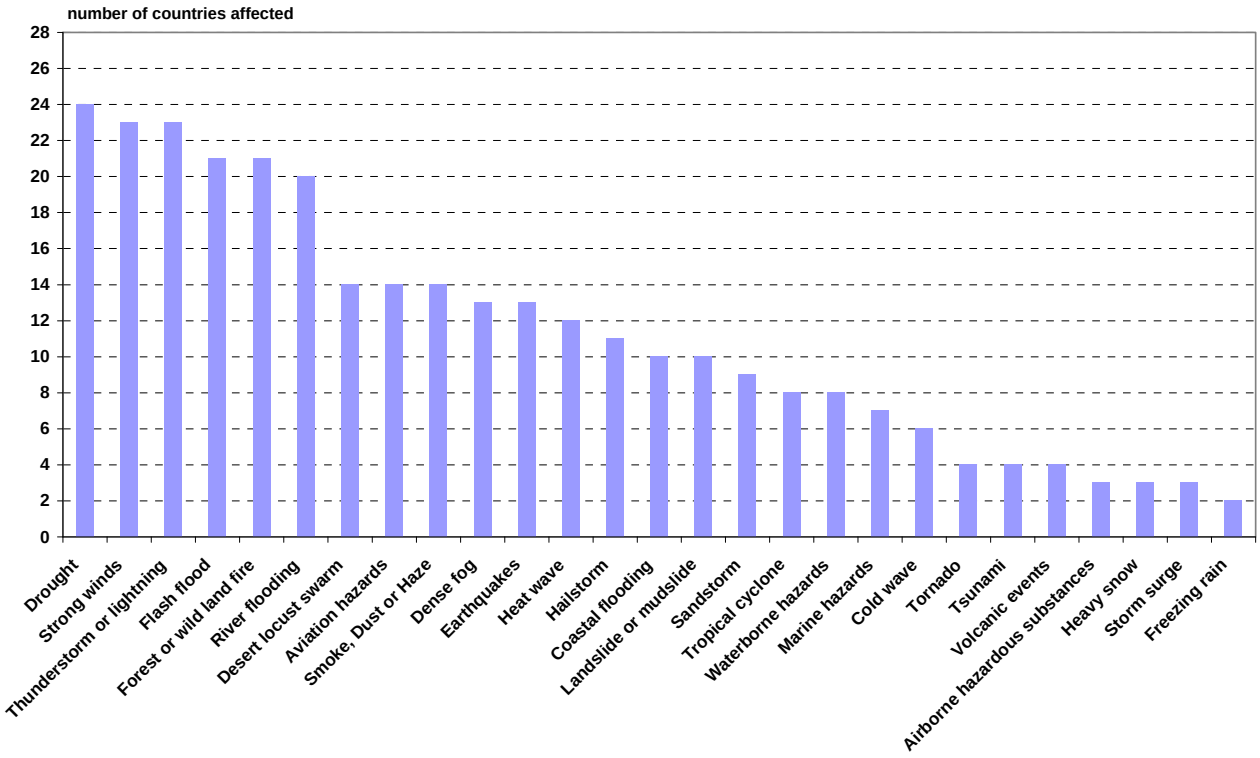


Figure 7. Number of responding African countries who identified themselves as being affected by specified hazards.

It is important to note that the survey data presented in Figure 7 simply indicates how many countries are exposed to the individual hydrological and meteorological hazards. The survey responses do not provide information on the magnitude of the impacts (or the "disaster-causing potential") of specific hazards or imply that a less widely occurring hazard may not result in disasters. Tropical cyclones, for example, are ranked lower on the list because they affect relatively few countries in Africa but the heavy rains and high winds associated with them do, on occasion, cause major disasters in those countries that experience them, such as widespread flooding, severe erosion and destruction of homes and other buildings.

4.3.1 Access to Data on Hazards and their Impacts

Most African NMHSs who responded to the survey (79% or 22 out of 28 respondents) stated that a designated national agency other than the NMHS was responsible for providing official information on the impacts of disasters in their country. More than half (57% or 16 of 28) of them went on to

state that they had access to official, reliable, information on impacts[4]. However, three NMHSs (11%) indicated that they maintained and regularly updated their own internal database of official information on the impacts of hazards[5]. Annex 3 presents an overview of the hazard databases maintained by survey respondents in Africa and includes some supplementary information on related metadata and impacts information.

4.3.2 Value Added Services based on Historical Hazard Data

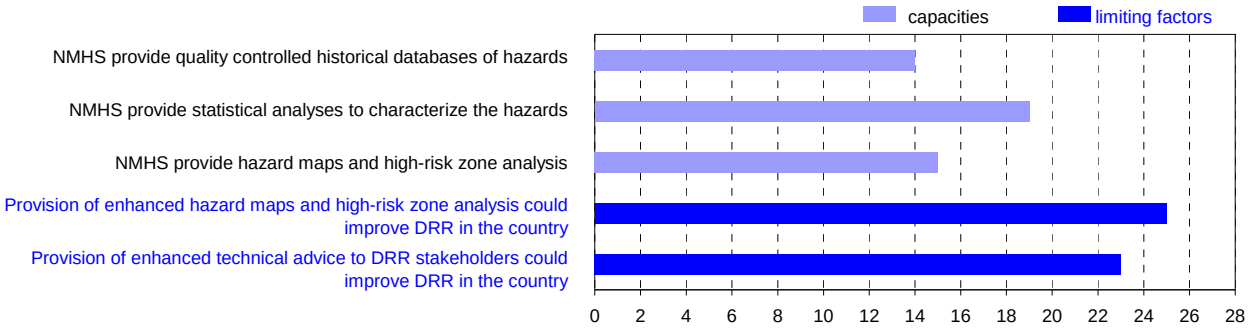


Figure 8. Provision of hazard information by NMHSs in Africa.

From the African survey responses, as seen in Figure 8 above, roughly three quarters of African NMHSs (73% or 19 of 26) reported that they provided technical advice on hazards with somewhat fewer (70% or 19 of 27) providing statistical analyses to characterize them. About half (52% or 14 of 27) maintained quality controlled historical databases of hazards and a similar number (56% or 15 of 27) provided hazard mapping and high-risk zone analysis. Only slightly over a third of respondents (37% or 10 of 27), however, indicated that they provided analyses of the potential impacts of hazards.

A majority of responding NMHSs identified several factors that limited their ability to provide hazard data products. These included the availability of professional staff with appropriate training (74% or 20 of 27 responses), quality assurance (74% or 20 of 27), data rescue (74% or 20 of 27), the ability to archive and update (63% or 17 of 27), and the customization of data for stakeholders (65% or 17 of 26). Overwhelmingly (96% or 24 of 25), respondents felt that the provision of enhanced value-added services in support of hydrometeorological risk assessment would strengthen their contributions to disaster risk reduction activities, identifying the following specialized services as particularly relevant - analyses of the potential impacts of hazards (96% or 25 of 26), hazard mapping and high-risk zone analysis (96% or 25 of 26) and technical advice (92% or 23 of 25).

4.4 The National Context for Disaster Risk Reduction

National legislative, governance and organizational structures establish the context within which NMHSs make their contributions to safety of life and property. The following sections summarize the survey responses regarding national systems for disaster risk reduction in Africa, the impacts of these systems on African NMHSs and the involvement in and contributions made to their countries' disaster risk activities by the NMHSs.

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[4] All percentage figures quoted in this report have been calculated by dividing the number of "yes" responses to a particular question by the total number of responses to that question that were received. The number of responses received often varied from one question to another.

[5] It is important to note, that, to date, no systematized, universally accepted, methodology or protocol has been established on a global basis for the creation and maintenance of hazard and hazard impacts databases.

4.4.1 Legislation and Governance

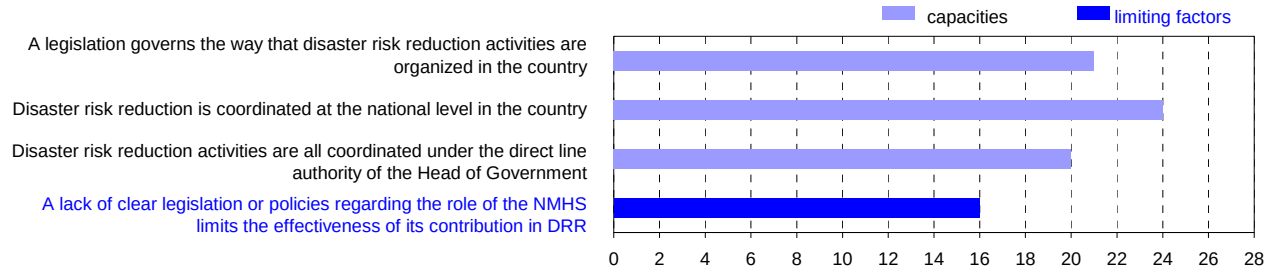

Figure 9. Legislation and coordination in support of disaster risk reduction at the national level in Africa.

From the African survey responses, as seen in Figure 9 above, a large majority (86% or 24 of 28) of African respondents to the survey reported that disaster reduction activities were coordinated at the national level, usually under the direct line authority of the head of government (83% or 20 of 24). In over half of responding countries (56% or 14 of 25) all disaster risk reduction activities were coordinated under one ministry. Most African respondents (75% or 21 of 28) also indicated that legislation governed the way that disaster risk reduction was organized in their countries. At the same time, roughly two thirds of respondents (67% or 16 of 24) considered that a lack of clear legislation or policies regarding the role of the NMHSs limited their contributions to disaster risk reduction. This is not surprising, however, given that the mandates of National Meteorological and Hydrological Services in Africa usually predate the adoption of Disaster Risk Reduction as a national, regional and global priority.

4.4.2 National Structures/Mechanisms for Disaster Risk Reduction

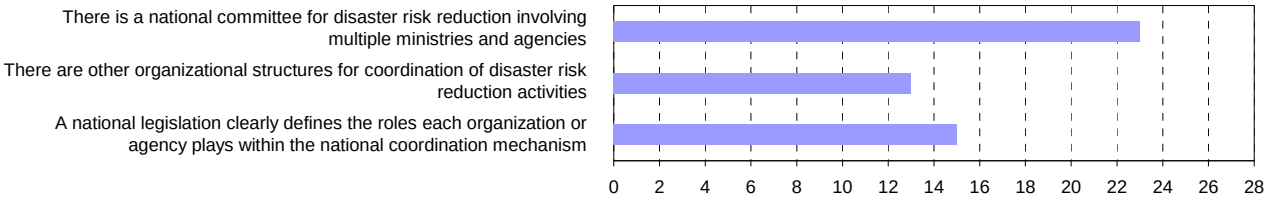

Figure 10. National structures for coordination of disaster risk reduction in Africa.

Most African respondents (85% or 23 of 27) reported that their countries had a national committee for disaster risk reduction that involved multiple ministries and agencies and also (88% or 24 of 27) stated that their NMHSs were members of their respective national coordinating committees. Slightly over half of them (56% or 15 of 27) stated that the roles of each participating agency in the national coordination mechanism were defined by legislation. A similar number (54% or 13 of 24) pointed out that there were, in addition, other organizational structures for coordination. However, a minority of NMHSs (15% or 4 of 26) felt that the national organizational structure in their countries limited their contributions to disaster risk reduction.

4.4.3 Contributions of NMHS to National Disaster Risk Reduction Structures/Mechanisms

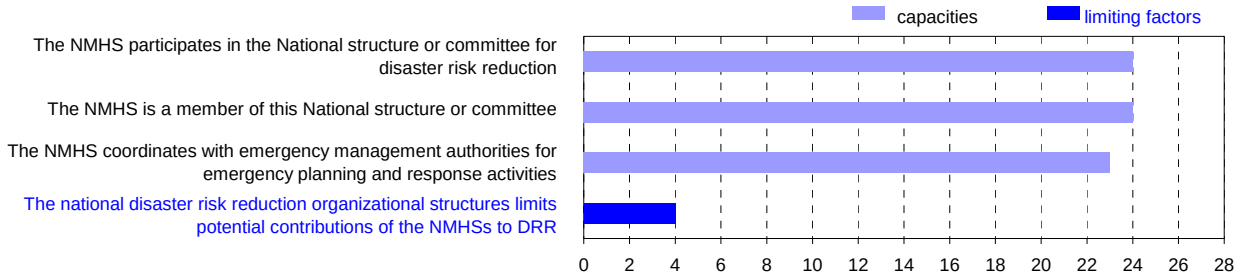

Figure 11. NMHS participation in national structures for disaster risk reduction in Africa.

Most NMHS (88% or 24 of 27) reported that they were members of their respective national coordinating committees for disaster risk reduction though, as noted earlier, a significant minority (15%) went on to suggest that their own national coordinating structure limited their contributions to disaster risk reduction. All respondents (100% or 28 of 28) indicated that they provided support to agencies responsible for disaster risk reduction at the national level. Most of this support (93% 26 of 28) was directed towards disaster prevention, emergency planning and preparedness or towards emergency response operations (89% or 25 of 28), with somewhat less (65% or 17 of 26) being devoted to post-disaster reconstruction. Most NMHSs (89% or 25 of 28) also provided support to provincial or state government disaster-related activities while a somewhat smaller number (65% or 17 of 26) extended it to municipal or local levels. A large majority of NMHSs (85% or 23 of 27) pointed to inadequate linkages with other involved organizations (e.g. emergency planners, emergency response agencies) as limiting their contributions to disaster risk reduction. It is noteworthy that a majority of respondents (88% or 21 of 24) considered that their contributions would be enhanced by the existence of a "readiness system" that involved all agencies and services engaged in disaster risk reduction in well-coordinated responses to early warnings and related information issued by the NMHS.

4.4.4 NMHS Collaboration with other Partners

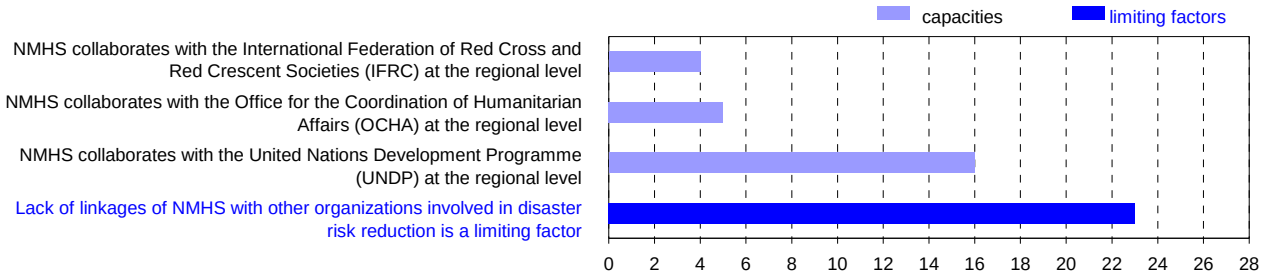

Figure 12. NMHS collaboration with partner agencies at the regional level in Africa.

A large majority of responding NMHSs (92% or 24 of 26) coordinated with partners at the national level, with most (88% or 21 of 24) indicating that they coordinated with emergency management authorities for emergency planning and response. More broadly, about three quarters (76% or 16 of 21) participated in activities of the United Nations Development Programme (UNDP) and about two thirds (67% or12 of 18) in activities of international organizations and/or on the level of a WMO Region or a regional economic grouping (67% or 18 of 27). A similar number (67% or 18 of 27) interacted with the office of the United Nations Coordinator in their country. Notably, however, less than half of respondents (35% or 9 of 26) collaborated with their National Red Cross and Red Crescent Societies. Furthermore, a large majority (85% or 23 of 27) cited inadequate linkages with other disaster-related organizations as limiting their contributions to disaster risk reduction.

4.4.5 The Organization and Priorities of NMHSs in Africa

The orientation and the priorities of NMHSs are, inevitably, influenced by the missions and priorities of their parent government Ministries or Departments. A parent department with a civil aviation mandate may, for example, emphasize provision of meteorological services to aviation while one with a natural resources or environment mandate might encourage its NMHS to provide warnings and other services to a broader range of sectors. As a result, the orientation of NMHSs may be more broadly focussed in some countries than in others. NMHSs, NMSs and NHSs in Africa report to a fairly broad spectrum of parent Ministries or Departments. Where National Meteorological Services or combined National Meteorological and Hydrological Services[6], are concerned, parent ministries include: Transport; Tourism & Air Transport; Economic Infrastructure; Communication; Civil Aviation; Environment and Natural Resources; Public Works, Transport and Meteorology; Land Use, Water and Environment; Transport and Communication and Transport and Civil Aviation. Correspondingly, the parent ministries of National Hydrological Services in Africa include: Agriculture and Hydraulics; Environment, Lands, Water, Forestry and Mines; Environment, Wildlife and Tourism; Hydraulics, Environment and Combating Desertification; Minerals, Energy and Water Affairs; Infrastructure Development; Natural Resources; Public Works and Housing; Water, Lands and Environment; Higher Education and Scientific Research; and Agriculture and Animal and Water Resources.

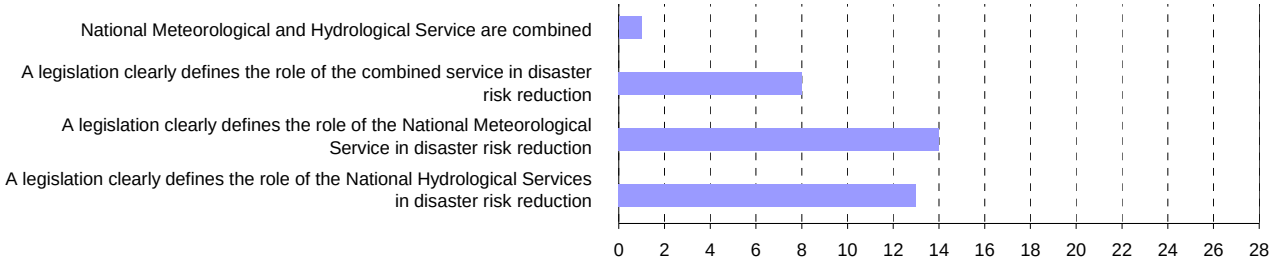

Figure 13. Operational Coordination between NMSs and NHSs in Africa.

The internal organization of National Meteorological and Hydrological Services within individual countries can also influence their ability to deliver well-coordinated hydrometeorological warnings and other services in support of disaster risk reduction. In Africa, roughly half of respondents (52% or 14 of 27) with separate NMSs and NHSs reported that they had legislation that clearly defined the role of their NMSs in disaster risk reduction and a similar percentage (52% or 13 of 25) applied to legislation regarding the role of their NHSs. At the same time, however, roughly three quarters (73% or 19 of 26) of respondents considered that legislation or partnership agreements were needed to better define the respective roles of their NMSs and NHSs in disaster risk reduction. It should be pointed out that, even though only one respondent in Africa reported that they had a combined National Meteorological and Hydrological Service, a sizeable number (53% or 8 of 15) indicated that their country had national legislation that clearly defined the NMHSs role in disaster risk reduction. This suggests that there was ambiguity in the interpretation of related questions in the survey questionnaire.

As noted earlier, the mandates of African National Meteorological and Hydrological Services have, in many instances, been legislated many years prior to the International Decade for Natural Disaster Reduction (IDNDR) and the endorsement of the Hyogo Framework for Action. The recognition of disaster risk reduction as an overriding priority can, therefore, represent a significant paradigm shift for them, their parent departments and their national partners. In such circumstances, NMHSs' mandates will need to be updated and harmonized with the new priority if they are to contribute effectively to it.

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[6] Parent departments of NMS and NMHS have been grouped together due to ambiguities in responses regarding the existence or otherwise of combined NMHSs.

4.4.6 Operational Coordination between NMSs and NHSs

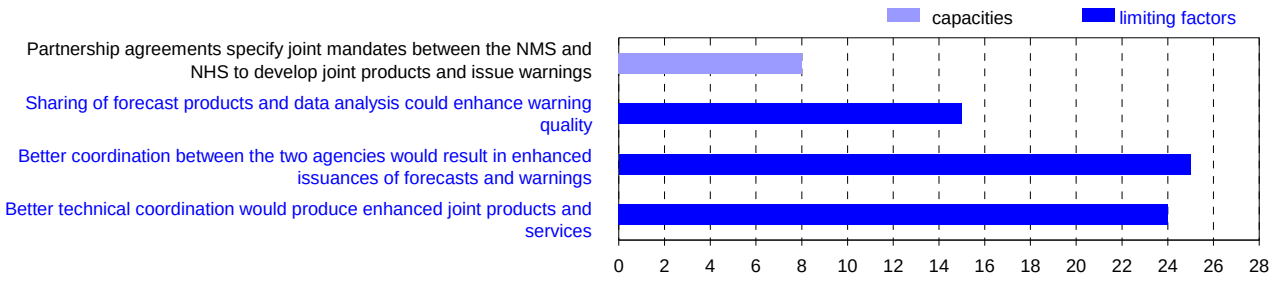


Figure 14. Coordination between NMS and NHS in Africa.

Roughly 30% (8 of 27) of African respondents from countries with separate NMSs and NHSs stated that partnership agreements were in place specifying mandates between the two Services to develop joint products and issue warnings. Over half (56% or 15 of 17) the respondents from such countries stated that the two agencies shared forecast products and data analysis that could enhance warning quality. Slightly less than half (44% or 12 of 27), however, indicated that coordination took place before hydrometeorological hazard warnings were issued. Moreover, the same number (44% or 12 of 27) reported that there was no coordination on hazard warnings. Virtually all respondents (96% or 25 of 26) considered that better overall coordination between the two agencies would enhance issuance of forecasts and warnings and a similar number (96% or 24 of 25) felt that better technical coordination would result in enhanced joint products and services.

4.5 NMHSs Infrastructure, Products and Services

The following sections summarize the information contained in the survey responses related to observational networks, telecommunications systems, warning and forecast production systems and products, dissemination systems and related aspects of the overall operational capacities of the NMHSs in Africa.

4.5.1 Observation and Monitoring Networks and Systems

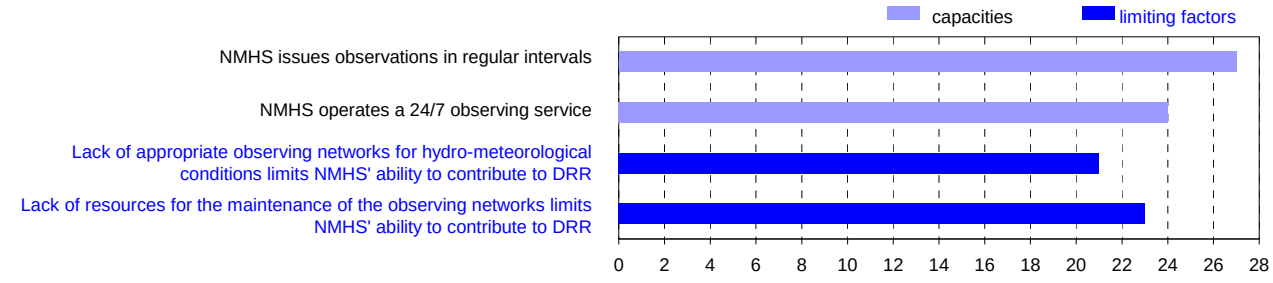


Figure 15. Observation and monitoring networks and systems in Africa.

All African respondents to the survey (100% or 27 of 27) stated that they had an operational observing capacity that issued observations at regular intervals. In most instances (89% or 24 of 27), the observing system was reported to operate on a 24 hourly/year-round basis[7]. In some

[7] Survey responses indicated that not all NMHSs in Africa had a 24 hourly/year-round observational program but were ambiguous as to the exact number (e.g. 23 stated that they had 24 hourly/year round observations but 22 identified the lack of such a service as a limiting factor).

cases (30% or 7 of 23), the observation networks included sea level monitoring stations. Most respondents (88% or 21 of 24), however, considered that the lack of appropriate hydrometeorological observing networks limited their ability to contribute to disaster risk reduction and almost half (48% or 12 of 25) identified the availability of a dedicated 24-hourly/year-round observing service as a limiting factor. Most respondents (93% or 25 of 27) also drew attention to the major challenges that they faced in maintaining hydrometeorological observing networks, citing a lack of resources (e.g. financial, replacement parts, personnel, etc) while a smaller number (30% of 7 of 23) drew attention to the impact on their networks of hazard related damage.

4.5.2 Telecommunications and Informatics

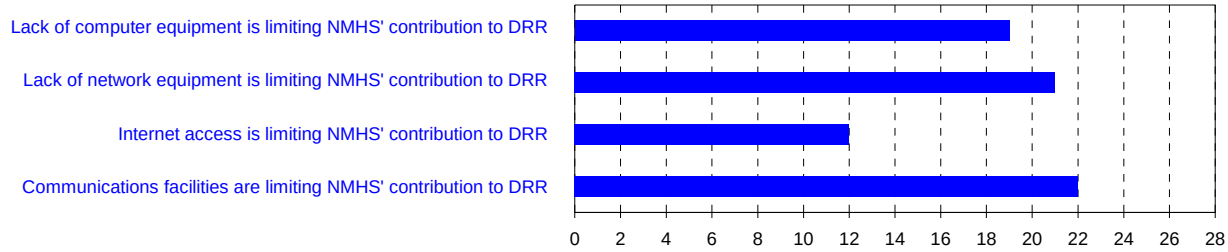


Figure 16. Telecommunication and informatics in Africa.

The majority of African NMHSs who responded to the survey (88% or 23 of 26) reported that their telecommunications systems were available 24-hourly/year round. Some confirmation was provided by responses indicating that, in most (83% or 20 of 24) cases, forecasting staff had access to real time hydrometeorological data. However, a large majority of respondents (88% or 22 of 25) also identified that their ability to deliver critical products for disaster risk reduction was limited by communications facilities. Compounding limitations on NMHSs' capacities to support disaster risk reduction were cited in major areas of informatics, with most respondents (92% or 24 of 26) highlighting the unavailability of application software, network equipment (84% or 21 of 25) and computers (76% or 19 of 25). Half of them (50% or 12 of 24) drew attention to inadequate Internet access. Virtually all African respondents (96% or 25 of 26) considered that upgrading the operational infrastructure for forecasting and warning services would enhance disaster risk reduction capacities in their countries.

4.5.3 Data Exchange

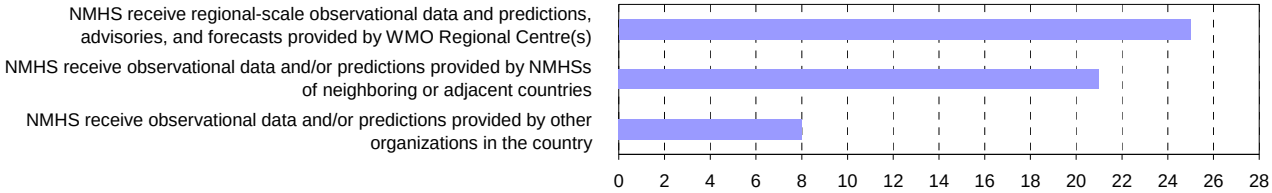


Figure 17. Data exchange in Africa.

Survey responses from NMHSs in Africa identified that most (83% or 20 of 24) forecasting staff had real time access to hydrometeorological data. In addition, most NMHSs (93% or 25 of 27) used regional scale observational data and forecasts provided by WMO Regional Specialized Meteorological Centres and most (81% or 21 of 26) also used data or predictions from neighbouring countries. Some NMHS (31% or 8 of 26) forecasters also used data and/or predictions provided by other organizations in their countries. In addition, more than half of respondents (59 or 13 of 22) indicated that they received real time marine observations from the WMO Global Telecommunications System (GTS) and some (27% or 4 of 15) relayed sea level

observations on that global network. Conversely, however, most respondents (88% or 22 of 25) indicated that their NMHSs were limited in their ability to deliver critical products and services for disaster risk reduction by communications facilities. Furthermore, almost three quarters (74% or 20 of 27) stated that their NMHS was limited in its ability to provide hazard data products by quality assurance, two thirds (65% or 17 of 26) by customization of data for stakeholders and a similar number (63% or 17 of 27) by ability to archive and update. Most responding NMHSs (96% or 26 of 27) considered that they required better coordination with neighbouring NMHSs and RSMCs (96% or 25 of 26) in relation to hydrometeorological data exchange in order to enhance their countries' disaster risk reduction activities.

4.5.4 Forecast and Warning Capability

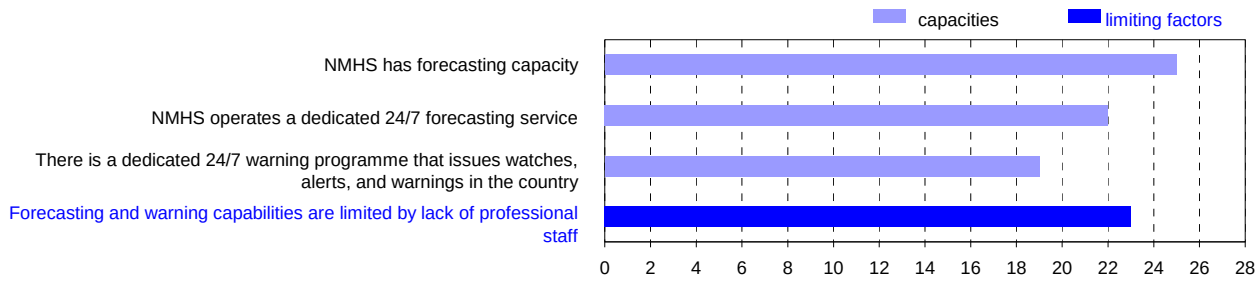


Figure 18. Forecast and warning capabilities in Africa.

Almost all African NMHSs (93% or 25 of 27) who responded to the country-level survey reported that they had an operational forecasting capability. Most (85% or 22 of 26) said that it was a dedicated 24-hourly/year-round forecast service and many (90% or 18 of 20) stated that a meteorologist was required to be on-site to operate this service. Almost three quarters of respondents (70% or 19 of 27) reported that they had a dedicated hazard warning programme that issued watches, alerts and warnings on a 24-hourly/year-round basis and almost all of these (86% or 18 of 21) indicated that a meteorologist was on site during the operational hours of the warning programme. In addition, about two thirds of responding NMHSs (65% or 15 of 23) indicated that they provided a marine forecast and warning service to mariners and coastal zone users and one of them also prepared marine forecasts for the Global Maritime Distress and Safety System (GMDSS). Conversely, however, most respondents stated that their NMHSs were limited in their ability to deliver critical products and services for disaster risk reduction by application software (92% or 24 of 26), professional staff (88% or 23 of 26) or computers (76% or 19 of 25). Furthermore, all responding African NMHSs (100% or 26 of 26) considered that upgrading their operational forecasting and warning services would enhance disaster risk reduction in their countries, with most (92% or 24 of 26) advocating the upgrading or technical training of professional staff.

4.5.5 Forecast and Warning Products

The survey responses referenced earlier in Figure 7 indicated that the six hydrometeorological hazards affecting the greatest numbers of African respondents were, in declining order, strong winds, flash floods, thunderstorms and lightning, drought, river flooding and forest and wild land fires[8]. Table 3 in Annex 4 summarizes information on hazard warnings and products issued by NMHSs in Africa who responded to the survey. Examination of the data in Table 3 reveals that virtually all affected NMHSs issued warnings for the first five of the preceding hazards but that only about half of them issued warnings for forest and wild land fires. Where less widely occurring, but

[8] The survey responses do not provide information on the magnitudes of the impacts associated with individual hazards, simply that they occur in the reported number of countries.

nevertheless potentially very severe, hazards are concerned, this latter pattern also often prevails. For example, survey responses indicated that 10 countries were affected by landslides or mudslides but warnings for these phenomena were issued in only five of the countries. Equally, 4 African countries were reported to be affected by tornadoes but warnings for these phenomena were issued in only two countries. At the same time, a substantially higher number of NMHSs reported that they issued warnings for aviation hazards and reductions to visibility (dense fog; smoke, dust or haze). Whether the preceding anomalies or weaknesses reflect a lack of predictive capacity, an organizational bias towards provision of meteorological support to aviation, or simply the traditional orientation of NMSs in some countries is largely irrelevant. What is important in the present context is that NMHSs should strive to re-orient their programmes and services to provide the best possible support to disaster risk reduction, as an overarching priority. This will require that their hazard warning programmes address all hydrometeorological hazards that can potentially lead to disasters and for which predictive skill can be said to exist.

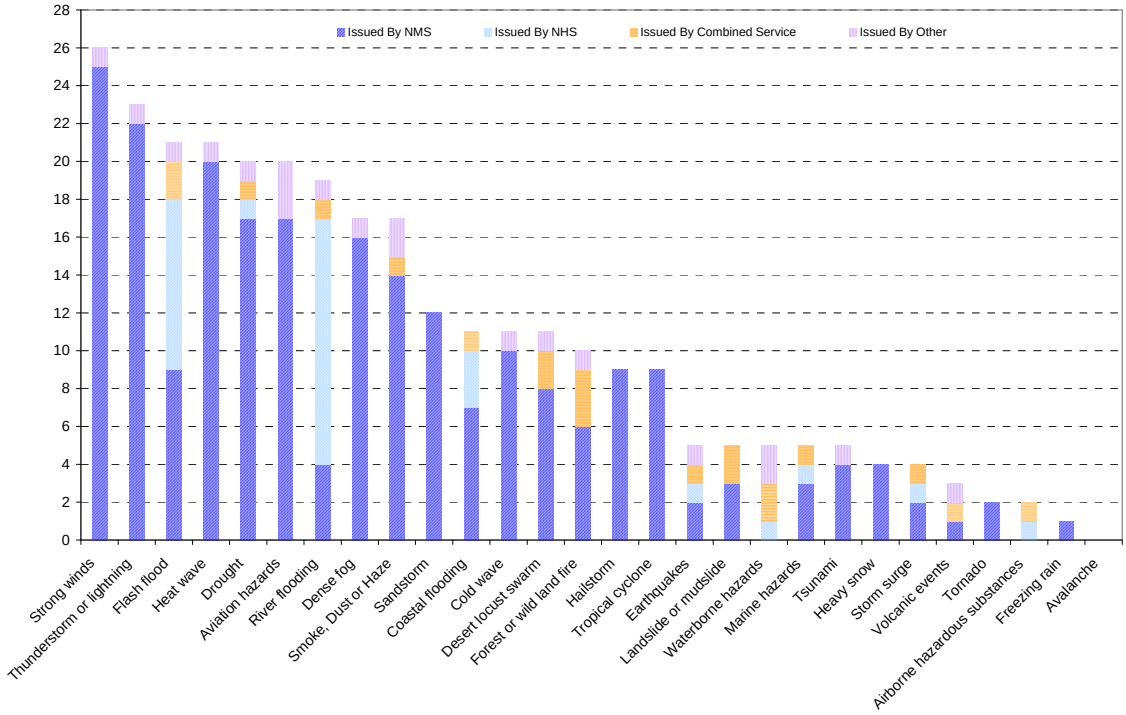


Figure 19. Agencies mandated for issuance of warnings in Africa.

The African survey responses, as seen in Figure 19 above, also reveal that National Meteorological Services were the issuers of virtually all warnings for the top hazards, with the only exceptions being flash floods and river flooding where National Hydrological Services or combined National Meteorological and Hydrological Services become major players. The survey data also suggest that the NMHSs, (or, as the case may be, NMSs or NHSs) are not the sole issuers of warnings for the most common hazards in a number of the responding countries but that there are other competing warning services. However, roughly half the NMHSs who issued warnings for the top hazards indicated that they included information about their potential impacts in their warning bulletins. Moreover, virtually all responding NMHSs considered that further improvements to their warnings were necessary. One apparent anomaly is in the case of airborne hazardous substances, said to be a concern in three countries, where the survey responses indicated that warnings were issued in two countries and in one of these cases by a National Hydrological Service.

4.5.6 Coordination of Warnings

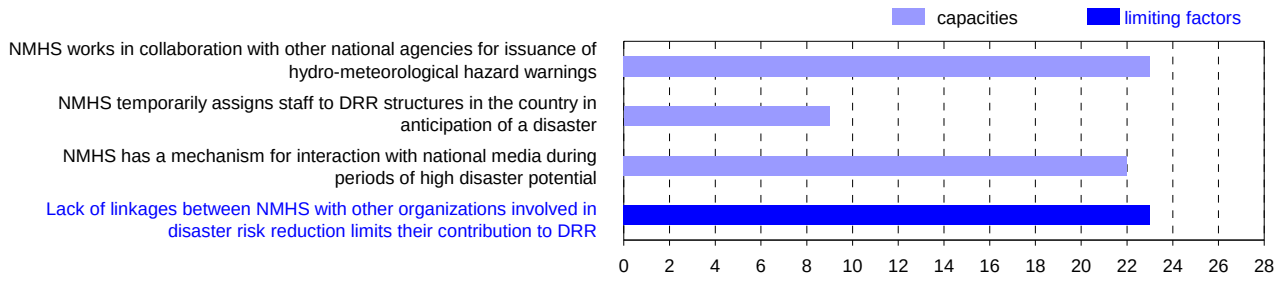


Figure 20. External coordination for issuance of warnings in Africa.

Early warnings of hydrometeorological hazards represent a vital contribution to disaster risk reduction. In Africa, most responding NMHSs (85% or 23 of 27) reported that they worked in collaboration with other agencies (e.g. agriculture, aviation, etc) with respect to hazard warnings and many of them (59% or 13 of 22) discussed the hazard's characteristics and potential impacts with these agencies prior to issuing a warning. In addition, all respondents (100% or 22 of 26) stated that they had a mechanism for interaction with their country's media during periods of high disaster potential. A significant number (35% or 9 of 26) also indicated that they temporarily assigned staff to disaster risk management structures in anticipation of a disaster. Several NMHSs (28% or 7 of 25) also pointed out that there were other public or commercial entities that provided competing warning services in their countries. Almost all respondents (96% or 26 of 27) considered that their NMHSs required better coordination of watches and warnings with the WMO Regional Specialized Meteorological Centres and with neighbouring NMHSs (93% or 25 of 27).

4.5.7 Products and Services for Selected Socio-Economic Sectors

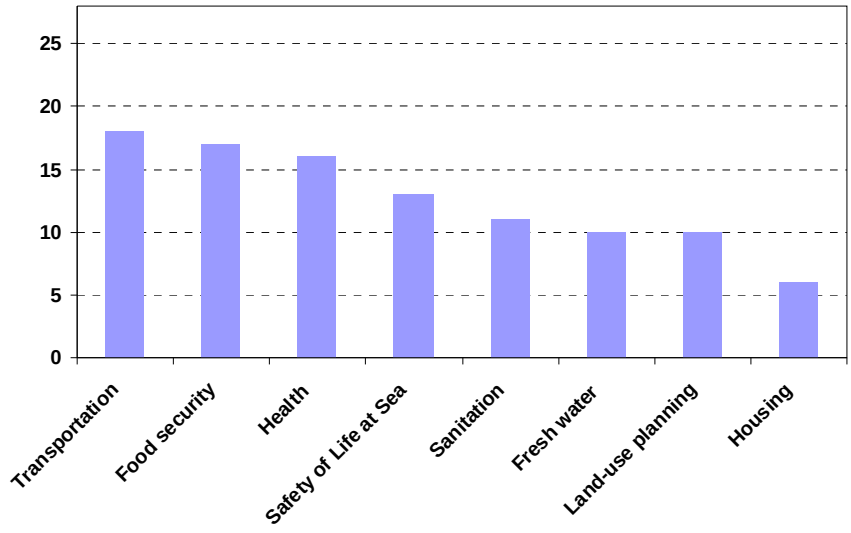


Figure 21. NMHS provision of services to selected economic sectors in Africa.

As a further refinement, Figure 21 illustrates the provision by NMHSs of specialized alerts, warnings and other products to significant socio-economic sectors that can be seriously affected by hazardous events. In the context of disaster risk reduction, it is noteworthy from Figure 21 that only slightly more than one quarter (29%) of responding NMHSs indicated that they provided

support to development and housing and only approximately a half of them provided support for the land-use planning (50%), fresh water (48%) and sanitation sectors (52%).

4.5.8 Dissemination Systems and Target Audiences

The following Figures 22 and 23 summarize the survey responses relating to the dissemination of hazard products by NMHS in Africa. They provide information on the types of products that are disseminated, to whom they are provided and on the methods of dissemination that are used to convey the products to the recipients. The same information is also presented in numerical form in Table 2 in Annex 5 where the figures represent the number of responding NMHSs who reported that they provided the specified product to the indicated target audience or, as appropriate, utilized a particular means of dissemination.

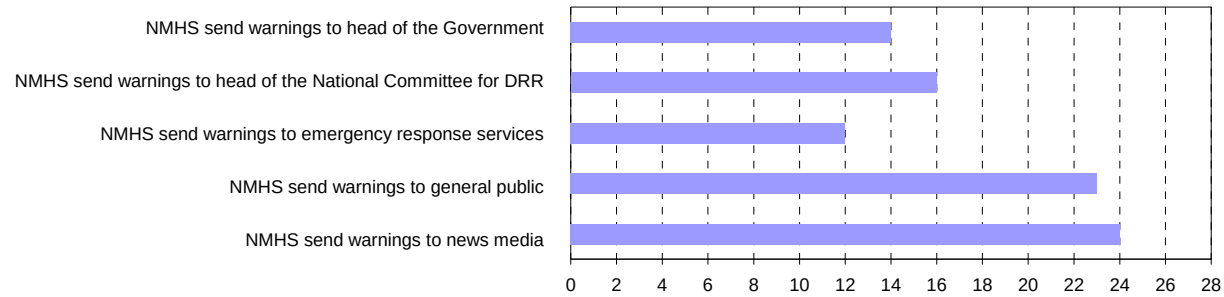


Figure 22. Warning target audience in Africa.

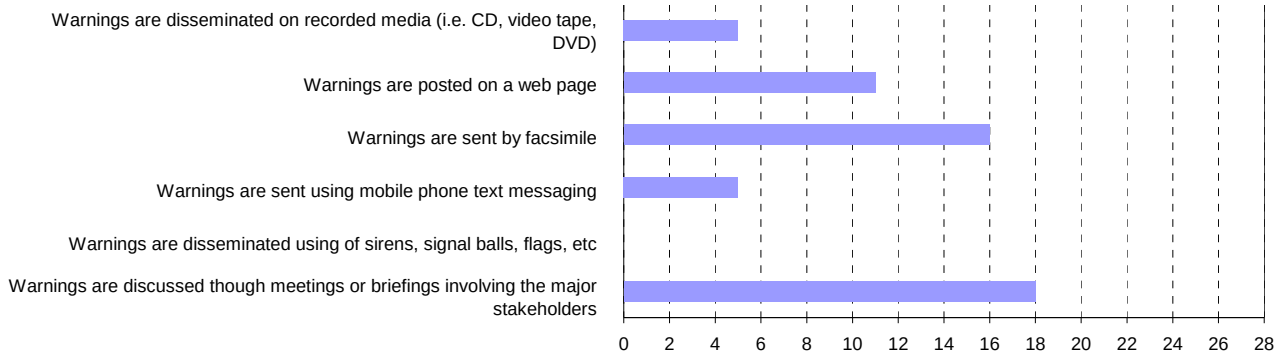


Figure 23. Warning dissemination methods in Africa.

As might be expected virtually all respondents from Africa indicated that they disseminated hazard warnings to the public and the media. In a majority of cases, warnings were also disseminated to relevant government departments and authorities and businesses. It is noticeable, however, that a much lower percentage of responding NMHSs disseminated warnings and other products to external partners in disaster risk reduction such as the Red Cross and Red Crescent Society, the UNDP and others. However, meetings, briefings, facsimile and mail were the most common dissemination methods though Internet seemed to be approaching the former in importance.

4.5.9 Product Utility and Product Improvement

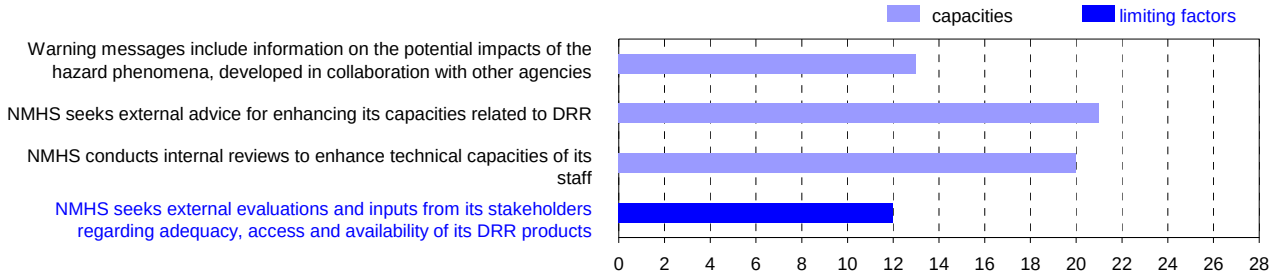


Figure 24. Ongoing feedback and improvement of products in Africa.

All (100% or 10 of 10) NMHSs in Africa who responded to the question indicated that they work with other agencies with respect to hazard warnings. The same number (59% or 10 of 17) stated that they had regular interaction with disaster risk authorities to enhance their warning capabilities and content. About half (54% or 13 of 24) of NMHSs who included information on potential risks (impacts) in warning statements indicated that they collaborated with other agencies to develop risk information. In addition, over three quarters (84% or 21 of 25) stated that their NMHSs sought external advice for enhancing their capacities to support disaster risk reduction. Most (88% or 23 of 26) sought advice to enhance monitoring and forecasting, watches and warnings (80% or 20 of 25), or overall products and services (72% or 18 of 25). Less than half the respondents (44% or 12 of 27) indicated that their NMHSs had a quality control mechanism to enhance their warning capabilities and content. Most of these (59% or 10 of 17) reported that it provided for regular interaction with stakeholders (disaster risk authorities). Somewhat fewer (47% or 8 of 17) stated that it also included feedback from stakeholders and the public after an event had occurred. Less than half (41% or 7 of 17) reported that the mechanism provided for training for stakeholders to understand the hazards, warnings and their implications. Some NMHSs (46% or 12 of 26) stated that they sought external evaluations and inputs from stakeholders regarding the adequacy, relevance, method of access and availability of their disaster risk reduction products. Most respondents (96% or 25 of 26) believed that the lack of public understanding of the effects of hazards limited the public response to them and some (96% or 8 of 10) considered that the lack of public understanding of watches and warnings similarly limited the response. Respondents universally (100% or 26 of 26) thought that the lack of joint training between staff of the NMHSs and emergency authorities and managers limited their disaster risk reduction efforts. Reflecting the preceding realities, all responding NMHSs (100% or 27 of 27) suggested that educational modules for media, public and disaster risk authorities would enhance their effectiveness in disaster risk reduction.

4.5.10 Internal NMHS Training and Capacity Enhancement

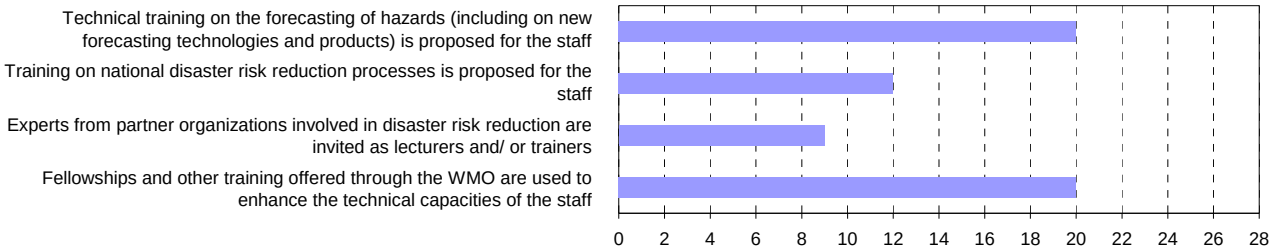


Figure 25. Training and capacity building of NMHS' staff in Africa.

In Africa, about three quarters (74% or 20 of 27) of NMHSs who responded to the survey indicated that they provided ongoing technical training to staff on forecasting of hazards, including up to date

training of new forecasting technologies and products. The same number stated that they utilized Fellowships and other training offered through WMO to enhance the technical capacities of staff and that they conducted internal reviews and sought staff inputs to enhance their capacity building and technical training activities. Just over one third of responding NMHSs (37% or 10 of 27) conducted evaluations of the suitability of communications, workstations, and software to support disaster risk reduction but a slightly larger number (44% or 12 of 27) implemented upgrades to these systems. Almost half of reporting NMHSs (48% or 12 of 25) provided training to staff on their country's disaster risk reduction processes and related topics and a majority of these (35% or 9 of 26) invited experts from partner organizations involved in disaster risk reduction as lecturers and/or trainers. However, only half of them (24% or 6 of 25) reported that they held or participated in joint training activities for NMHSs staff and emergency response agencies. Balancing the preceding realities, roughly three quarters of respondents (74% or 20 of 27) stated that (lack of) professional staff with appropriate training limited their ability for real time monitoring of hazards and providing hazard data products. Almost as many (76% or 19 of 25) indicated that lack of forecaster training at the NMHSs reduced the effectiveness of their warning services. Expanding on this theme, all respondents (100% or 26 of 26) stated that a lack of joint training involving NMHSs staff and disaster risk managers limited their contributions to disaster risk reduction, while a slightly lower number (96% or 25 of 26) pointed to the lack of joint training with emergency authorities and managers as a limiting factor. Finally, almost all (96% or 26 of 27) identified the lack of joint training with the media as a further limiting factor. Not surprisingly, all NMHSs who responded to the survey question (100% or 26 of 26) considered that upgrading and improving their operational forecasting and warning activities would enhance their disaster risk capacities. They (96% or 26 of 27) advocated the value of cross-border training activities with neighbouring NMHSs, targeted at common hydrometeorological hazards.

4.5.11 Outreach Activities

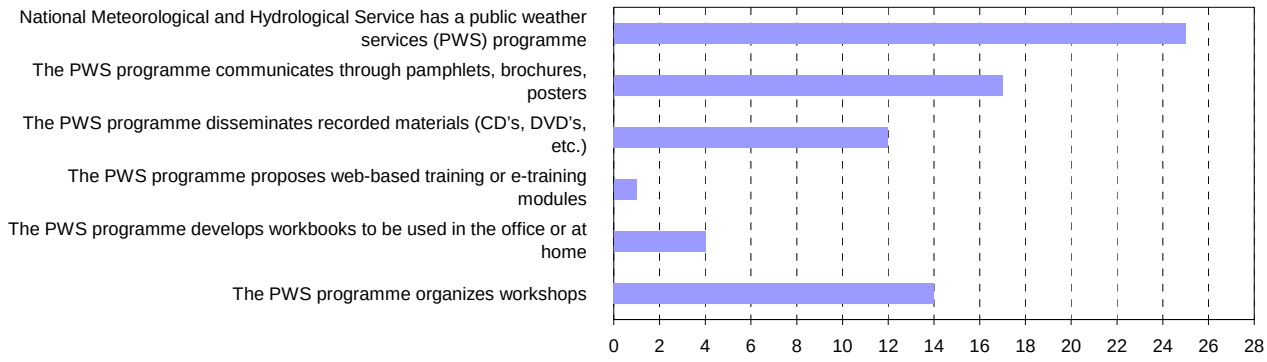


Figure 26. Outreach activities in Africa.

Outreach activities aimed at the general public and other stakeholders are an important component of any effective disaster risk reduction programme. Within NMHSs, outreach activities are often part of a public weather services programme. In Africa (RA I), most NMHSs (93% or 25 of 27) who responded to the survey identified that they had a public weather services programme. Less than half (41% or 7 of 17) of respondents, however, stated that their NMHS quality control programme included training for the stakeholders to understand hazards, warnings and their implications. Similar percentages (44% or 12 of 27) indicated that they provided education and training on hazards, watches, warnings, etc to disaster risk reduction and operational emergency response managers or held joint training sessions with them. Slightly fewer (41% or 11 of 27) provided training to the news media. Less than a third of respondents (30% or 8 of 27) identified that they provided training targeted at the trainers (i.e. of disaster risk authorities, emergency response staff, media, etc) and an even smaller number (19% or 5 of 26) provided educational modules and training programmes targeted at the general public. The following materials and methods were

identified by respondents as being used in NMHS public outreach programmes in Africa: - pamphlets, brochures, posters (71% or 17 of 24), workshops (64% or 14 of 22), recorded materials (CDs, DVDs, etc) (50% or 12 of 24), Web-based training (23% or 5 of 22), workbooks for office or home use (17% or 4 of 24), and E-training modules (4% or 1 of 23).

Almost all (96% or 25 of 26) respondents considered that the lack of public understanding of the effects of hazards limited the public response to warning services and that the lack of joint training between with emergency authorities and managers limited their disaster risk reduction efforts. All respondents (100% or 26 of 26) felt that the lack of joint training between NMHS staff and disaster risk managers was a further limiting factor and most (96% or 26 of 27) also identified the lack of joint training with the media as such. In view of the preceding, it is not surprising that respondents universally (100% or 27 of 27) suggested that educational modules that NMHSs could target at media, public and disaster authorities would enhance their effectiveness in disaster risk reduction.

4.5.12 NMHS Contingency Planning

Less than half of responding NMHSs in Africa (37% or 10 of 27) stated that their NMHS had a contingency plan to maintain the continuity of products and services in the event of organizational emergencies such as power failure or communications disruption. A few of these (36% or 4 of 11) indicated that their contingency plans involved agreements or protocols with neighbouring NMHS to support each other in the event of catastrophic failure. A small number (19% or 5 of 27) also stated that they conducted or participated in drills and exercises to ensure disaster preparedness. However, most respondents (93% or 25 of 27) identified needs for improved coordination with neighbouring NMHS and specifically cited the need for support from them in the event of disruption of services.

4.6 Overarching Factors

NMHS participating in the country-level survey were asked to respond to a series of questions that centred on obtaining expressions of opinion from them regarding overarching factors or realities that either limited or could enhance their ability to make optimal contributions to disaster risk reduction. To varying degrees, NMHS responses to these questions also served to validate statements, expressions of opinion and/or recommendations contained in responses to earlier sections of the survey. The following summarizes the inputs that fall under the above broad category:

4.6.1 NMHS Visibility

Most respondents in Africa (92% or 24 of 26) indicated that their NMHS needed higher visibility and recognition within government as a major contributing agency to disaster risk reduction. A majority (75% or 18 of 24) felt that a lack of understanding by government authorities of the value provided by the NMHS limited their contributions to that priority area. All African respondents (100% or 26 of 26) considered that improved ministerial level understanding of the socio-economic benefits of hydrometeorological products and services would increase their national visibility of their NMHS.

4.6.2 Organization and Governance

A relatively small number of African NMHSs (15% or 4 of 26) felt that their national disaster risk reduction structure limited their potential contributions to disaster risk reduction. However, a sizeable majority (67% or 16 of 24) considered that the effectiveness of their contributions was limited by the lack of clear legislation or policies regarding their role (e.g. as the sole issuer of warnings of hydrometeorological hazards). As a particular concern, almost three quarters of respondents (73% or19 of 26) from countries with separate NMSs and NHSs identified a need for legislation or partnership agreements to better define each agency's role in disaster risk reduction.

4.6.3 Coordination and Partnership

Most African NMHSs who responded to the survey (85% or 23 of 27) considered that their contributions to disaster risk reduction were limited by a lack of linkages between their NMHS and other involved organizations. Furthermore, almost all of them (96% or 26 of 27) felt that that better coordination with neighbouring countries and WMO Regional Specialized Meteorological Centres would improve their contribution to their own nation's disaster risk reduction activities.

4.6.4 Resources and Capacity

Almost all African NMHSs who responded to the country-level survey (96% or 26 of 27) stated that resources and infrastructure limited their ability to deliver critical products and services for disaster risk reduction. More specifically, most (92% or 24 of 26) identified financial resources and (88% or 23 of 26) professional staff as limiting factors. Consequently, all respondents (100% or 26 of 26) considered that upgrading and improving NMHSs operational forecasting and warning services would enhance the disaster risk reduction capacity within their country.

4.7 WMO Support

The following prioritized list summarizes the needs for support from WMO identified by the NMHSs in Africa who responded to the survey. Needs are identified in the order of priority assigned by the respondents.

1. Technology transfer, capacity building, technical guidelines and technical training (e.g. forecasting tools and methodologies, hazard mapping, and other inputs to risk assessment tools, etc.).
2. Provision of technical advice and specifications (e.g. to enhance observing networks, operational infrastructures, relevant products and services for disaster risk reduction applications).
3. Resource mobilization.
4. Assist members to contribute to the development of the national disaster risk reduction plans.
5. Advocacy for enhanced visibility of National Meteorological and Hydrological Service' in the area of disaster risk reduction.
6. Cost benefit analysis of hydro-meteorological services in disaster risk reduction.
7. Strengthening strategic partnerships with stakeholders (e.g. disaster risk managers, media, etc.).
8. Education, training and public outreach programmes in disaster risk reduction (e.g. targeted at National Meteorological and Hydrological Service and their stakeholders).
9. Strengthening strategic partnerships with other technical organizations and agencies (e.g. meteorology, hydrology, ocean services, etc.).
10. Establishment of regional emergency protocols for the National Meteorological and Hydrological Services in support of each other in case of disruption of services due to the impact of a disaster.

4.8 Sub-Regional Considerations

The following section examines the involvement and capacities of the NMHS in Least Developed Countries (LDC) in Africa in relation to disaster risk reduction. It presents a brief overview of similarities and differences between responses from African LDCs relative to African responses as a whole.

4.8.1 Least Developed Countries in Africa

Thirty-three out of a worldwide total of fifty Least Developed Countries (LDC) are located in Africa. Against the backdrop of the preceding analysis of all survey responses from African NMHSs, the following paragraphs briefly examine the responses from the 14 LDCs in Africa who are WMO Members and who responded to the country-level survey. These countries were: Burkina Faso, Comoros, Ethiopia, Guinea Bissau, Madagascar, Malawi, Mali, Mozambique, Niger, Rwanda, Senegal, Sudan, Uganda and the United Republic of Tanzania.

Broadly speaking, the survey responses from Least Developed Countries in Africa show a similar overall picture to those from the larger group of all African respondents. However, a number of specific aspects are worthy of note. Of interest is the fact that desert locust swarms, smoke, dust and haze, and aviation hazards affect a larger proportion of LDCs than was the case for African respondents as a whole (Figure 27).

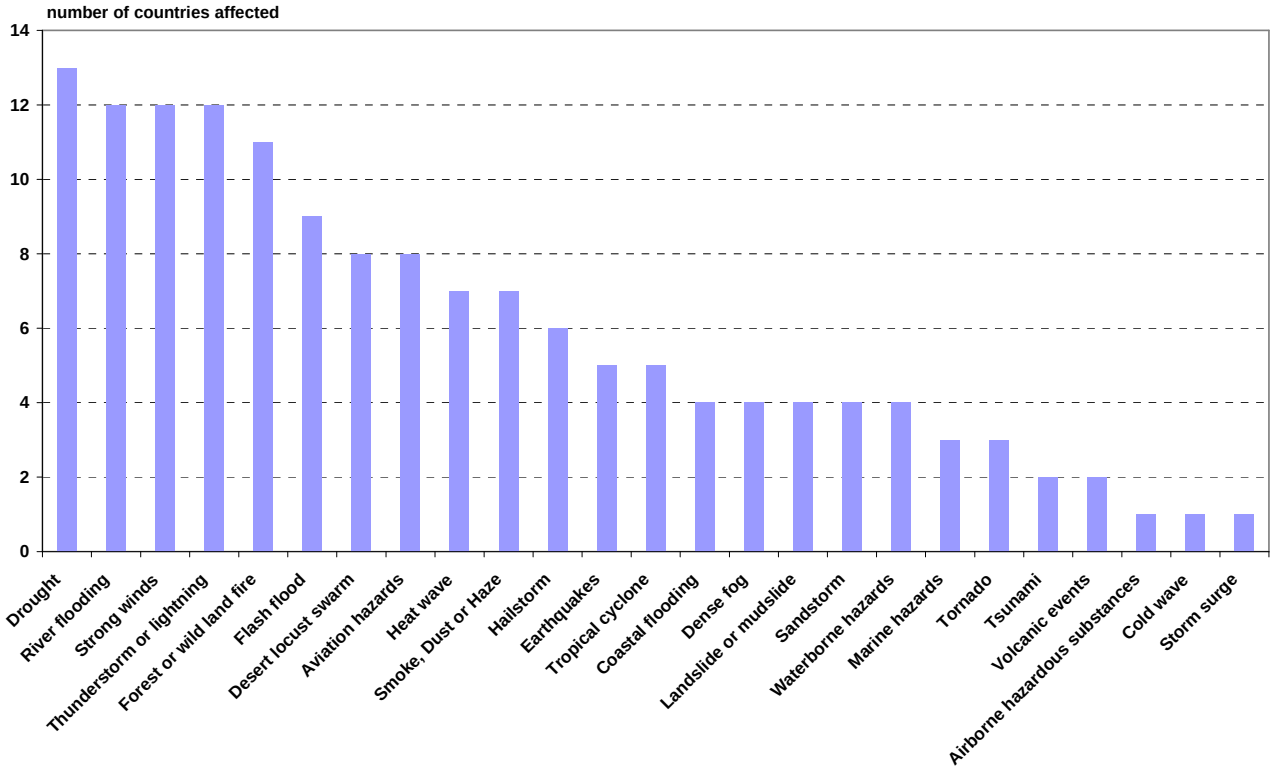


Figure 27. Number of responding Least Developed Countries in Africa who identified themselves as being affected by the specified hazards.

On the organizational and governance level, proportionately more NMHSs from Least Developed Countries in Africa felt that their national disaster management organizational structure limited their contributions to disaster risk reduction than was the case for African respondents as a whole. In addition, all, as opposed to most, NMHSs from African LDCs endorsed the need for enhanced value added services based on hazard data records. Furthermore, a higher percentage of LDCs identified professional staff with appropriate training as a limiting factor on their ability to support disaster risk reduction. In addition, LDC respondents in Africa, almost without exception, identified a lack of adequate observational networks, trained professional staff, maintenance resources and money. In particular, almost three quarters of them identified the availability of a dedicated 24 hourly/year round observing programme as a constraining factor on their ability to support disaster risk reduction, as opposed to roughly half for all African respondents. In the critical area of early warning capacity, only half of African LDC respondents stated that they had a dedicated warning service that was operational round the clock, every day of the year – a poorer picture than for African respondents as a whole. Moreover, all African LDC respondents indicated that major deficiencies or limitations in their warning and forecast capacity arose from lack of professional staff, computers and applications software. Finally, as a compounding factor, fewer LDC NMHSs had a contingency plan to maintain services in emergency situations. In short, the infrastructure and capacities of NMHSs in Least Developed Countries in Africa will require significant enhancements if they are to provide state of the art support to disaster risk reduction.

4.9 Concluding Assessments for Africa

The following summarizes assessments and conclusions related to the analysis of the survey responses from African NMHSs presented in this chapter. In order to facilitate identification of subject areas, the titles associated with individual assessments and conclusions presented below match those used during the analyses of African survey responses outlined in the preceding pages.

4.9.1 Access to Data on Hazards and their Impacts (Ref. 4.3.1)

As Annex 3 illustrates, many NMHSs in Africa do not maintain records of even the most common hazards such as strong winds or thunderstorms and lightning. As agencies responsible for monitoring and prediction of hydrometeorological hazards within their countries, however, NMHSs (or NMSs and NHSs) may be expected to maintain records of occurrences of those hazards. Such records are important for various applications ranging from verification of warnings and forecasts to hazard mapping and analysis. **The survey responses substantiate the need for many NMHSs and countries in Africa to improve their archiving and access systems for hazard and impact data**.

4.9.2 Value Added Services based on Historical Hazard Data (Ref. 4.3.2)

The respondents' recommendation regarding enhanced value-added data services is strongly supported by earlier survey responses. These responses indicate that **most NMHSs in Africa would benefit from capacity development and training related to disaster risk applications**, including hazard and impact analysis, hazard mapping and risk zone analysis and preparation of enhanced products**.** It is also clear that quality controlled, regularly updated, hazard data archives remain to be established in almost half of the African NMHSs and that **there are associated requirements for capacity development related to data rescue, quality assurance and data management and archival techniques**. Development of the preceding capacities and capabilities will require significant investments in training and infrastructure along with the continued provision of resources to sustain the delivery of the enhanced services.

4.9.3 Legislation and Governance (Ref. 4.4.1)

Where it is felt to be essential to enhancing their contributions to disaster risk reduction, **NMHSs should press for clear policy direction regarding their roles and responsibilities**.

4.9.4 National Structures/Mechanisms for Disaster Risk Reduction (Ref. 4.4.2)

The degree to which NMHSs are integrated into national disaster risk reduction organizational structures and their operational relationships with civil protection agencies, planning authorities and important non-governmental partners exercise a significant influence on their ability to contribute effectively to disaster risk reduction. For optimum effectiveness, **state of the art NMHS scientific, technical and operational capacities must be mainstreamed into national planning, decision-making and disaster response structures and systems** and, in addition, be well connected to important non-governmental partners. African responses to the survey indicate tha**t general needs exist in most countries for enhanced involvement and integration of NMHSs into national disaster risk reduction systems** and for strengthened partnerships with other involved agencies and organizations**.** Increased involvement in mechanisms, processes and partnerships must, of course, be matched by adequate scientific, technical and operational capacity to produce and deliver timely, relevant and accurate products and services if NMHSs are to make truly effective contributions to disaster risk reduction.

4.9.5 Contributions of NMHS to National Disaster Risk Reduction Systems (Ref. 4.4.3)

The survey responses indicate that NMHSs in Africa should devote continuing attention to building effective working relationships with national disaster authorities by providing timely, accurate and relevant products and services for disaster risk reduction. **Those NMHSs who are not already members of their national coordinating committees should take the initiative to gain**

membership and become an integral part of their countries' disaster risk reduction system, if they are to make optimal contributions to that priority. Equally, the responses underscore the need for expansion and reinforcement of partnerships with other agencies and organizations involved in related activities. Experience elsewhere indicates that the respondents' recommendation for establishment of a national readiness system makes good sense and suggests that NMHSs should encourage the establishment such systems within their countries.

4.9.6 NMHS Collaboration with other Partners (Ref. 4.4.4)

The survey responses suggest that most NMHSs in Africa are not well connected to important non-government organizations, particularly their National Red Cross and Red Crescent Societies, and a substantial number are not well connected to important regional bodies or international organizations**.** Expanded collaboration and effective partnerships can benefit NMHSs through broader utilization of their products and services, enhance their visibility and influence, and result in more effective contributions to disaster risk reduction. Consequently, the **establishment and maintenance of such relationships should be given significant priority by NMHS management.**

4.9.7 The Organization and Priorities of NMHSs in Africa (Ref. 4.4.5)

The survey responses suggest that, in some countries in Africa**, legislation, policy direction or partnership agreements are needed to clarify the roles and responsibilities of their NMSs and NHSs** in relation to disaster risk reduction and, in particular, the issue of early warnings for hydrometeorological hazards. Where this is the case, clarification will need to be sought at the national level.

4.9.8 Operational Coordination between NMSs and NHSs (Ref. 4.4.6)

The survey responses clearly indicate **general needs for greatly enhanced operational coordination between NMSs and NHSs in Africa** if they are to provide optimal support to disaster risk reduction. Survey contributors' almost unanimous recommendation should, therefore, be pursued at the country level through immediate action to achieve effective operational coordination, particularly with respect to hazard warnings and other critical products.

4.9.9 Observation and Monitoring Networks and Systems (Ref. 4.5.1)

Reliable, round the clock, observations that are made available in real time are the essential raw material needed for the production of early warnings of hydrometeorological hazards, forecasts and other operational products. In addition, observation networks provide the historical observational data sets that are required for risk analysis, hazard mapping, return period calculations and generation of other data products required for disaster risk reduction applications. Furthermore, they provide essential ground truth measurements for the calibration of remotely sensed readings from earth satellites and other systems. In consequence, **every effort must be made to ensure that adequate hydrometeorological observation networks are established and maintained in operation on a 24-hourly/year-round basis.** This requires not only up-front investments in observational instrumentation and staff training but also, and often more problematic, the continuing commitment by national governments of adequate funding to sustain the ongoing operation and maintenance of their national observation networks for the foreseeable future. The survey responses confirm the need to devote particularly **urgent priority to upgrading the observational infrastructure and related human resources capacities of NMHSs in Developing and Least Developed Countries in Africa** if these countries are to acquire the observational data needed to support effective disaster risk reduction through early warnings and other data related products and services.

4.9.10 Telecommunications and Informatics (Ref. 4.5.2)

The respondents' recommendation for upgrading of operational infrastructure is strongly supported by the survey responses that confirm that deficiencies in telecommunications, Internet access,

computer hardware and software are widespread. These deficiencies undercut the abilities of NMHSs in Africa to contribute effectively to disaster risk reduction. As in the case of observational networks, rectifying these deficiencies will require not only up-front investments in telecommunications and informatics systems and in staff training but will also necessitate continuing commitment by national governments of adequate funding to sustain the ongoing operation and maintenance of their hydrometeorological telecommunications networks over the long term. Once again, the survey responses confirm the need for **urgent priority enhancement of NMHS telecommunications and informatics infrastructure and capacities in Developing and Least Developed Countries in Africa**.

4.9.11 Data Exchange (Ref. 4.5.3)

Survey responses indicate that substantial enhancements are needed to telecommunications, quality assurance and archiving systems and data processing capabilities in most of the NMHS in Africa. The identified deficiencies and limitations related to data exchange support requirements for **substantial investments in capacity development and sustained, long term, funding** for continuing operation and maintenance of data exchange systems.

4.9.12 Forecast and Warning Capability (Ref. 4.5.4)

The respondents' strong recommendation for upgrading the expertise of professional staff is validated by the responses summarized earlier. In addition, however, the cited deficiencies in applications software and computer capability need to be addressed. Furthermore, the fact that several NMHSs in Africa do not have a warning and forecast capability and a larger number do not provide such services on a round the clock basis represent major deficiencies in relation to provision of effective support to disaster risk reduction. As with other aspects of NMHSs infrastructure and capacities, **enhancement of forecast and warning capacities in Developing and Least Developed African countries represent particularly high priorities**.

4.9.13 Forecast and Warning Products (Ref. 4.5.5)

The respondents' recommendation regarding the need to improve their warning products and services is well-founded. In addition, however, the responses suggest that **greater emphasis may be needed on significant hazards such as forest and land fires** in some countries in Africa where aviation hazards appear to have taken priority.

4.9.14 Coordination of Warnings (Ref. 4.5.6)

Respondents' strong recommendations for improved coordination with RSMCs and neighbouring NMHS in relation to watches and warnings is well supported. Such coordination reduces the risk of ambiguous or, in the worst case, conflicting warning messages from different sources reaching the same audience. A compounding issue here is the increased potential for confusion that arises when commercial or other entities also prepare and issue warnings of hydrometeorological hazards to the public at large. Survey responses drew attention to problems that arise when private companies issue warnings that may, or appear to, conflict with NMHS warnings. **As a general principle, therefore, it is desirable to work towards a situation where official warnings for hydrometeorological hazards emanate from a single recognized issuing authority within each country.** Ideally being prepared by NMHSs with the scientific and technical capacity to make such predictions, hydrometeorological warnings may, in some circumstances, benefit from assessment and interpretation by civil defense authorities as to their likely impacts before being relayed to local communities, perhaps accompanied by advice from the authorities on actions that people should take to minimize loss of life and property.

4.9.15 Products and Services for Selected Socio-Economic Sectors (Ref. 4.5.6)

Experience around the globe demonstrates that the socio-economic sectors discussed earlier can benefit significantly from the incorporation of hydrometeorological information and products into their planning and decision-making processes. Sensible land-use planning to minimize risk of

flooding and other hazards, rational planning and engineering design of housing and other developments to withstand expected wind loads or heavy rains and other similar measures contribute to hardening societies and communities against disastrous hydrometeorological events. Equally, early warnings of severe events enable people to take avoidance or mitigating actions to prevent disasters. The survey responses illustrate that considerable room exists to **contribute significantly to disaster risk reduction by enhancing the provision of relevant products and services to these economic sectors in Africa**.

4.9.16 Dissemination Systems and Target Audiences (Ref. 4.5.8)

Reliable and timely dissemination of early warnings of hazards to stakeholders and the public at large is among the most useful services that NMHSs can provide in support of disaster risk reduction. Consequently, every effort should be made to ensure that warnings and other relevant products reach important target audiences. In the context of disaster risk reduction**,** national **Red Cross/Red Crescent Societies and similar non-government bodies should be targeted for receipt of hazard warnings** on virtually the same level as government disaster authorities. NMHSs should seek to encourage and support such bodies to access and utilize early warnings of hazards and other relevant NMHS products.

4.9.17 Product Utility and Product Improvement (Ref. 4.5.9)

The survey responses confirm that there is substantial room to improve the utility of hydrometeorological products in Africa. Overwhelmingly, they identify critical needs to enhance efforts to increase public and stakeholder awareness and understanding of hazards, watches, and warnings and how to react to them. The responses point to insufficient interaction with disaster authorities in almost half of the responding countries. In addition, **less than half of the reporting countries operate a quality control or verification/validation programme for warnings** yet such verification data are not only fundamental to achieving improvements in accuracy, timeliness, and utility of hazard warnings but can also be effective in demonstrating NMHSs capabilities, and improvements in these capabilities, to senior government officials, disaster risk agencies and international donors**.** The respondents' recommendation regarding the value of educational modules is consistent with the preceding analysis, albeit somewhat narrowly focussed on a single methodology.

4.9.18 Internal NMHS Training and Capacity Enhancement (Ref. 4.5.10)

The respondents' recommendations for upgrading of operational forecasting and warning capabilities and for cross-border operational training of forecasters are validated by the survey responses**.** However, they appear somewhat narrowly focussed in that the responses also indicate that a large percentage of NMHSs would benefit from **much closer collaboration with disaster risk authorities and emergency managers in developing and delivering internal training programmes** for NMHS staff and joint training programmes with disaster risk agencies**.**

4.9.19 Outreach Activities (Ref. 4.5.11)

The respondents' recommendation addresses the evident need to give much higher priority to outreach activities in most countries in Africa. Even the most timely and accurate early warnings of hydrometeorological hazards and related products for disaster risk reduction are of little value if the recipients are unable to understand them and do not know how to act on receipt of them. Equally, all survey responses stressed the value of joint training between NMHS staff, disaster authorities, emergency response agencies and media. It seems clear, therefore, that **continuing emphasis should be devoted to well-designed outreach activities** directed at key stakeholders and the public at large. The most effective and appropriate tools for outreach will vary with target audience and local circumstances. However, many examples of what may be considered best practices exist and these can be drawn upon through contacts with WMO and other NMHS.

4.9.20 NMHS Contingency Planning (Ref. 4.5.12)

The survey responses confirm that many African NMHSs **do not have back-up arrangements in place to maintain hazard warnings and other critical services** in the event of disruption of their operations. This represents a critical deficiency in the context of provision of hydrometeorological support to disaster risk reduction authorities. The establishment of partnership agreements with neighbouring NMHS to provide back-up capabilities can be an effective and low-cost approach to remedying this deficiency.

4.9.21 WMO Support (Ref. 4.7)

African respondents to the survey, probably not surprisingly, identified their highest priority needs for support from WMO as being in **capacity building and infrastructure development areas and in resource mobilization**. Many of the identified needs are in areas that have been the traditional focus of WMO scientific and technical development, training and outreach programmes. However, some new requirements for support related to disaster risk reduction have also been expressed. These include **hazard mapping, inputs to risk assessment tools and the development of national disaster risk reduction plans and,** as somewhat lower priorities, "softer" areas such as **visibility enhancement and strategic partnerships.** The issue of assistance in resource mobilization presents a major challenge, particularly since it involves two threads**:**

- The limited-duration injection, on a project basis, of resources to **upgrade infrastructure or conduct training programmes or demonstration projects**. WMO can sometimes assist in this area either through internal WMO or external donor funding.
- The parallel need in many African countries for **sustained long-term funding to maintain the round-the-clock operations** of their NMHS observation, telecommunication and informatics networks, warning and forecast production and dissemination systems and other operational components for the foreseeable future. The most realistic source of such long-term, continuing, funding is the responsible national governments.

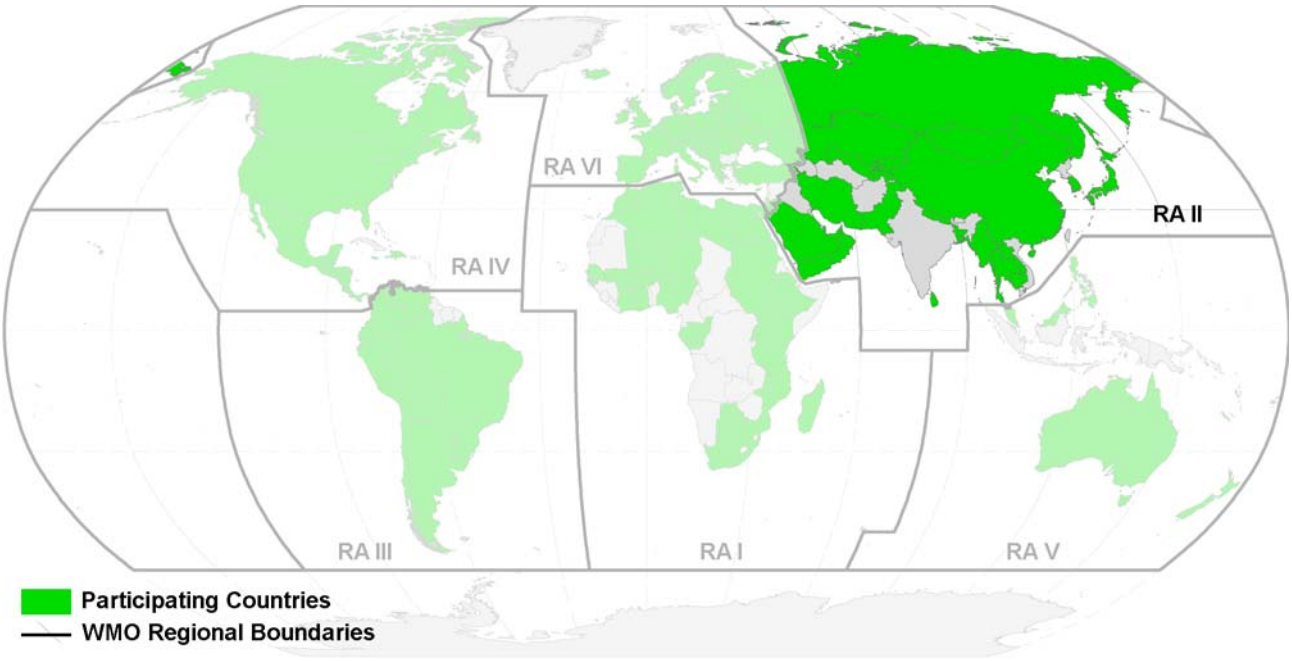
4.10 Region-wide Capacities and Resources

In contributing to disaster risk reduction at the country level, NMHS in Africa can draw upon and benefit from the expertise and capacities of capabilities of WMO global systems and of a variety of regional and sub-regional institutions and programmes. Seven WMO Regional Specialized Meteorological Centres (RSMCs) are located in Africa, at Algiers, Antananarivo, Cairo, Dakar, Lagos, Nairobi and Tunis/Casablanca, and these Centres support NMHS operational programmes through provision of guidance products and advice. Several other designated centres of expertise also supply relevant advice and services to NMHS. In particular, the African Centre of Meteorological Application for Development(ACMAD), IGAD Climate Prediction and Application Centre (ICPAC), SADC Drought Monitoring Centre(SADC-DMC) and the Tropical Cyclone Centre play important roles both as suppliers of products and services and as centres of expertise. Moreover, Regional Meteorological Training Centres in Algeria, Angola, Egypt, Kenya, Madagascar, Niger and Nigeria represent important training resources that can assist in strengthening NMHS capacities.

In the hydrological sphere, a number of regional initiatives are also underway aimed at building hydrological capacities within countries, enhancing hydrological observation networks on major basins, strengthening cooperation and promoting free exchange of hydrological data. These include the SADC-HYCOS in the Southern African Development Community, the Niger-HYCOS and Volta-HYCOS, IGAD-HYCOS, Congo-HYCOS, Lake Chad-HYCOS, Senegal-HYCOS and Med-HYCOS, all of which fall under the umbrella of the WMO World Hydrological Cycle Observing System (WHYCOS) programme. A further resource is UNESCO's International Hydrological Programme (IHP) that focuses on hydrological studies and training and education in the water sciences, with current emphasis on water resources management for sustainable development including adaptation to changing climate and environmental conditions. More broadly, the African Union (AU) and the New Partnership for Africa's Development (NEPAD), in collaboration with

various regional and international institutions, have developed the “Africa Regional Strategy for Disaster Risk Reduction”. In co-operation with Regional Economic Communities (RECs) in Africa, AU/NEPAD and the African Development Bank (ADB) will lead the process of developing the competence required for the implementation of the regional strategy. In this effort, they are being supported by the UNDP, International Strategy for Disaster Reduction (ISDR) and other development partners and donors and by specialized technical institutions such as WMO, UNESCO and EUMETSAT. A number of projects and activities of particular relevance are already underway or completed. Examples include projects to enhance the capacities of NMHSs to identify risks and generate sector specific products, educate users to interpret and apply climate information and products, the African Monsoon Multidisciplinary Analysis (AMMA) project to improve understanding and prediction of West African monsoons, and a training initiative to improve the satellite remote sensing capacities of NMHSs. These and other projects provide opportunities for NMHSs to strengthen their capacities to support disaster risk reduction by accessing support and expertise from well beyond their own national boundaries.

CHAPTER 5



ASIA

WMO REGIONAL ASSOCIATION II

5 ASIA (WMO Regional Association II)

5.1 Abstract

Survey responses from twenty-five Asian NMHSs indicate that almost all of them operate 24-hourly hydrometeorological observation and telecommunications networks. While most also maintain hazard databases and have access to information on hazard impacts, needs for capacity building are identified in data management, data rescue and data customization. Almost all Asian NMHSs have hazard warning capabilities, in many instances with emergency back-up, but warning programmes are not always in place for some significant hazards nor are warning messages always routed to important stakeholders. Moreover, targeted support is not always provided to critical economic sectors. Most Asian survey respondents identify needs to upgrade their infrastructures and professional staff capacities. In addition, they generally advocate expansion of public outreach and joint training activities along with pursuit of improved coordination and partnerships. Most of them consider that their financial and human resources are inadequate. Though the majority of Asian NMHSs participate in national disaster coordination committees, many feel constrained by these structures and by a lack of clarity regarding their roles. Relative to regional norms, those NMHSs who are members of the Typhoon Committee or the Tropical Cyclone Panel generally have better capacities and infrastructures and are more tightly integrated into their disaster management systems. In contrast, NMHSs in Central Asia tend to have weaker capacities and infrastructures be less closely integrated into their national disaster management systems. Finally, the capacities of those from the countries bordering the Persian Gulf more closely reflect the overall regional patterns. These survey results support the following conclusions and recommendations aimed at enhancing the contributions of Asian NMHs to disaster risk reduction:

- The minority of Asian NMHSs who are not already members should seek membership in their national coordinating committees for disaster risk management. Where necessary, in about half the countries in the region, they should also seek clear policy direction regarding their roles and responsibilities. All of them should strive for effective partnerships with other disaster stakeholders at national, regional and international levels.
- Though many Asian NMHSs already maintain hazard data archives, some of them need to establish archiving systems for hazard data and to improve their access to reliable hazard impacts data. Consequently, requirements exist for capacity development in data rescue, data management and archiving techniques.
- Over half of the NMHSs in Asia require training and capacity development in disaster risk applications including hazard and impact analysis, hazard mapping and risk zone analysis and preparation of enhanced products.
- All Asian NMHSs should make every effort to ensure that adequate hydrometeorological observation and telecommunications networks are operational in their countries. Special attention should be give to upgrading the weaker national networks, particularly those in the region's Least Developed (LDCs) and Developing Countries (DCs) and Small Island Developing States (SIDS).
- Official warnings of hydrometeorological hazards should emanate from a single competent authority in each Asian country, ideally the NMHS. In some circumstances, warnings may benefit from assessment and interpretation by civil defense authorities before being widely disseminated.
- Needs for upgrading of NMHSs' professional staff and informatics capacities are widespread in Asia. In addressing these, particular emphasis should be given to strengthening the capacities of those few Asian NMHSs that do not provide 24-hourly hazard warning services.
- The minority of Asian NMHSs who have not already done so should establish back-up arrangements to maintain hazard warnings and other services in emergency situations, perhaps through partnership agreements with neighbouring NMHS.

- Asian NMHSs should encourage the establishment of national readiness systems within their countries.
- More effective operational coordination between National Meteorological Services (NMSs) and National Hydrological Services (NHSs) should be pursued in many Asian countries, particularly in relation to issue of hazard warnings. Furthermore, collaboration and coordination with neighbouring NMHSs and Regional Specialized Meteorological Centers(RSMCs) should be enhanced.
- Most Asian NMHSs should give higher priority to the provision of products and services to sensitive economic sectors such as land-use planning, housing and development and water resources. This will contribute significantly to disaster risk reduction.
- Asian NMHSs should continue to emphasize education and outreach activities directed at key stakeholders and the public at large. The minority of Asian NMHSs who are not already active in these areas should initiate such education and outreach programmes.
- Asian NMHSs' highest priority needs for WMO support are in capacity building and infrastructure development areas. Capacity development is particularly needed in hazard mapping, inputs to risk assessment tools, the development of national disaster risk reduction plans and in relation to visibility enhancement, strategic partnerships and resource mobilization.

The present chapter centres on the assessment of the survey responses from NMHSs in Asia (WMO RA II). The internal structure of the chapter follows the sequence outlined earlier in section 2.6.1.

5.2 The Response to the Survey

The 25 countries in Asia who contributed responses to the WMO country-level survey are listed in Annex 2. It is important to note here that, under the WMO Regional Association system, the survey responses from Russia are not included in the analysis for Asia while those from Kazakhstan are included.[9]

5.3 The Hazards affecting Countries in Asia

Figure 28 below lists the number of responding countries in Asia (WMO RA II) who identified themselves as being affected by specified hydrometeorological hazards.

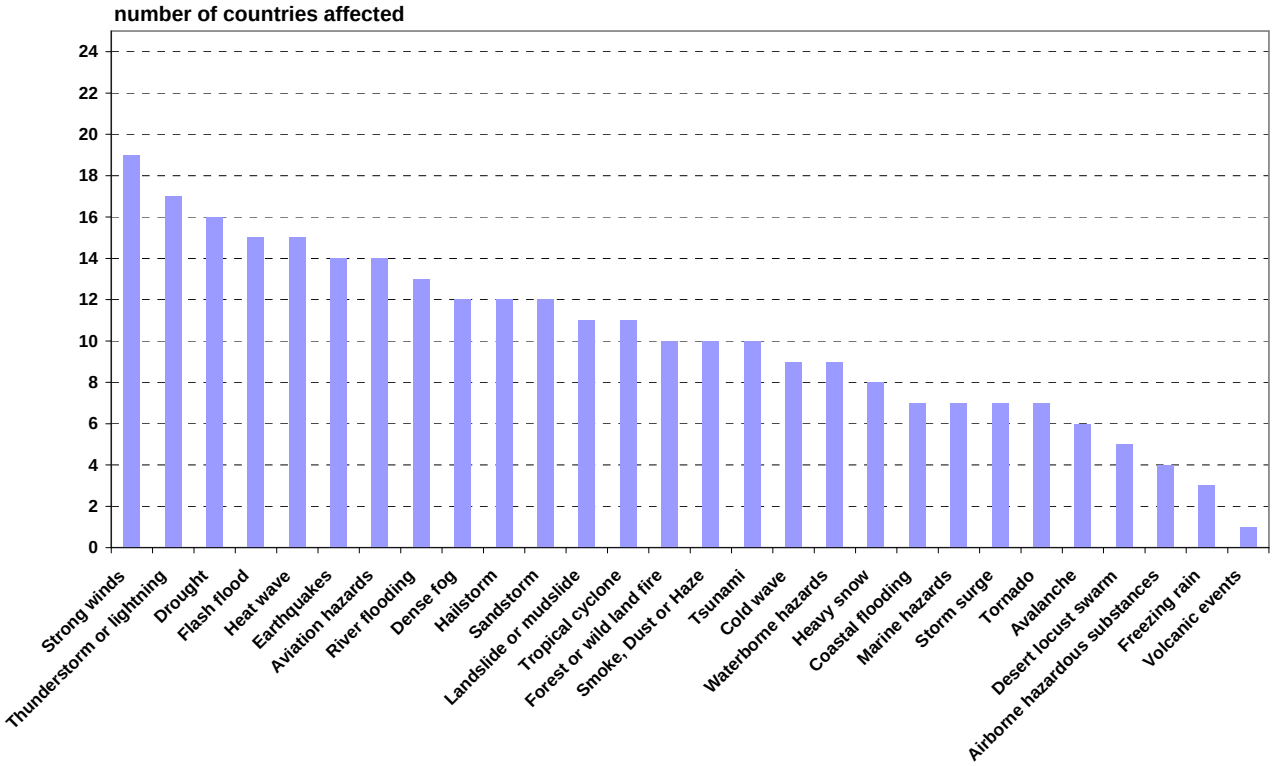


Figure 28. Number of responding Asian countries who identified themselves as being affected by specified hazards.

5.3.1 Access to Data on Hazards and their Impacts

Annex 3 presents an overview of the hazard databases maintained by survey respondents in Asia (RA II) and includes some supplementary information on related metadata and impacts information. It is important to note here that most Asian NMHSs who responded to the survey (83% or 20 of 24 respondents) indicated that a designated national agency other than the NMHS was responsible for providing official information on the impacts of disasters in their country. Most of them (78% or 18 of 23) went on to state that they had access to official, reliable, information on impacts. Over

[9] Due to Russia and Kazakhstan spanning two regions (II and VI), those countries have been taken into account for the analysis in the Region in which the capital city is located.

half of the responding NMHSs (58% or 14 of 24), however, indicated that they maintained their own internal database of official information on the impacts of hazards that affected their countries and most of these (79% or 11 of 14) said that they regularly updated this database[10].

5.3.2 Value Added Services based on Historical Hazard Data

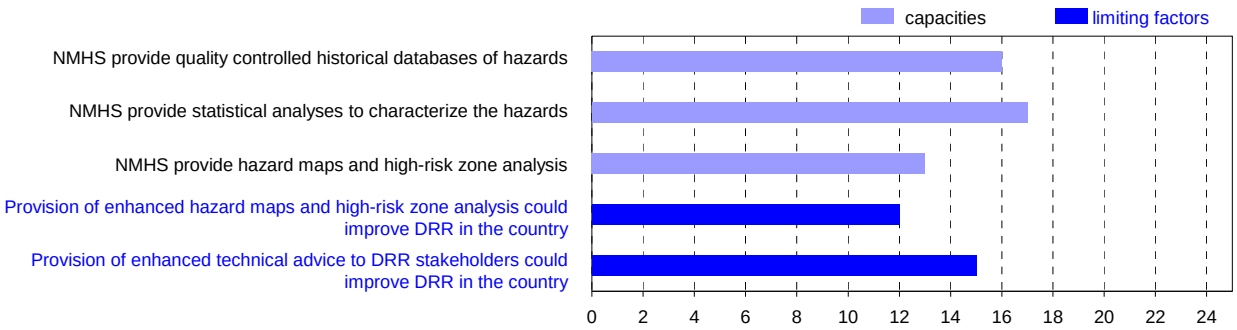


Figure 29. Provision of hazard information by NMHSs in Asia.

Most Asian NMHSs who responded to the country-level survey (83% or 19 of 25) stated that that they provided technical advice on hazards with somewhat fewer (74% or 17 of 23) providing statistical analyses to characterize them. Over two thirds (70% or 16 of 23) maintained quality controlled historical databases of hazards with a lesser number (57% or 13 of 23) providing hazard mapping and high-risk zone analysis. Less than half of respondents (43% or 10 of 23), however, stated that they provided analyses of the potential impacts of hazards.

Over half of responding NMHSs identified factors that limited their ability to provide hazard data products, citing professional staff with appropriate training (65% or 15 of 23), the ability to archive and update (64% or 14 of 22), quality assurance (61% or 14 of 23), data rescue (59% or 13 of 22) and customization of data for stakeholders (55% or 12 of 22). Almost three quarters of respondents (74% or 17 of 23) considered that the provision of enhanced value added NMHS services in support of hydrometeorological risk assessment would strengthen their contributions to disaster risk reduction activities. The following specialized or value-added services were identified - analyses of the potential impacts of hazards (80% or 16 of 20), technical advice (79% or 15 of 19) and hazard mapping and high-risk zone analysis (67% or 12 of 18).

5.4 The National Context for Disaster Risk Reduction

National legislative, governance and organizational structures for disaster risk reduction establish the context within which NMHSs make their contributions to safety of life and property. The following sections summarize survey responses regarding their countries' national systems and the impact of these systems on NMHSs and their ability to contribute optimally to disaster risk reduction.

[10] It is important to note, that, to date, no systematized, universally accepted, methodology or protocol has been established on a global basis for the creation and maintenance of hazard and hazard impacts databases.

5.4.1 Legislation and Governance

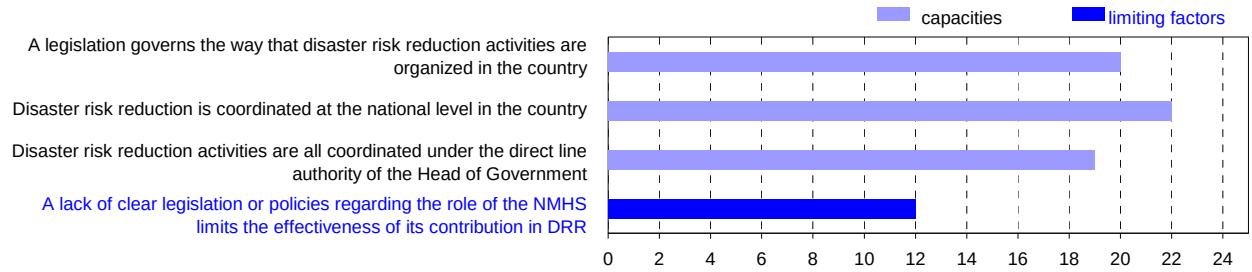


Figure 30. Legislation and coordination in support of disaster risk reduction at the national level in Asia.

Most Asian NMHSs who responded to the survey (92% or 22 of 24) reported that disaster reduction activities were coordinated at the national level, usually (83% or 19 of 23) under the direct line authority of the head of government. In most cases (83% or 20 of 24), the organization of these activities was governed by legislation and half of the respondents (50% or 12 of 24) stated that they were coordinated under one ministry. At the same time, half of the respondents (50% or 12 of 24) also considered that a lack of clear legislation or policies regarding the role of the NMHSs (e.g. as the sole issuer of hydrometeorological hazard warnings) limited their contributions to disaster risk reduction.

5.4.2 National Structures/Mechanisms for Disaster Risk Reduction

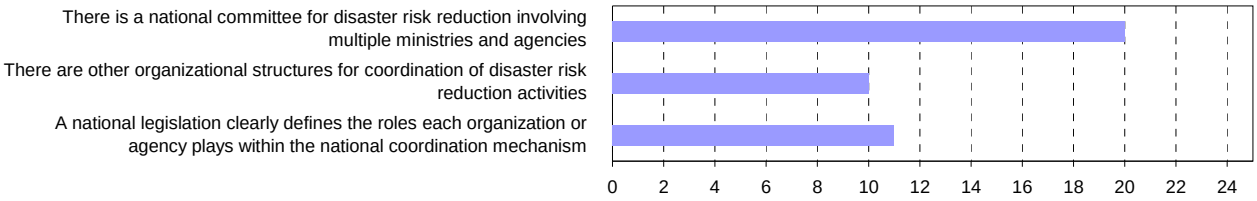


Figure 31. National structures for coordination of disaster risk reduction in Asia.

Most Asian respondents (83% or 20 of 24) reported that their countries had a national committee for disaster risk reduction that involved multiple ministries and agencies and (87% or 20 of 23) stated that they were members of their national coordinating committees. Roughly half of them (48% or 11 of 23) indicated that the roles of each participating agency in the national coordination mechanism were defined by legislation. A similar number (43% or 10 of 23) pointed out that there were, in addition, other organizational structures for coordination. A significant percentage of respondents (38% or 9 of 24) felt, however, that their national disaster management structures limited their NMHSs contributions to disaster risk reduction. The same number of respondents (39% or 9 of 23) considered that a lack of linkages with other involved organizations was also a limiting factor.

5.4.3 Contributions of NMHSs to National Disaster Risk Reduction Systems

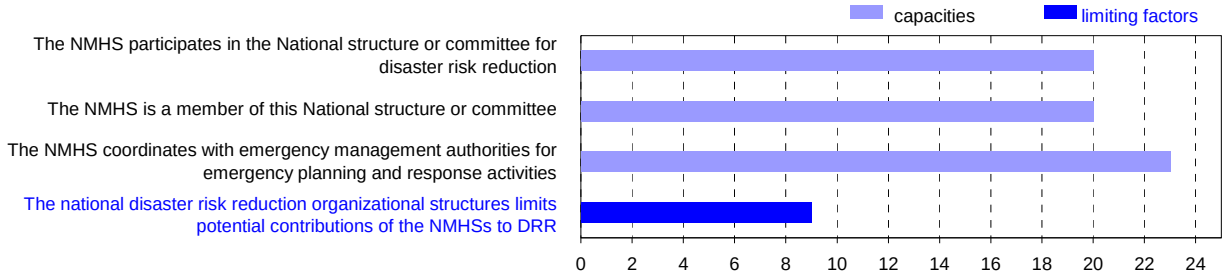


Figure 32. NMHS participation in national structures for disaster risk reduction in Asia.

Most Asian NMHSs (87% or 20 of 23) reported that they were members of their respective national coordinating committees for disaster risk reduction, though a significant minority (38% or 9 of 24) went on to suggest that their national coordinating structure limited their contributions to disaster risk reduction. Most respondents (92% or 22 of 24) indicated that they provided support to agencies responsible for disaster risk reduction at the national level. Most of this support (96% or 23 of 24) related to emergency response operations, followed by emergency planning and preparedness (92% or 22 of 24), disaster prevention (88% or 21 of 24) and post-disaster reconstruction (71% or 17 of 24). Most NMHSs (88% or 21 of 25) also provided support to provincial or state government disaster-related activities and to municipal or local levels (83% or 20 of 25). A significant minority (39% or 9 of 23), however, pointed to inadequate linkages with other involved organizations (e.g. emergency planners, emergency response agencies) as limiting their contributions to disaster risk reduction. Furthermore, a solid majority of them (83% or 20 of 24) considered that their contributions would be enhanced by a “readiness system” that required appropriate responses by authorities to information issued by the NMHSs.

5.4.4 NMHS Collaboration with other Partners

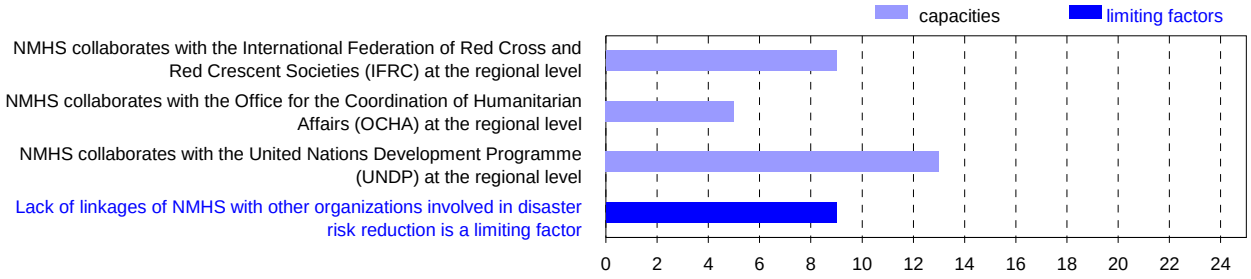


Figure 33. NMHS collaboration with partner agencies at the regional level in Asia.

A large majority of responding NMHSs (92% or 22 of 24) in Asia reported that they coordinated with partners at the national level. Similarly almost all (96% or 23 of 24) indicated that they coordinated with emergency management authorities for emergency planning and response. More broadly, over two thirds (70% or 16 of 23) of respondents participated in activities on the level of a WMO Region or a regional economic grouping while somewhat smaller numbers interacted with the United Nations Development Programme (UNDP) (68% or 13 of 19), their National Red Cross and Red Crescent Societies (54% or 13 of 24), the office of the United Nations Coordinator in their country (54% or 13 of 24) and in activities of other international organizations (63% or 10 of 16). A significant proportion of responding NMHSs (39% or 9 of 23), however, cited inadequate linkages with other involved organizations as limiting their contributions to disaster risk reduction.

5.4.5 The Organization and Priorities of NMHSs in Asia

The priorities of individual NMHSs can be influenced by the mission and priorities of their parent government ministries or departments. In consequence, the priorities of some NMHSs may be more broadly focussed than those of others. A parent department with an aviation mandate might, for example, emphasize NMHS services to aviation while one with a natural resources or environment mandate might encourage its NMHS to provide warnings and other services to a broader range of sectors. Where National Meteorological Services or combined National Meteorological and Hydrological Services[11] in Asia are concerned, parent ministries include: Defence and Aviation; Nature and Environment; Environment, Science and Technology; Environment, Energy and Water; Agriculture and Forestry; Transportation; Environmental Protection; Meteorological Agency; Disaster Management and Human Rights; Water Resources and Meteorology; Civil Aviation and Road and Transportation. Parent departments of National Hydrological Services in Asia include: Environment, Transport and Works Bureau; Nature and Environment; Agriculture and Forestry; Electricity and Water; Defence; Water Resources; Environment and Water; Construction and Transportation; Power; Land, Infrastructure and Transport, and Irrigation.

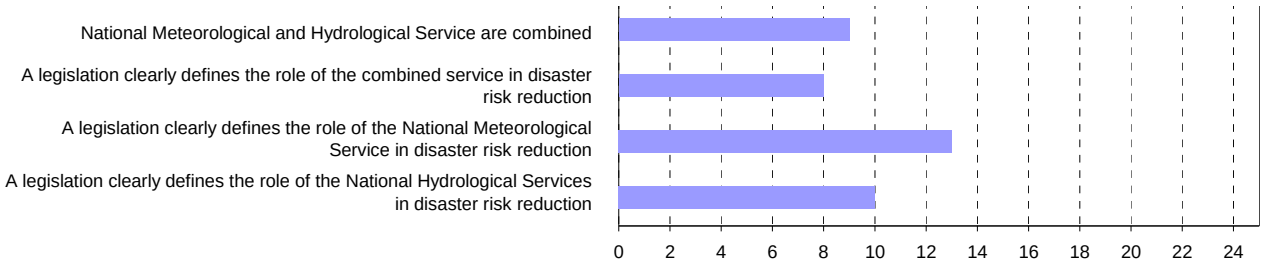


Figure 34. Organizational structure of meteorological and hydrological services in Asia.

The internal organization of National Meteorological and Hydrological Services within individual countries can also influence their ability to deliver well-coordinated hydrometeorological warnings and other services in support of disaster risk reduction. In Asia, about one third of respondents (36% or 9 of 25) stated that they had a combined National Meteorological and Hydrological Service and most of these (53% or 8 of 15) indicated that their country had national legislation that clearly defined the NMHS role in disaster risk reduction[12]. Roughly two thirds of Asian respondents (65% or 13 of 20) with separate NMSs and NHSs reported that they had legislation that clearly defined the role of the NMS in disaster risk reduction and half (50% or 10 of 20) reported that legislation defined the role of the NHS. Conversely, however, roughly two thirds (67% or 12 of 18) of them considered that legislation or partnership agreements were needed to better define the respective roles of their NMSs and NHSs in disaster risk reduction.

[11] Parent departments of NMSs and NMHSs have been grouped together due to ambiguities in responses regarding the existence or otherwise of combined NMHSs.

[12] An anomaly may exist in relation to the reported number of combined NMHSs.

5.4.6 Operational Coordination between NMSs and NHSs

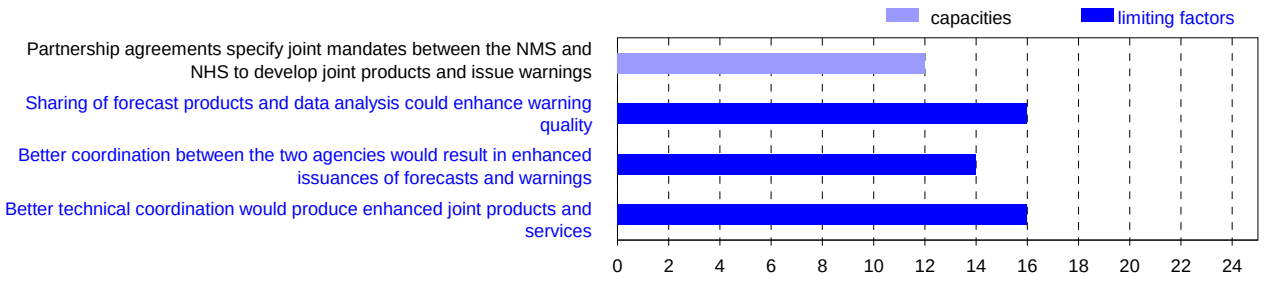


Figure 35. Coordination between NMS and NHS in Asia.

Almost two thirds (63% or 12 of 19) of Asian respondents from countries with separate NMSs and NHSs stated that partnership agreements were in place specifying mandates between their NMS and NHS to develop joint products and issue warnings. Over three quarters (80% or 16 of 20) of them stated that the two agencies shared forecast products and data analyses that could enhance warning quality. Most (70% or 14 of 20) indicated that coordination took place before hydrometeorological hazard warnings were issued. However, a few (13% or 2 of 16) reported that there was no coordination on warnings. Most respondents (78% or 14 of 18) also considered that better overall coordination between the two agencies would enhance issuance of forecasts and warnings. Furthermore, most (89% or 16 of 18) believed that improved technical coordination would result in enhanced joint products and services.

5.5 NMHSs Infrastructure, Products and Services

The following sections summarize the information contained in survey responses related to observational networks, telecommunications systems, warning and forecast production systems and products, dissemination systems and related aspects of the overall operational capacities of the NMHSs in Asia.

5.5.1 Observation and Monitoring Networks and Systems

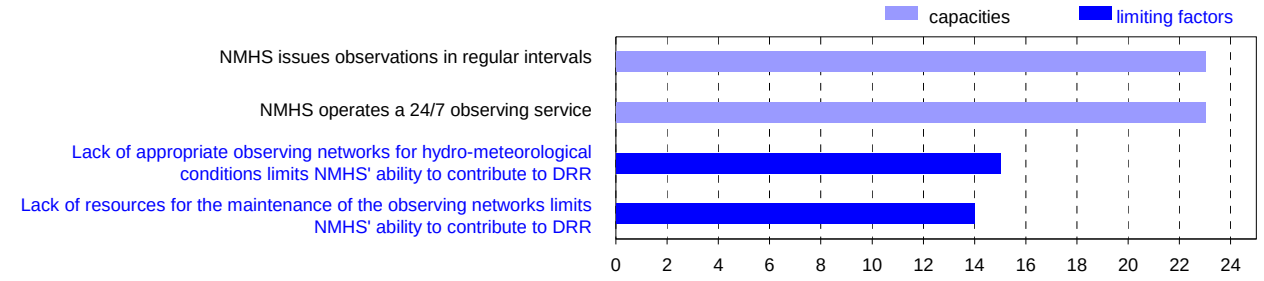


Figure 36. Observation and monitoring networks and systems in Asia.

Almost all Asian respondents to the survey (96% or 23 of 24) stated that they had an operational observing capacity that issued observations at regular intervals and operated on a 24-hourly/year-round basis. About half (50% or 11 of 22) reported that their observation networks included sea level monitoring stations. However, almost two thirds (63% or 15 of 24) identified the lack of appropriate hydrometeorological observing networks as limiting their ability to contribute to disaster risk reduction. About half of these (38% or 8 of 22) also identified the availability of a dedicated 24

hour/year-round observing service as a limiting factor[13]. In addition, respondents drew attention to the major challenges that they faced in maintaining hydrometeorological observing networks. Three quarters of them (75% or 18 of 24) pointed to a lack of resources (e.g. financial, replacement parts, personnel, etc) and a significant number (61% of 14 of 23) cited hazard related damage. Furthermore, two thirds of responding NMHSs (68% or 15 of 22) considered that a shortage of professional staff with appropriate training limited their ability for real time monitoring of hazards.

5.5.2 Telecommunications and Informatics

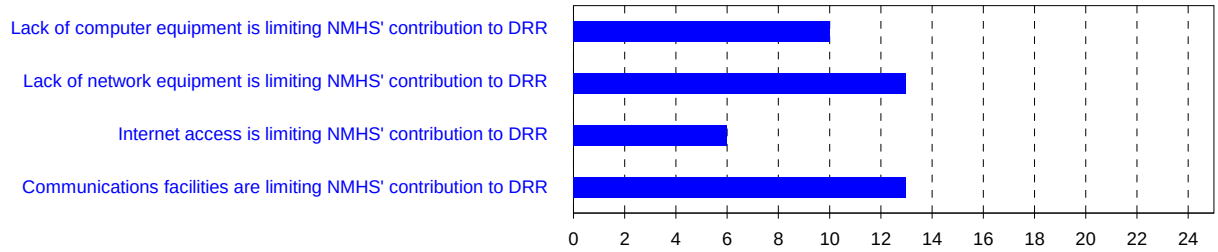


Figure 37. Telecommunication and informatics in Asia.

The majority of Asian NMHSs who responded to the survey (91% or 21 of 23) reported that their telecommunications systems were available 24-hourly/year-round. Confirmation was provided by responses indicating that, in a similar number of instances (88% or 21 of 24), forecasting staff had access to real time hydrometeorological data. Nevertheless, over half of respondents (59% or 13 of 22) also identified that their ability to deliver critical products for disaster risk reduction was limited by communications facilities. Additional, compounding, limitations on NMHSs capacities were cited in major areas of informatics, with many respondents (77% or 17 of 22) highlighting the unavailability of application software, network equipment (62% or 13 of 21), computers (48% or 10 of 21) and almost one third of them (29% or 6 of 21) drawing attention to inadequate Internet access. Most Asian respondents (78% or 18 of 23) considered that upgrading the operational infrastructure for forecasting and warning services would enhance disaster risk reduction capacities in their countries.

5.5.3 Data Exchange

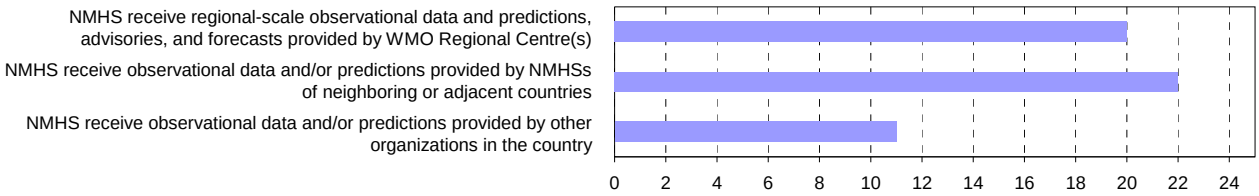


Figure 38. Data exchange in Asia.

Survey responses from NMHSs in Asia identified that most (88% or 21 of 24) forecasting staff had real time access to hydrometeorological data and used regional scale observational data and forecasts provided by WMO Regional Specialized Meteorological Centres (83%), along with data from neighbouring countries (92% or 22 of 24) and other organizations in their countries (46% or 11 of 24). In addition, many (64% or 14 of 22) received real time marine observations from the GTS and relayed sea level observations (53% or 8 of 15) on that global network. Conversely,

[13] Though almost all NMHSs in Asia stated that they had a 24-hourly/year round observational program, over a third of respondents identified the 24-hourly availability of observations as a factor that limited their ability to contribute to disaster risk reduction. This raises an obvious question regarding the continuity of observations at some sites.

however, more than half of respondents (59% or 13 of 22) indicated that their NMHSs were limited in their ability to deliver critical products and services for disaster risk reduction by communications facilities. Furthermore, almost two thirds (64% or 14 of 22) stated that their NMHS was limited in its ability to provide hazard data products by ability to archive and update, over half (61% or 14 of 23) by quality assurance and by customization of data for stakeholders (55% or 12 of 22). Most responding NMHSs (95% or 18 of 19) considered that they required better coordination with neighbouring NMHSs and RSMCs (86% or 18 of 21) in relation to hydrometeorological data exchange in order to enhance their countries' disaster risk reduction activities.

5.5.4 Forecast and Warning Capability

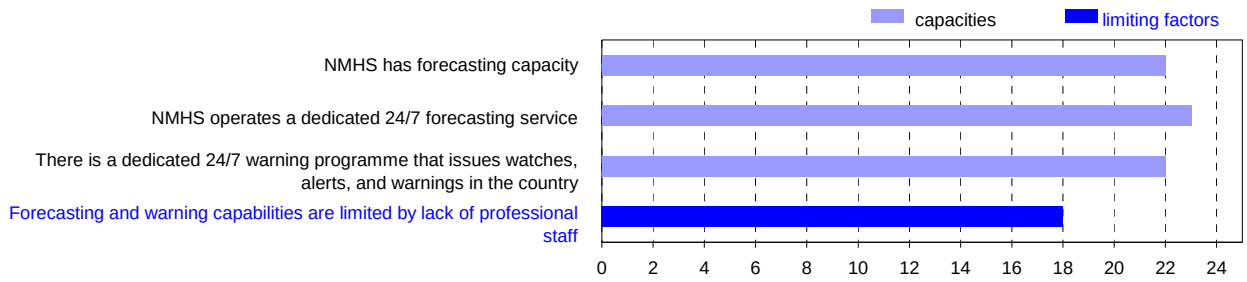


Figure 39. Forecast and warning capabilities in Asia.

Almost all Asian NMHSs (96% or 23 of 24) who responded indicated that they had an operational forecasting capability and that it was a dedicated 24-hourly/year-round forecast service. Most (88% or 21 of 24) stated that a meteorologist was required to be on-site to operate this service. Similarly, almost all respondents (92% or 22 of 24) reported that they had a dedicated hazard warning programme that issued watches, alerts and warnings on a 24-hourly/year-round basis and all who answered the question (100% or 21 of 21) indicated that a meteorologist was on site during the operational hours of the warning programme. In addition, most responding NMHSs (86% or 19 of 22) stated that they provided a marine forecast and warning service to mariners and coastal zone users and some of them (27% or 6 of 22) also prepared marine forecasts for the Global Maritime Distress and Safety System (GMDSS). Nevertheless, most respondents stated that their NMHS was limited in its ability to deliver critical products and services for disaster risk reduction by professional staff (82% or 18 of 22), application software (77% or 17 of 22) or computers (48% or 10 of 21). Almost all (91% or 21 of 23) respondents also considered that upgrading their NMHSs operational forecasting and warning services would enhance disaster risk reduction in their countries, with most (78% or 18 of 23) advocating the upgrading of operational infrastructure and a substantial number (86% or 8 of 10) citing needs for upgrading or technical training of professional staff.

5.5.5 Forecast and Warning Products

Table 4 in Annex 4 summarizes information on hazard warnings and products issued by NMHSs in Asia. The survey responses indicated that the hydrometeorological hazards affecting the greatest numbers of Asian respondents are, in declining order, strong winds, thunderstorms and lightning, drought, flash floods and heat waves, aviation hazards and earthquakes, river flooding, hailstorms, dense fog, sandstorms, tropical cyclones and landslides or mudslides[14]. These are closely followed by forest and wild land fires, smoke, dust or haze, tsunami, cold waves, waterborne hazards, heavy snow, coastal flooding, storm surges, tornadoes and marine hazards.

[14] The survey responses do not provide information on the magnitudes of the impacts associated with individual hazards, simply that they occur in the reported number of countries.

Examination of the data in Table 4 reveals that almost all affected NMHSs issue warnings for the most widely occurring hazards, with the notable exception of earthquakes for which warnings are issued in less than half of the affected countries. This apparent deficiency may reflect the fact that the feasibility of reliable short-term prediction and early warning of earthquake occurrences is still a matter of considerable scientific debate. It is, moreover, also notable that not all affected NMHSs issue warnings for some other significant hazards such as droughts, tsunamis, forest and wild land fires, tornadoes, avalanches, marine hazards and desert locust swarms. In view of the disaster-causing potential of such phenomena, it would seem desirable that affected NMHSs should consider broadening their early warning programmes to include these additional hazards.

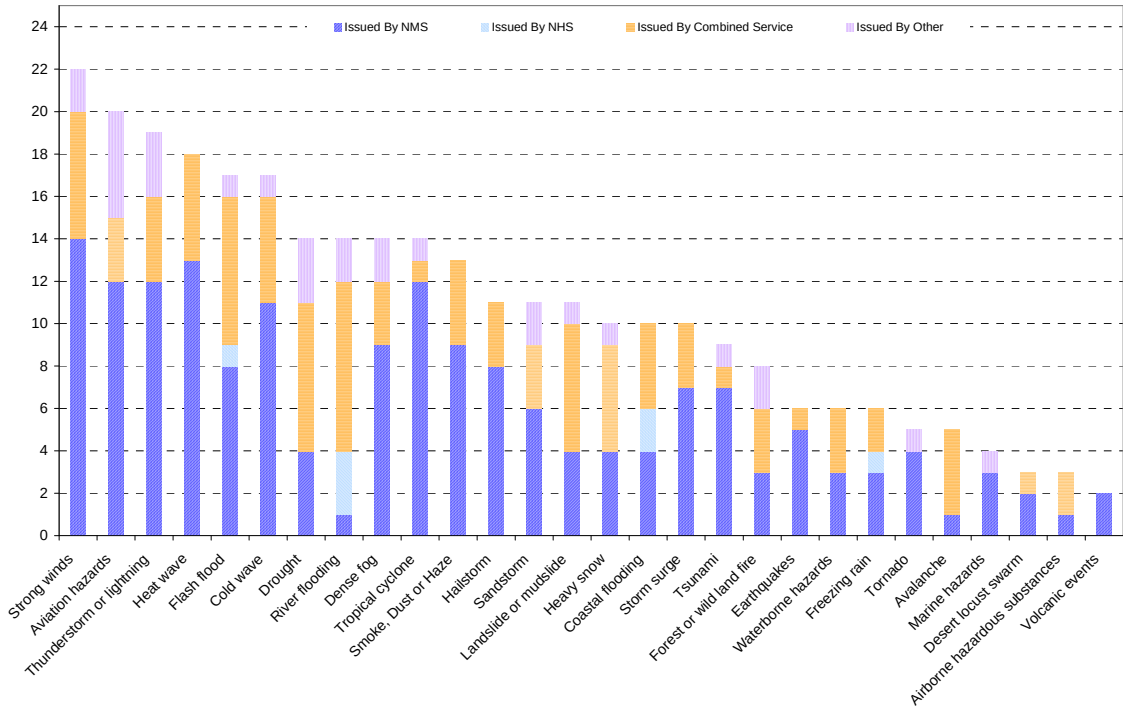


Figure 40. Agencies mandated for issuance of warnings in Asia.

The Asian survey responses reveal that NMSs or combined NMHSs are the issuers of virtually all warnings for the top hazards in that region. The only exceptions are flash floods, river flooding and coastal flooding where NHSs are reported to issue warnings in a few countries. It is also noteworthy that combined NMHSs are the dominant issuers of warnings for river flooding and drought in Asia and are, furthermore, responsible for about half the warnings issued for flash floods. An apparent anomaly in the Asian responses is, however, the indication that one NHS issues warnings for freezing rain, an atmospheric phenomenon and an unlikely prediction target for a Hydrological Service. The survey data also suggest that, in a few responding Asian countries, NMHSs (or, as the case may be, NMSs or NHSs) are not the sole issuers of warnings for the major hydrometeorological hazards but that other competing warning services also exist. However, one half or more of the NMHSs, NMSs or NHSs who issued warnings for the major hazards indicated that they included information about the potential impacts in their warning bulletins. Moreover, almost all NMHSs who responded to the survey considered that further improvements to their warnings were necessary.

5.5.6 Coordination of Warnings

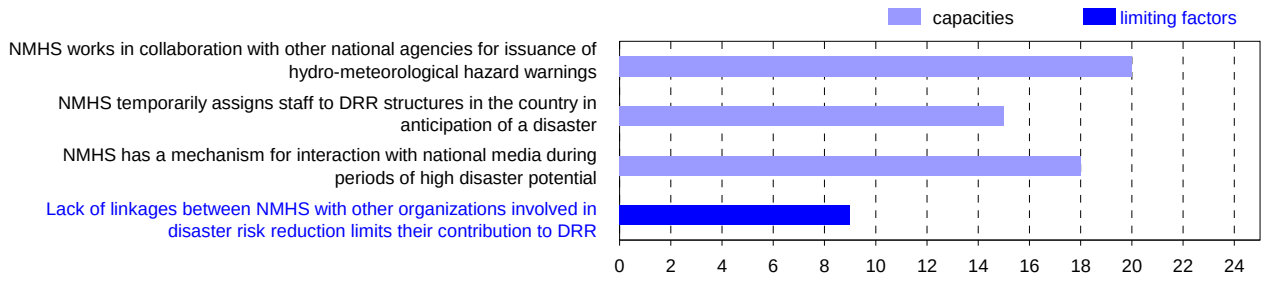


Figure 41. External coordination for issuance of warnings in Asia.

Early warnings of hydrometeorological hazards represent a vital contribution to disaster risk reduction. In Asia, most responding NMHSs (83% or 20 of 24) reported that they worked in collaboration with other agencies (e.g. agriculture, aviation, etc) with respect to hazard warnings and many (68% or 15 of 22) discussed the hazard's characteristics and potential impacts with these agencies prior to issuing a warning. A few NMHSs (13% or 3 of 23), however, pointed out that there were other public or commercial entities that provided competing warning services in their countries. Most respondents (78% or 18 of 23) also stated that they had a mechanism for interaction with their country's media during periods of high disaster potential and almost two thirds of them (63% or 15 of 24) indicated that they temporarily assigned staff to disaster risk management structures in anticipation of a disaster. However, most respondents (90% or 18 of 20) considered that their NMHSs required better coordination of watches and warnings with neighbouring NMHSs and with the WMO Regional Specialized Meteorological Centres (83% or 20 of 24).

5.5.7 Products and Services for Selected Socio-Economic Sectors

As a further refinement, Figure 42 illustrates the provision by NMHSs of specialized alerts, warnings and other products to significant socio-economic sectors in Asia that can be seriously affected by hazardous events. In the context of disaster risk reduction, it is noteworthy from Figure 42 that only slightly more than one third (33%) of responding NMHSs indicated that they provided support to development and housing, and less than one half of them provided support for the land-use planning (42%) and fresh water (46%) sectors.

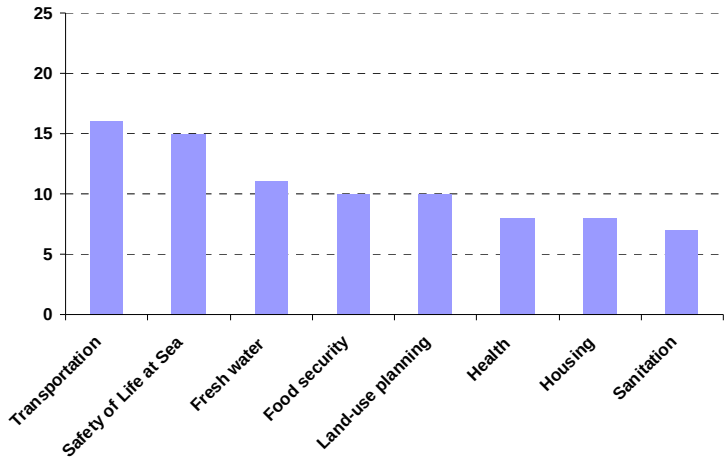


Figure 42. Provision of services to selected economic sectors in Asia.

5.5.8 Dissemination Systems and Target Audiences

The following Figures 43 and 44 summarize the survey responses relating to the dissemination of hazard products by NMHSs in Asia. They provide information on the types of products that are disseminated, to whom they are provided and on the methods of dissemination that are used to convey the products to the recipients. The same information is also presented in numerical form in Table 3 of Annex 5 where the figures represent the number of responding NMHSs who reported that they provided the specified product to the indicated target audience or, as appropriate, utilized a particular means of dissemination.

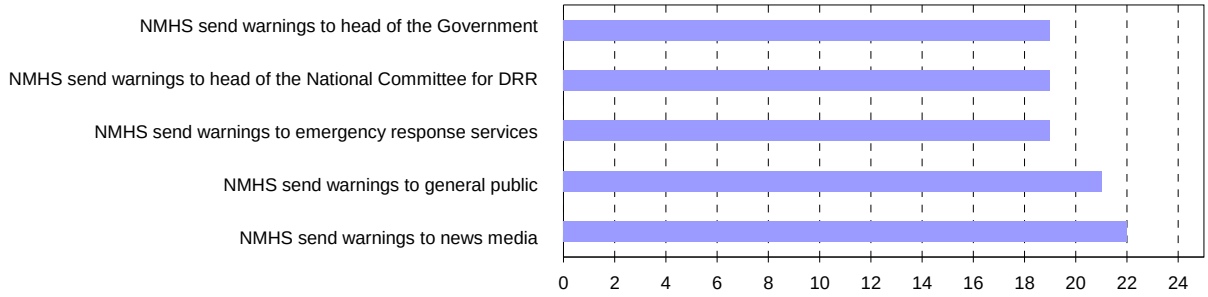


Figure 43. Warning target audience in Asia.

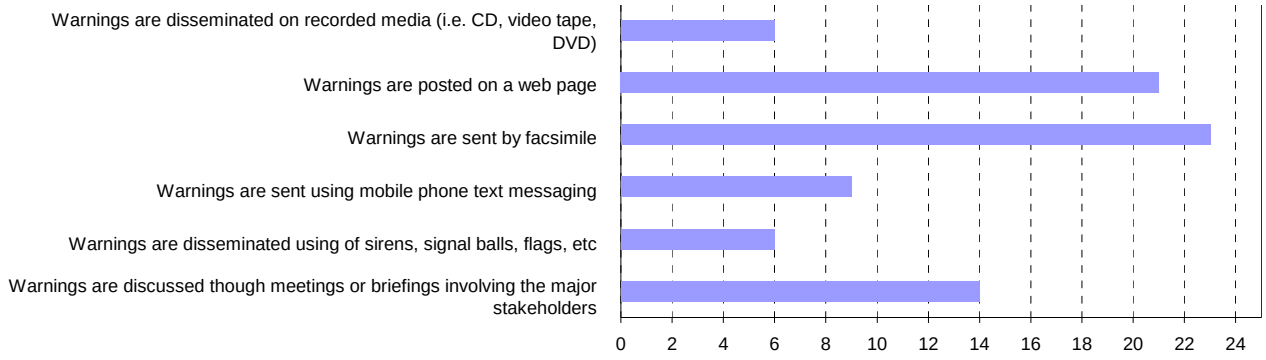


Figure 44. Warning dissemination methods in Asia.

As might be expected, virtually all respondents from Asia indicated that they disseminated hazard warnings to the public and the media and to relevant government authorities. It is noticeable, however, that a much lower percentage of disseminated warnings and other products to external partners in disaster risk reduction such as their Red Cross and Red Crescent Societies, the UNDP and others. However, facsimile, web page and Internet were the most common dissemination methods in Asia, followed by briefings and hard copy mailing. Unlike the situation in Africa, sirens, signal balls and flags were also used fairly widely

5.5.9 Product Utility and Product Improvement

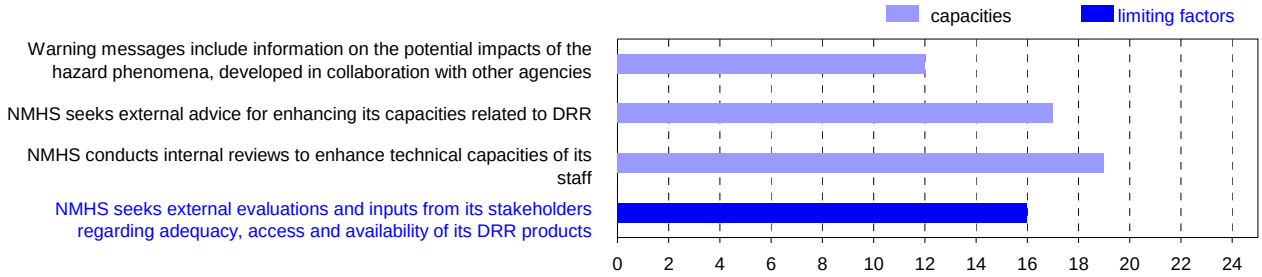


Figure 45. Ongoing feedback and improvement of products in Asia.

As pointed out in earlier sections**,** most (83% or 20 of 24) respondents in Asia indicated that they work with other agencies with respect to hazard warnings. Most of these (80% or 16 of 20) also stated that they had regular interaction with disaster risk authorities to enhance their warning capabilities and content. About half (52% or 12 of 23) of the NMHSs who included information on potential risks (impacts) in warning statements indicated that they collaborated with other agencies to develop risk information. In addition, over three quarters (77% or 17 of 22) of responding NMHSs pointed out that they sought external advice to enhance their capacities to support disaster risk reduction. Such advice was particularly sought to enhance monitoring and forecasting (85% or 17 of 20), watches and warnings (80% or 16 of 20), or overall products and services (86% or18 of 21). Over three quarters of respondents (78% or 18 of 23) also indicated that their NMHSs had a quality control mechanism to enhance their warning capabilities and content. Most (85% or 17 of 20) indicated that the mechanism included feedback from stakeholders and the public after an event had occurred. Most (80% or 16 of 20) also stated that it provided for regular interaction with stakeholders (disaster risk authorities) and over half (65% or 13 of 20) reported that the mechanism provided for training for stakeholders to understand the hazards, warnings and their implications. In addition, most NMHSs (67% or 16 of 24) reported that they sought external evaluations and inputs from stakeholders regarding the adequacy, relevance, method of access and availability of their disaster risk reduction products. On the negative side, however, three quarters of respondents (75% or 18 of 24) considered that the lack of public understanding of the effects of hazards and the lack of public understanding of watches and warnings limited the public response to them. Furthermore, almost two thirds (63% or 16 of 24) of them considered that the lack of joint training between staff of their NMHSs and emergency authorities and managers limited their disaster risk reduction efforts. Consequently, three quarters of responding NMHSs (75% or 18 of 24) in Asia felt that educational modules for media, public and disaster risk authorities would enhance their effectiveness in disaster risk reduction.

5.5.10 Internal NMHS Training and Capacity Enhancement

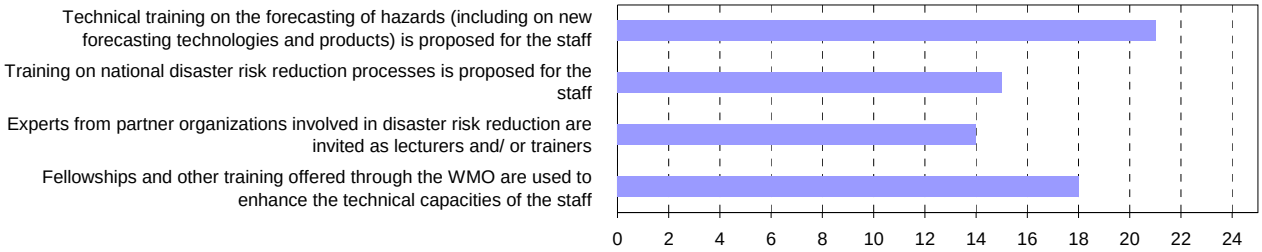


Figure 46. Training and capacity building of NMHS' staff in Asia.

Most Asian NMHSs (88% or 21 of 24) indicated that they provided ongoing technical training to their staff on forecasting of hazards, including up to date training on new forecasting technologies and products. Most (79% or 19 of 24) also stated that they conducted internal reviews and sought staff inputs to enhance their capacity building and technical training activities. Furthermore, three quarters (75% or 18 of 24) of them reported that they utilized Fellowships and other training offered through WMO to enhance the technical capacities of their staff. The same number also conducted evaluations of the suitability of communications, workstations, and software to support disaster risk reduction and subsequently implemented upgrades to these systems. In addition, more than half of reporting NMHSs (63% or 15 of 24) provided training to staff on their country's disaster risk reduction processes and related topics and most of them (58% or 14 of 24) invited experts from partner organizations involved in disaster risk reduction as lecturers and/or trainers. However, less than half (42% or 10 of 24) stated that they held or participated in joint training activities for NMHS staff and emergency response agencies. Balancing the preceding realities, over two thirds of respondents (68% or 15 of 22) considered that (lack of) professional staff with appropriate training limited their ability for real time monitoring of hazards. The same number felt that this situation also limited their ability to provide hazard data products. Expanding on this theme, over half (63% or 15 of 24) of responding NMHSs considered that a lack of joint training between NMHS staff and emergency authorities and managers also limited their contributions to disaster risk reduction. A slightly lower number (54% or 13 of 24) pointed to the lack of joint training between NMHS staff and disaster risk managers as a limiting factor. Finally, half of responding NMHSs (50% or 12 of 24) were of the view that lack of forecaster training at the NMHS reduced the effectiveness of their warning services. To compound this, almost half (46% or 11 of 24) identified the lack of joint training between NMHS staff and the media as a further limiting factor. Not surprisingly, therefore, most NMHSs who responded to the survey (91% or 21 of 23) considered that upgrading and improving their operational forecasting and warning activities would enhance their disaster risk capacities. Furthermore, the majority of them (90% or 18 of 20) advocated the value of cross-border training activities with neighbouring NMHSs, targeted at common hydrometeorological hazards.

5.5.11 Outreach Activities

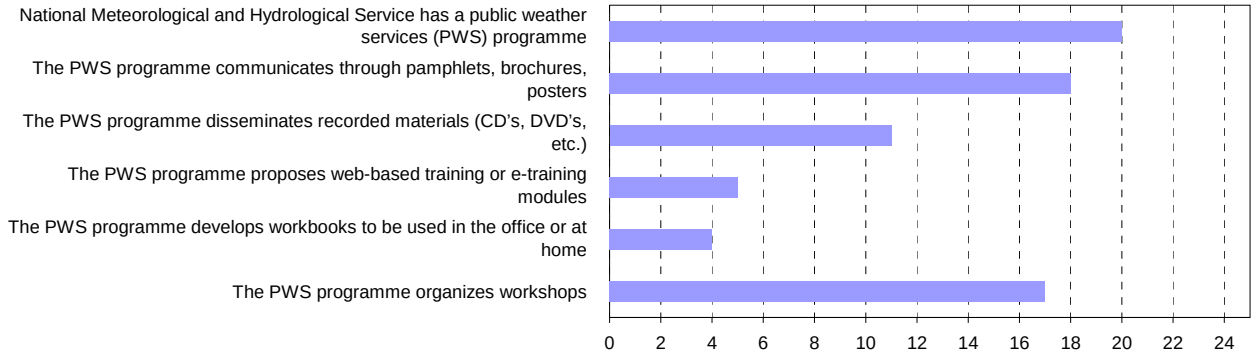


Figure 47. Outreach activities in Asia.

Outreach activities aimed at the general public and other stakeholders are a vital component of any effective disaster risk reduction programme. Within NMHSs, outreach activities are often part of a public weather services programme. In Asia (RA II), most NMHSs (87% or 20 of 23) who responded to the survey identified that they had a public weather services programme. Roughly two thirds (65% or 13 of 20) of them stated that their NMHSs quality control programmes included training for the stakeholders to understand the hazards, warnings and their implications. A similar number (63% or 15 of 24) indicated that they provided education and training on hazards, watches, warnings, etc to disaster risk reduction managers and authorities and operational emergency response managers. Over half of respondents (58% or 14 of 24) stated that they provided training

targeted at the trainers (i.e. of disaster risk authorities, emergency response staff, media, etc). In addition, half of them (50% or 12 of 24) reported that they provided educational modules and training programmes targeted at the general public. Slightly fewer (42% or 10 of 24) provided training to the news media or were involved in joint training activities for NMHS staff and emergency response agencies. The following materials and methods were identified as being used in public outreach programmes: - pamphlets, brochures, posters (75% or 18 of 24), workshops (71% or 17 of 24), recorded materials (CDs, DVDs, etc) (48% or 11 of 23), Web-based training (23% or 5 of 22), workbooks for office or home use (17% or 4 of 23), and E-training modules (9% or 2 of 23). A majority of responding NMHSs (58% or 14 of 24) also stated that they sought external reviews and inputs regarding the adequacy of the education and public outreach services they provided. Nevertheless, three quarters (75% or 18 of 24) of them felt that the lack of public understanding of the effects of hazards limited the public response to warning services. In addition, almost two thirds (63% or 15 of 24) believed that the lack of joint training between NMHS staff and emergency authorities and managers limited their disaster risk reduction efforts. Roughly half (54% or 13 of 24) also felt that the lack of joint training between NMHS staff and disaster risk managers limited their disaster risk reduction efforts. Finally, almost half (46% or 11 of 24) considered that the lack of joint training between NMHS staff and media limited their disaster risk reduction efforts. In view of the preceding, it is not surprising that three quarters of respondents (75% or 18 of 24) considered that educational modules that NMHSs could target at media, public and disaster authorities would enhance their effectiveness in disaster risk reduction.

5.6 NMHS Contingency Planning

Encouragingly, three quarters of responding NMHSs in Asia (75% or 18 of 24) reported that they had a contingency plan to maintain the continuity of products and services in the event of organizational emergencies such as power failure or communications disruption. More than half of these (56% or 10 of 18) indicated that their contingency plans involved agreements or protocols with neighbouring NMHSs to support each other in the event of catastrophic failures. Two thirds (67% or 16 of 24) also stated that they conducted or participated in drills and exercises to ensure disaster preparedness. Nevertheless, almost all respondents (89% or 17 of 19) identified needs for improved coordination with neighbouring NMHSs, specifically citing the need for support from them in the event of disruption of services.

5.7 Overarching Factors

NMHS participating in the country-level survey were asked to respond to a series of questions that centred on obtaining expressions of opinion regarding overarching factors or realities that either limited or could enhance their ability to make optimal contributions to disaster risk reduction. To varying degrees, NMHSs responses to these questions also served to validate statements, expressions of opinion and/or recommendations contained in responses to earlier sections of the survey. The following summarizes the inputs that fall under the above broad category:

5.7.1.1 NMHS Visibility

Two thirds of respondents in Asia (67% or 16 of 24) indicated that their NMHSs needed higher visibility and recognition within government as a major contributing agency to disaster risk reduction. Almost half (46% or 11 of 24) felt that a lack of understanding by government authorities of the value provided by the NMHS limited their contributions to that priority area. Most respondents (88% or 21 of 24) considered that improved ministerial level understanding of the socio-economic benefits of hydrometeorological products and services would increase the national visibility of their NMHS.

5.7.1.2 Organization and Governance

Just over a third of Asian NMHSs (38% or 9 of 24) felt that their national disaster risk reduction structure limited their potential contributions to disaster risk reduction. A greater number (50% or 12 of 24) considered that the effectiveness of their contributions was limited by the lack of clear

legislation or policies regarding their role (e.g. as the sole issuer of warnings of hydrometeorological hazards). As a particular concern, two thirds of respondents (67% or 12 of 18) from countries with separate NMS and NHS considered that legislation or partnership agreements were needed to better define each agency's role in disaster risk reduction.

5.7.1.3 Coordination and Partnership

Over one third of Asian NMHSs who responded to the survey (39% or 9 of 23) considered that their contributions to disaster risk reduction were limited by a lack of linkages between their NMHS and other involved organizations. In addition, even more of them (83% or 20 of 24) also felt that better coordination with WMO Regional Specialized Meteorological Centres and/or with neighbouring countries (82% or 18 of 22) and would improve their contributions to their own nations' disaster risk reduction activities.

5.7.1.4 Resources and Capacity

Most NMHSs (91% or 21 of 23) considered that upgrading and improving their operational forecasting and warning services would enhance the disaster risk reduction capacity within their country. However, most (89% or 17 of 19) stated that resources and infrastructure limited their ability to deliver critical products and services for disaster risk reduction, identifying professional staff (82% or 18 of 22) and financial resources (74% or 17 of 23) as limiting factors.

5.8 WMO Support

The following list summarizes the needs for support from WMO expressed by the NMHS in Asia who responded to the survey. Needs are identified in the order of priority assigned by the respondents.

1. Technology transfer, capacity building, technical guidelines and technical training (e.g. forecasting tools and methodologies, hazard mapping, and other inputs to risk assessment tools, etc.).
2. Provision of technical advice and specifications (e.g. to enhance observing networks, operational infrastructures, relevant products and services for disaster risk reduction applications).
3. Education, training and public outreach programmes in disaster risk reduction (e.g. targeted at National Meteorological and Hydrological Service and their stakeholders).
4. Advocacy for enhanced visibility of National Meteorological and Hydrological Service' in the area of disaster risk reduction.
5. Assist members in the development of the national disaster risk reduction plans.
6. Cost-benefit analysis of hydro-meteorological services in disaster risk reduction.
7. Strengthening strategic partnerships with other technical organizations and agencies (e.g. meteorology, hydrology, ocean services, etc.).
8. Establishment of regional emergency protocols for the National Meteorological and Hydrological Services in support of each other in case of disruption of services due to the impact of a disaster.
9. Strengthening strategic partnerships with stakeholders (e.g. disaster risk managers, media, etc.).
10. Resource mobilization.

5.9 Sub-Regional Considerations

Asia (WMO RA II) encompasses a huge geographic expanse, a variety of climates and broad spectrum of hydrometeorological hazards. The following sections examine sub-regions of Asia defined by countries' membership on the ESCAP/WMO Typhoon Committee and the ESCAP/WMO Tropical Cyclone Panel and, in addition, at Central Asian countries and at the drier countries in the vicinity of the Persian Gulf. The country groupings falling within these four sub-regions are listed in Annex 2.

5.9.1 Survey Responses from Typhoon Committee Members

Seven members of the ESCAP/WMO Typhoon Committee responded to the WMO Country-level survey. These were the NMHSs from: Cambodia, China, Hong Kong (China), Japan, Lao PDR, Republic of Korea and Thailand. The following paragraphs briefly assess the responses from this selected group of NMHSs against the backdrop of the analysis of all survey responses from Asia presented earlier. Figure 48 below illustrates the number of responding members of the ESCAP/WMO Typhoon Committee who stated that they were affected by the specified hazards.

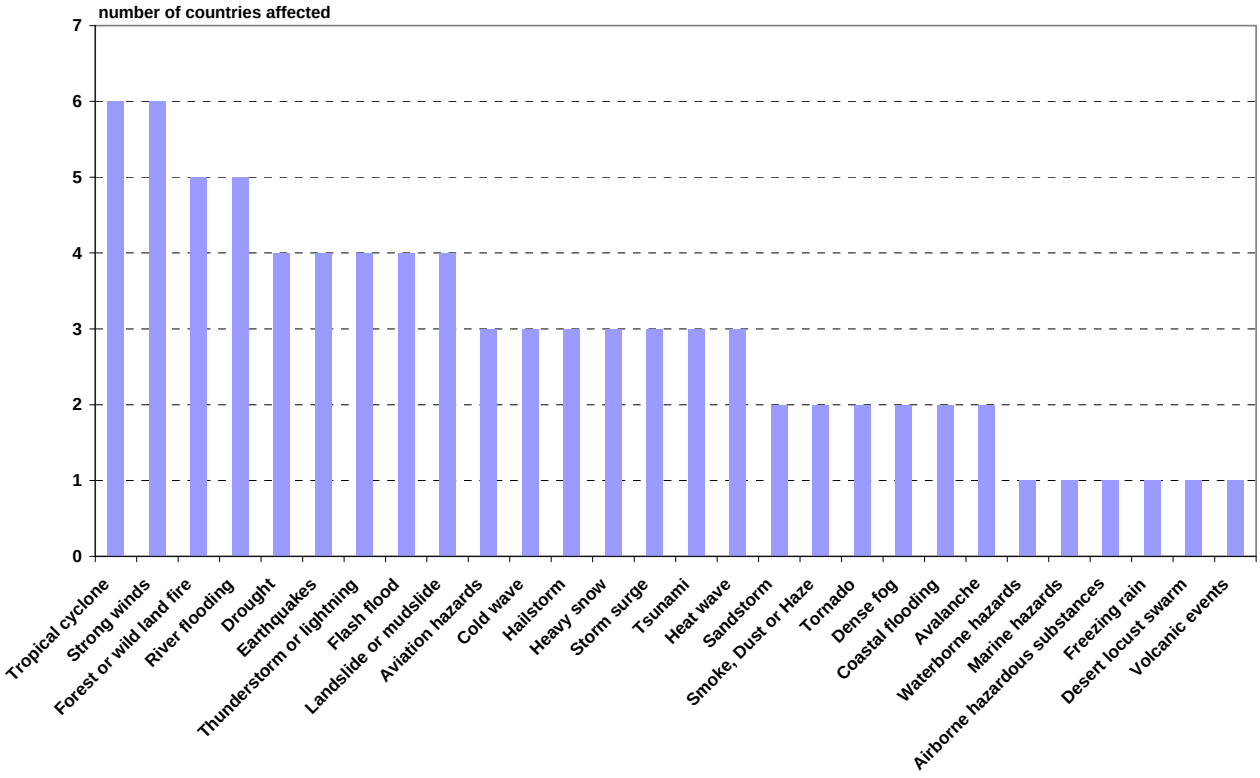


Figure 48. Number of responding members of the ESCAP/WMO Typhoon Committee who identified themselves as being affected by specified hazards.

While the broad pattern of responses from Typhoon Committee members paralleled that from Asian respondents as a whole there were some variations. A noticeably higher proportion of Typhoon Committee members maintained both quality controlled hazard databases and their own databases on the impacts of hazards. All Typhoon Committee respondents were members of their national committees for disaster management. A noticeably higher percentage of them indicated that they provided services in support of post-disaster reconstruction. Their responses also demonstrated a somewhat higher degree of collaboration and coordination with major partners involved in disaster risk reduction, though this pattern was uneven. While only one respondent indicated that they had a combined NMHS, a lower percentage than in Asia as a whole felt the need for legislation or partnership agreements to define the roles that their NMSs and NHSs played in disaster risk reduction.

Where NMHS infrastructure, warning and forecast capacity, and products and services are concerned, the Typhoon Committee picture was, again, generally similar to that for Asian respondents as a whole, though tending to be either more positive or more negative in a few areas. Fewer Typhoon Committee members, for example, identified telecommunications systems as a limiting factor on their ability to deliver critical products and services. All had a dedicated 24-hourly/year-round warning capacity in place and fewer of them expressed needs for improved

coordination of warnings with RSMCs and neighbouring NMHSs. In addition, a higher proportion had a mechanism in place for coordination with the media in emergency situations. The picture with respect to improvement of product quality and utility and training and capacity building was also, broadly speaking, more positive than the overall Asian picture.

Conversely, however, somewhat higher percentages of responses from Typhoon Committee members identified difficulties with Internet access and limitations related to quality assurance and data customization. Where overarching factors are concerned, Typhoon Committee members' responses displayed somewhat lower identification of needs for clear legislation or policies regarding the NMHSs role or for legislation or partnership agreements to better define the respective roles of the NMS and NHS in disaster risk reduction. They also indicated a lower requirement for improved collaboration with RSMCs but, at the same time, felt somewhat more limited by lack of linkages with other organizations involved in disaster risk reduction.

5.9.2 Survey Responses from Tropical Cyclone Panel Members

Seven members of the ESCAP/WMO Panel on Tropical Cyclones responded to the WMO Country-level survey. These were: Bangladesh, Maldives, Myanmar, Oman, Pakistan, Sri Lanka, and Thailand. The following paragraphs briefly assess the responses from this selected group of NMHSs against the backdrop of the preceding analysis of all survey responses from Asia. Figure 49 below illustrates the number of responding members of the ESCAP /WMO Tropical Cyclone Panel who stated that they were affected by specified hazards.

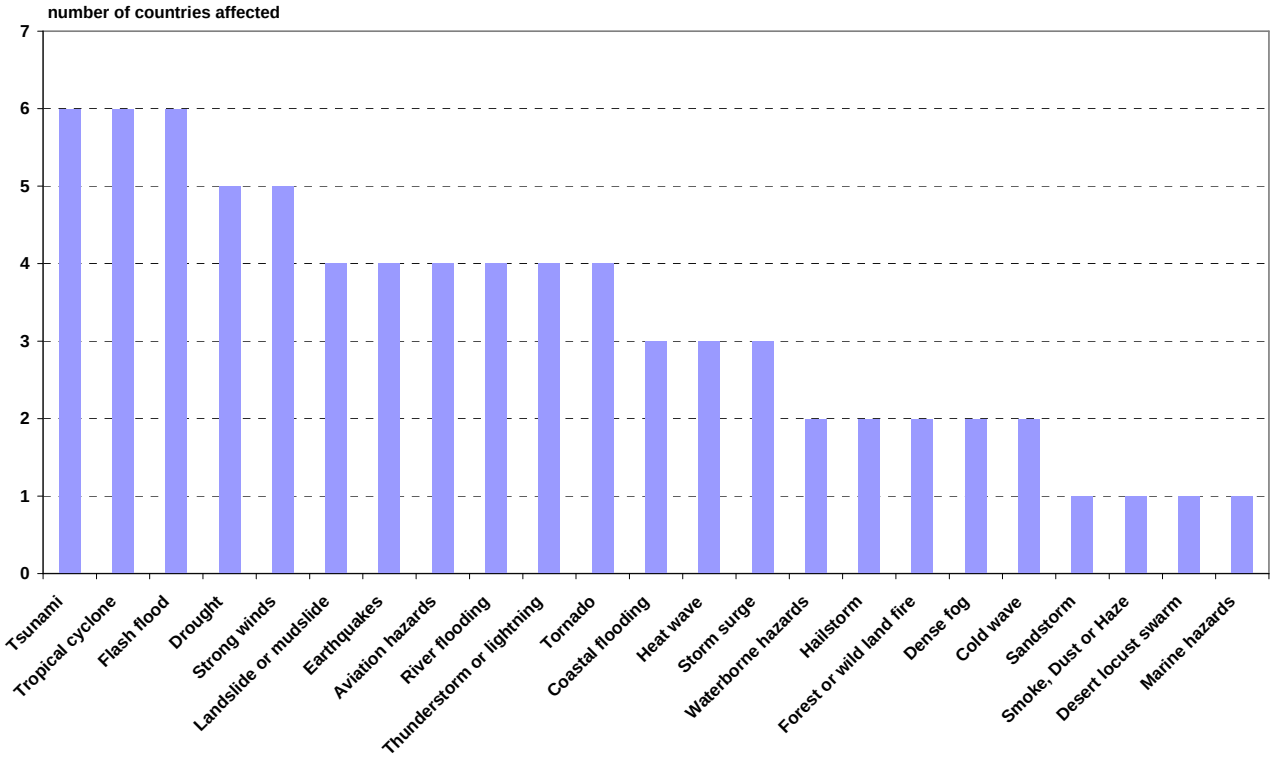


Figure 49. Number of responding members of the ESCAP/WMO Tropical Cyclone Panel who identified themselves as being affected by specified hazards.

As might be expected, the responses show that the hazards that affect most Tropical Cyclone Panel members are tropical cyclones, tsunamis and flash floods followed closely by strong winds and drought. It is also worth noting that tropical cyclones and tsunamis have moved significantly higher in the list of hazards as compared to the corresponding data in Figure 28 for Asian countries

as a whole. Moreover, several hazards that affected other parts of Asia (e.g. heavy snow, volcanic events) are not significant concerns for the member countries of the Tropical Cyclone Panel.

Taken overall, the broad pattern of responses from Tropical Cyclone Panel members paralleled that from Asian respondents as a whole but with some variation in the degree of emphasis in certain areas. Proportionately more Cyclone Panel members, for example, indicated that they maintained hazard databases and provided hazard maps and high-risk zone analyses than was the case for Asian respondents as a whole. The group also provided a somewhat stronger endorsement for the provision of value added data based services in support of disaster risk reduction. All Tropical Cyclone Panel respondents stated that they were members of their national committees for disaster management and, relatively speaking, fewer of them felt that their national structure limited their contributions. Panel members without exception indicated that they contributed to all phases of disaster risk reduction except for the reconstruction phase where just over one half of them provided support. Their responses also demonstrated a somewhat higher degree of collaboration with partners involved in disaster risk reduction.

Where NMHS infrastructure, warning and forecast capacity, and products and services are concerned, the Cyclone Panel picture was, again, somewhat more positive than with Asian respondents as a whole. An apparent anomaly was evident in relation to telecommunications and data exchange, however. Despite reporting somewhat better infrastructure, round-the-clock operations and forecasting/warning capacity, a lower percentage (71%) of respondents indicated that their forecasting staff had access to real time hydrometeorological data for development of forecast products (While the small sample size of 7 respondents may have skewed the statistics, some clarification will be required here). As a broad generalization, survey responses also suggested that Tropical Cyclone Panel members devoted greater emphasis and levels of effort to improving products and pursuing outreach activities than was general in Asia. Moreover, all but one Cyclone Panel member had a contingency plan to maintain operations in emergency situation and half of them had involved neighbouring NMHSs in their contingency planning – a significant improvement over the situation for the region as a whole. Finally, the preceding, generally more positive, pattern also applied to the overarching factors addressed in the survey questionnaire. Here, Cyclone Panel respondents displayed a lower level of concern regarding their visibility, felt less constrained by their national disaster coordination structures, and did not consider themselves as limited by inadequate linkages with other organizations than was the case for Asia generally.

5.9.3 Survey Responses from Central Asia

The subgroup of Central Asian countries who responded to the WMO country-level survey were: Kazakhstan, Kyrgyz Republic, Tajikistan and Uzbekistan. The following paragraphs briefly assess the responses from this group of NMHSs against the backdrop of the analysis of all survey responses from Asia. Figure 50 below illustrates the number of responding NMHS from Central Asia (CA) who stated that they were affected by specified hazards.

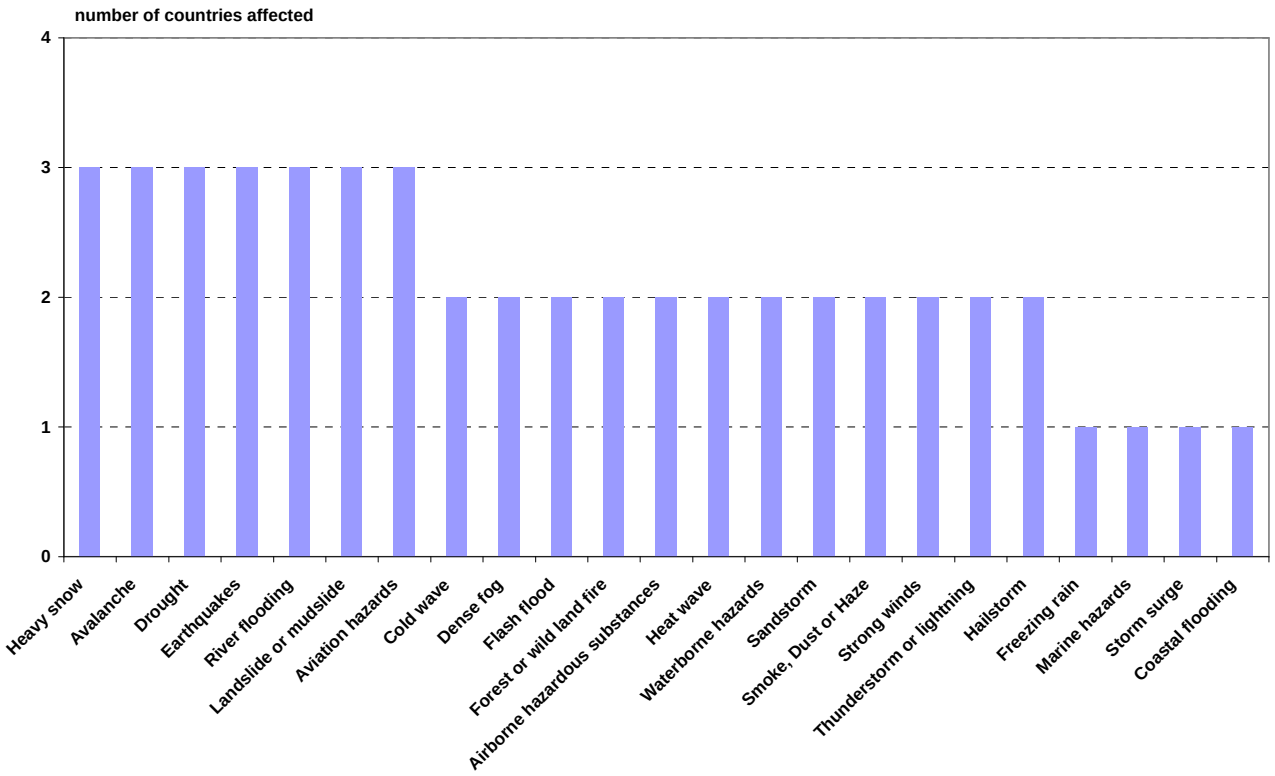


Figure 50. Number of responding NMHSs from Central Asia who identified themselves as being affected by specified hazards.

As is evident from Figure 50, the pattern of hazards for Central Asian countries is quite different from that for the Tropical Cyclone Committee members. The most common hazards affecting the Central Asian countries are heavy snow, landslides or mudslides, avalanches, earthquakes, drought, river flooding, and aviation hazards. It is noteworthy here that heavy snow, drought and river flooding have moved up the occurrence list relative to the overall Asian pattern while strong winds and flash floods have moved down. This is not to imply, of course, that commonly occurring hazards across the Asian region, such as strong winds, flash floods, thunderstorms and lightning and hailstorms, cold waves and heat waves, are not still significant concerns in the Central Asian context as they remain potentially serious hazards.

Taken overall, the broad pattern of responses from Central Asian NMHSs paralleled that from Asian respondents as a whole though with some variations. A much smaller percentage of Central Asian NMHS, for example, indicated that they maintained hazard databases and provided hazard maps and high-risk zone analyses than was the case for all Asian respondents. The Central Asian group also provided a somewhat weaker endorsement for the view that the provision of value added data-based services would enhance their contributions to disaster risk reduction. Moreover, only one (of 3) Central Asian respondent stated that they were a member of their national committee for disaster risk reduction and only one felt that their national structure limited their contributions. In addition, partnerships and collaboration with other agencies and institutions were somewhat less extensive than in Asia as a whole. However, Central Asian respondents, without exception, indicated that they had combined NMHSs and half of them stated that national legislation clearly defined the combined NMHS role in disaster risk reduction.

The Central Asian respondents placed even stronger emphasis than the region as a whole on deficiencies in resources, telecommunications and computing capabilities, network infrastructure and professional staff capacities and on the desirability of upgrading forecasting and warning services. The responses suggested, however, that Central Asian NMHSs have given somewhat less attention to product improvement and outreach activities. Only one Central Asian NMHS

reported that it had a contingency plan to maintain operations in emergencies and all of them advocated better coordination with neighbouring NMHSs in this context. Central Asian respondents also displayed somewhat higher levels of concern regarding the need for NMHS visibility and for clear legislation or policies regarding the NMHS role in disaster risk reduction. Finally, all Central Asian NMHSs endorsed the desirability of enhancing coordination with RSMCs and, without exception, stressed the value for disaster risk reduction of improving forecasting and warning services.

5.9.4 Survey Responses from Arid Asian Countries

As defined for the purposes of this sub-regional analysis, the subgroup of seven Asian Arid countries who responded to the WMO country-level survey is as follows: Bahrain, Islamic Republic of Iran, Oman, Qatar, Republic of Yemen, Saudi Arabia and the United Arab Emirates. The following paragraphs briefly assess the responses from this group against the backdrop of the analysis of all survey responses from Asian NMHSs. Figure 51 below illustrates the number of responding NMHSs from Asian Arid countries who stated that they were affected by specified hazards.

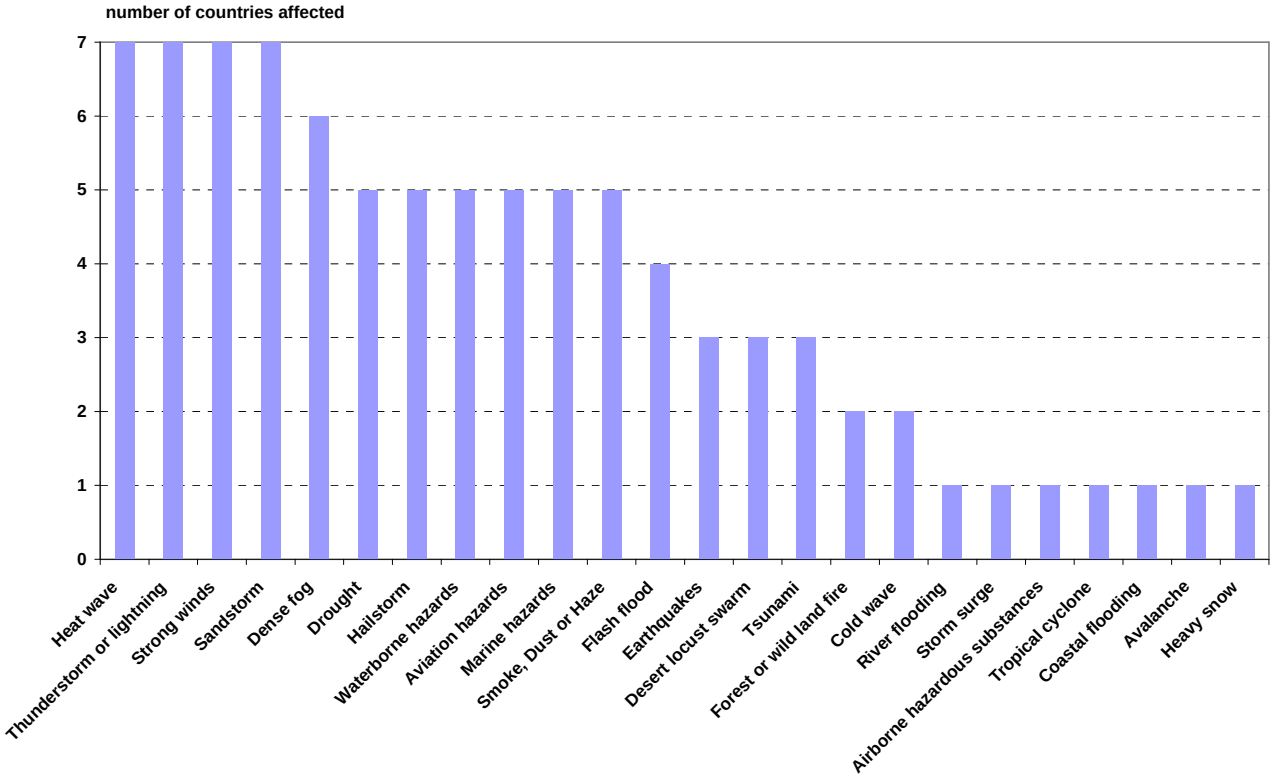


Figure 51. Number of responding NMHSs from Arid Asian countries who identified themselves as being affected by specified hazards.

As is evident from Figure 51, the pattern of hazard occurrence for Asian Arid countries is, not surprisingly, markedly different from that for the Tropical Cyclone Committee countries and, in some respects, from that for the Asian region as a whole. The most common hazards affecting the Asian Arid group of countries are strong winds, thunderstorms and lightning, heat waves and sandstorms, followed closely by dense fog, hailstorms, drought, smoke, dust and haze, marine and waterborne hazards and aviation hazards. It is noteworthy here that sandstorms and dense fog have moved up in relative position while flash floods, heavy snow, river and coastal flooding and tropical cyclones have moved downward and are significantly less widely occurring than was the case for Asia as a whole.

Taken overall, the broad pattern of responses from Asian Arid NMHSs paralleled that for Asian respondents as a whole though with notable variations in the strength of the responses to certain questions. Fewer Asian Arid country respondents, for example, indicated that their country had a designated agency responsible for maintaining a database of official information on the impacts of disasters. Furthermore, less than half of them had access to such information and less than one third maintained an internal database of impacts information. A significantly lower than average percentage of these NMHSs also indicated that they maintained hazard databases and provided services based on these data. Moreover, a somewhat higher percentage of Asian Arid country NMHSs felt that their national disaster structure limited their contributions to disaster risk reduction. Partnerships and collaboration with other disaster-related agencies and institutions were also somewhat less extensive than general across Asia. However, Asian Arid country respondents indicated that all of them had separate NMSs and NHSs and all agreed on the importance of improved coordination between these agencies to enhance products and services for disaster risk reduction.

Where NMHS infrastructure, warning and forecast capacity, and products and services were concerned, the broad pattern of Asian Arid country responses was similar to the regional situation. Deficiencies in resources, telecommunications and computing capabilities, network infrastructure and professional staff capacities were cited and the desirability of upgrading forecasting and warning services was stressed. The survey responses, however, indicated that Asian Arid country NMHSs have paid somewhat less attention to product improvement and internal staff training than was normal across the region. A somewhat higher percentage of Asian Arid country respondents advocated the benefits of training on hazard prediction, joint training with disaster agencies, and improved coordination with neighbouring NMHSs, including cross-border training on common hazards.

A somewhat lower than average percentage of Asian Arid country NMHSs was involved in outreach activities and they also displayed somewhat less concern regarding the need for increased NMHS visibility. Finally, all Asian Arid country respondents, without exception, stressed the value for disaster risk reduction of improving forecasting and warning services. All of them also identified resources as limiting their ability to contribute, with a large majority identifying professional staff capacities and more than half citing financial resources as limiting factors.

5.10 Concluding Assessments and Recommendations for Asia

The following summarizes assessments and conclusions related to the analysis of the survey responses from Asian NMHS that has been presented in this chapter. In order to facilitate identification of subject areas, the titles associated with individual assessments and conclusions presented below match those used during the analysis of Asian survey responses outlined in the preceding pages.

5.10.1 Access to Data on Hazards and their Impacts

NMHSs need to have easy access to official information on hazards and on the impacts of disasters in order to provide support for planning activities and to facilitate monitoring the effectiveness of NMHS services in support of disaster risk reduction. As Annex 3 illustrates, while many NMHSs in Asia maintain hazard data archives, some do not maintain records of even the most common hazards such as strong winds or thunderstorms and lightning. As the agencies responsible for monitoring and prediction of hydrometeorological hazards within their countries, NMHSs (or NMSs and NHSs) may, reasonably, be expected to maintain records of occurrences of those hazards. Such records are important for various applications ranging from verification of warnings and forecasts to hazard mapping and analysis. The survey responses also substantiate the need for some NMHSs and countries in Asia to improve their access to disaster impact data.

5.10.2 Value Added Services based on Historical Hazard Data

The respondents' recommendation regarding enhanced value-added data services is supported by earlier survey responses. These responses indicate that more than half of the NMHSs in Asia would benefit from capacity development and training related to disaster risk applications, including hazard and impact analysis, hazard mapping and risk zone analysis and preparation of enhanced products. It is also clear that quality controlled, regularly updated, hazard data archives remain to be established in some NMHSs with associated requirements for capacity development in data rescue, quality assurance and archival techniques.

5.10.3 Legislation and Governance

Where it is felt to be essential to enhance their contributions to disaster risk reduction, NMHSs should press for clear policy direction from their governments regarding their roles and responsibilities.

5.10.4 National Structures/Mechanisms for Disaster Risk Reduction

The degree to which NMHS are integrated into national disaster risk reduction coordination structures and their operational relationships with civil protection agencies, planning authorities and important non-governmental partners exercise a significant influence on their ability to contribute effectively to disaster risk reduction. For optimum effectiveness, state of the art NMHS scientific, technical and operational capacities must be mainstreamed into national planning, decision-making and disaster response structures and systems and, in addition, be well connected to important non-governmental partners. Asian responses to the survey indicate that most NMHSs in the region are part of their national disaster risk reduction system. However, they also suggest there is room for improvement in operating processes and, in particular, draw attention to needs to expand partnerships with other involved agencies.

5.10.5 Contributions of NMHSs to National Disaster Risk Reduction Systems

The survey responses indicate that NMHSs in Asia should devote continuing attention to building effective working relationships with national disaster authorities by providing timely, accurate and relevant products and services for disaster risk reduction. The responses suggest that those few NMHS who are not already members of their national coordinating committees should take the initiative to gain membership and become an integral part of their countries' disaster risk reduction system. Furthermore, they suggest that efforts are needed in some countries to establish more effective and collaborative working relationships between the NMHS and their national coordinating committees for disaster risk reduction. They also underscore the need for expansion and reinforcement of partnerships with other agencies and organizations involved in disaster related activities. Experience elsewhere indicates that the respondents' recommendation for the establishment of a "readiness system" could, if implemented, enhance the overall NMHS contribution and visibility.

5.10.6 NMHS Collaboration with other Partners

Survey responses indicate that a number of NMHSs in Asia do not actively pursue coordination and collaboration with some important national, regional and international partners in the disaster community. They illustrate that a significant number of NMHS are not well connected to regional bodies or international organizations that play important roles in disaster situations. Expanded collaboration and effective partnerships can benefit NMHS through broader utilization of their products and services, enhance their visibility and influence, and result in more effective contributions to disaster risk reduction. Consequently, the development and maintenance of such relationships should be given significant priority by NMHS management.

5.10.7 The Organization and Priorities of NMHS in Asia

The survey responses, though somewhat inconsistent, suggest that legislation, policy direction, or partnership agreements may be needed to clarify the disaster risk reduction roles and responsibilities of the NMSs and NHSs in roughly half of the countries in Asia. Where this is the case, clarification will need to be sought at the national level.

5.10.8 Operational Coordination between NMS and NHS

The survey responses summarized above indicate general needs for enhanced operational coordination between NMSs and NHSs in many countries in Asia. The survey respondents' majority recommendation should, therefore, be pursued at the country level through immediate action to achieve more effective operational coordination between NMSs and NHSs, particularly with respect to hazard warnings and other critical products.

5.10.9 Observation and Monitoring Networks and Systems

Reliable, round the clock, observations that are made available in real time are the essential raw material needed for the production of early warnings of hydrometeorological hazards, forecasts and other operational products. In addition, such observational networks provide the historical data sets that are required for risk analysis, hazard mapping, return-period calculations and generation of other data products required for disaster risk reduction applications. Moreover, they provide essential "ground truth" measurements for the calibration of remotely sensed readings from earth satellites and aircraft. In consequence, every effort should be made to ensure that adequate hydrometeorological observation networks are established and maintained in operation on a 24-hourly/year-round basis. This requires not only up-front investments in observational instrumentation, staff training and telecommunications but also, and often more problematic, the continuing commitment by national governments of adequate funding to sustain the ongoing operation and maintenance of their national observation networks for the foreseeable future.

5.10.10 Telecommunications and Informatics

The respondents' recommendation regarding upgrading of their operational forecasting and warning infrastructure is validated by the survey responses which confirm deficiencies in telecommunications, Internet access, computer hardware and software. These deficiencies undercut the abilities of affected Asian NMHSs to contribute effectively to disaster risk reduction. As in the case of observational networks, rectifying these deficiencies will not only require up-front investments in telecommunications and informatics systems and in staff training. It will also necessitate continuing commitment by national governments of adequate funding to sustain the ongoing operation and maintenance of their hydrometeorological telecommunications networks and informatics systems over the long term.

5.10.11 Data Exchange

The respondents' recommendations for enhanced coordination with neighbouring NMHSs and RSMCs to improve data exchange are well considered. In addition, however, the survey responses indicate that enhancements to telecommunications, quality assurance and archiving systems are needed in more than half of the NMHS in the region, along with capacity building in relation to data processing and customization.

5.10.12 Forecast and Warning Capability

The respondents' strong recommendations for upgrading of forecasting infrastructure and the training level of professional staff are validated by the survey responses. Widespread needs for upgrading of NMHSs professional staff, computing and applications software capacity and operational infrastructure were identified by survey contributors. However, it also appears that a few NMHSs in Asia do not operate warning and forecast services on a round the clock basis. This

represents a major deficiency in the context of disaster risk reduction and should be remedied as soon as possible.

5.10.13 Forecast and Warning Products

The respondents' recommendation regarding the need to improve their warning products and services is unchallengeable.

5.10.14 Coordination of Warnings

Respondents' recommendation for improved coordination with RSMCs and neighbouring NMHSs in relation to watches and warnings makes good sense. Such coordination reduces the risk of ambiguous or, in the worst case, conflicting warning messages from different sources reaching the same audience. A compounding issue here is the increased potential for confusion that arises when commercial or other entities also issue hazard warnings, as is the case in a few Asian countries.. As a general principle, therefore, it is desirable to work towards a situation where official warnings for hydrometeorological hazards emanate from a single recognized issuing authority within each country**.** Ideally being prepared by NMHSs with the scientific and technical capacity to make such predictions, hydrometeorological warnings may, in some circumstances, benefit from assessment and interpretation by civil defense authorities as to their likely impacts before being relayed to local communities, perhaps accompanied by advice from the authorities on actions that people should take to minimize loss of life and property. It is also evident from the survey responses that best practices in relation to coordination of warnings issues, utilization of the media's warnings dissemination capabilities, and assignment of NMHS staff to disaster management centres are not being followed in some Asian countries. These situations, where they exist, should be rectified by the NMHSs concerned.

5.10.15 Products and Services for Selected Socio-Economic Sectors

Experience around the globe demonstrates that the socio-economic sectors discussed earlier can benefit significantly from the incorporation of hydrometeorological information and products into their planning and decision-making processes. Sensible land-use planning to minimize risk of flooding and other hazards, rational planning and engineering design of housing and other developments to withstand expected wind loads or heavy rains and other similar measures contribute to hardening societies and communities against disastrous hydrometeorological events. Equally, early warnings of hazards enable people to take avoidance or mitigating actions to prevent disasters. The survey responses illustrate that considerable room exists to contribute significantly to disaster risk reduction in Asia by enhancing the provision of relevant products and services to planning, development, water resources and other key economic sectors.

5.10.16 Dissemination Systems and Target Audiences

Reliable and timely dissemination of early warnings of hazards to stakeholders and the public at large is among the most useful services that NMHS can provide in support of disaster risk reduction. Consequently, every effort should be made to ensure that warnings and other relevant products reach all important target audiences. In the context of disaster risk reduction, national Red Cross/Red Crescent Societies and similar non-government bodies should be targeted for receipt of hazard warnings on virtually the same level as government disaster authorities. NMHSs should seek to encourage and support such bodies to access and utilize early warnings of hazards and other relevant NMHS products.

5.10.17 Product Utility and Product Improvement

The survey responses indicate that most NMHSs in Asia have adopted best practices in relation to enhancing the utility of their warnings and other products through interaction with their stakeholders, including the general public. NMHSs who have not as yet adopted this approach should draw on the experience of other Services and endeavour to work with the recipients of their warning products to ensure that they understand the content of warnings and know how to react to

them. Despite the efforts made to date, however, the survey responses confirm that, in Asia, continuing efforts need to be devoted to enhancing public and stakeholder awareness and understanding of hazards, hazard impacts, the content of hazard warnings and prudent actions to take on receipt of the latter. The respondents' recommendation regarding the value of educational modules is consistent with the preceding analysis, albeit somewhat narrowly focussed on a single methodology.

5.10.18 Internal NMHS Training and Capacity Enhancement

The respondents' recommendations for upgrading of operational forecasting and warning capabilities and for cross-border operational training of forecasters are validated by the survey responses. However, they appear somewhat narrowly focussed in that the responses also indicate that a large percentage of NMHS would benefit from much closer collaboration with disaster risk authorities and emergency managers in developing and delivering internal training programmes for NMHS staff and joint training programmes with disaster risk agencies.

5.10.19 Outreach Activities

The respondents' recommendation that educational modules would be helpful is valid. However, it is clear that many NMHS in Asia, perhaps even a majority, have not assigned a particularly high priority to public outreach activities. The survey responses regarding lack of public and stakeholder awareness and understanding suggest that Asian NMHS should give increased emphasis to outreach activities aimed at both the public at large and disaster authorities and decision makers. Even timely and accurate early warnings and other high quality products will be of little value if the users do not understand their contents and implications.

5.10.20 NMHS Contingency Planning

The survey responses confirm that, while most Asian NMHS have established back-up arrangements to maintain hazard warnings and other critical services in the event of disruption of their operations, some have not as yet done so. This represents a critical deficiency in the context of hydrometeorological support to disaster risk reduction, particularly in relation to maintaining a capability to issue warnings of hazards in the event of telecommunications or other system failures. The establishment of partnership agreements with neighbouring NMHS can be an effective and low-cost approach to providing back-up capability and is clearly supported by the recommendations of the majority of respondents.

5.10.21 WMO Support

Asian respondents to the survey identified their highest priority needs for support from WMO as being in capacity building and infrastructure development areas. Many of these highest priority needs are in areas that have been the traditional focus of WMO scientific and technical development, training and outreach programmes. However, requirements for support have also been expressed in less traditional areas related to disaster risk reduction such as hazard mapping, inputs to risk assessment tools and preparation of national disaster risk reduction plans. Furthermore, though somewhat lower on the list of needs, the "softer" areas such as visibility enhancement and strategic partnerships have been raised. Finally, the issue of assistance in resource mobilization, while generally at a lower priority than in Africa, will continue to present a further challenge for WMO and for the NMHSs in question.

5.11 Region-wide Capacities and Resources in Asia

In their disaster risk reduction efforts, Asian NMHSs can draw upon expertise and support from beyond their national borders, accessing products, expertise and capacity building support from the WMO system and other resources across the Asian region. Five WMO Regional Specialized Meteorological Centres (RSMCs) in Asia, located at Beijing, Jeddah, New Delhi, Tashkent and Tokyo, provide operational products and expertise that can support the disaster risk reduction

activities of NMHSs. Some NMHSs in the region have very limited data-processing and Numerical Weather Prediction (NWP) capabilities. However, a pilot project is currently underway to address this deficiency by providing selected NMHS with forecast products generated at three NWP centres in the region along with training in the utilization of these products. The World Meteorological Organization/United Nations Economic and Social Commission for Asia and the Pacific (WMO/ESCAP) Typhoon Committee and WMO/ESCAP Panel on Tropical Cyclones focus on enhancing warning and other services related to Pacific typhoons and Indian Ocean/Arabian Sea Cyclones including sponsoring workshops, developing plans, organizing expert teams and pursuing outreach activities. The WMO Voluntary Cooperation Programme (VCP) also provides significant assistance to NMHSs in Asia to enhance their hazard warning capabilities and related infrastructures. WMO Regional Meteorological Training Centres located in China, India, Iran, Iraq and Uzbekistan also represent important sources of expertise for building capacities throughout the Asian region.

Where hydrological hazards are concerned, a regional cooperation programme (Aral-HYCOS) is in the preparatory stage in the Aral Sea Region. This project aims to build capacity in water resources management and promote cooperation in the collection, processing and use of hydrological data and information in Central Asia, with a major deliverable being a consistent regional hydrological information system. A second Asian WHYCOS project, the Hindu-Kush Himalaya HYCOS has as its goal to establish an operational flood information system and involving Bangladesh, Bhutan, China, India, Nepal and Pakistan. A third project, the Mekong-HYCOS, is at the discussion stage. UNESCO's International Hydrological Programme (IHP), with a Regional Office in New Delhi represents an additional resource for the countries of the region. Major IHP projects include Asia Pacific FRIEND (Flow Regimes from International Experimental and Network Data) and Hindu-Kush Himalayan FRIEND and are aimed at developing a better understanding of hydrological variability and similarity across the areas of concern through the exchange of data, knowledge and techniques.

A number of more broadly-based regional mechanisms and capacities also support and facilitate national disaster risk reduction efforts in Asia. The Association of South East Asian Nations (ASEAN) Committee on Disaster Management is pursuing a regional programme for disaster management. In August 2005, member countries adopted the ASEAN agreement on Disaster Management and Emergency Response to further enhance regional cooperation. Some specialized disaster oriented institutions have been established such as the Asian Disaster Preparedness Center (ADPC), Asian Disaster Reduction Center (ADRC). Sub-regional initiatives such as the ASEAN International Center for Integrated Mountain Development (ICIMOD), Mekong River Commission (MRC) and South Asian Association for Regional Cooperation (SAARC) are also relevant. Furthermore, the UN ISDR Regional Office has a mandate that includes awareness-raising and promotion of regional activities in disaster risk reduction, forging partnerships and pursuing projects under the United Nations Flash Appeal for the Indian Ocean Tsunami Early Warning System (IOTWS). It draws upon operational support and expertise of members of the ISDR Asian Partnership on Disaster Reduction (IAP) and other relevant players. Finally, the World Bank, Asian Development Bank (ADB) and similar institutions represent potential sources of financial assistance for disaster risk reduction initiatives.

CHAPTER 6

SOUTH AMERICA

WMO REGIONAL ASSOCIATION III

6 SOUTH AMERICA (WMO Regional Association III)

6.1 Abstract

Survey responses from 10 South American NMHSs indicate that all of them operate hydrometeorological observation networks. Many, however, identify these networks as inadequate and also draw attention to deficiencies in their telecommunications systems. Though all South American NMHSs have access to information on hazard impacts and a majority maintains hazard data archives, relatively few undertake hazard mapping, high-risk zone or impacts analysis. Most of them advocate closer collaboration between their National Meteorological Services (NMSs) and National Hydrological Services (NHSs) and with Regional Specialized Meteorological Centers RSMCs) and other disaster stakeholders. All ten NMHSs have hazard warning capacities and most have emergency contingency plans. However, many recommend that their hazard warning capabilities be strengthened, pointing to deficiencies in professional staff and informatics capacities. Moreover, needs are cited for expansion of warning services to address all relevant hazards, dissemination of warnings to key sectors and improved coordination. Most NMHSs also suggest that emphasis should be increased on public outreach and joint training activities. All of them are adversely affected by financial constraints and shortages of trained professional staff. Most are active in their national coordinating committees for disaster risk reduction, though some identify needs for clearer policy direction on their roles. Some differences from the preceding regional picture emerge at sub-regional levels. In particular, proportionately fewer Andean countries have national coordinating committees, only three of five have 24-hourly telecommunications, only two provide 24-hourly warning services and volcanic events and earthquakes and avalanches gain prominence as hazards. Conversely, non-Andean countries tend to have better infrastructures and capacities though a somewhat higher proportion of them advocate clearer definition of their roles in disaster risk reduction. These survey results provide support for the following conclusions and recommendations directed at enhancing the contributions of South American NMHSs to disaster risk reduction.

- Those few South American NMHSs who are not integrated into their national disaster risk coordination mechanisms should seek membership on these committees. Where necessary, NMHSs should press for clarification of their roles and responsibilities.
- Roughly a third of South American NMHSs need to establish hazard data archives and ensure access to reliable hazard impacts data. There are associated requirements for capacity development and training in data rescue, data management and archiving.
- Virtually all the NMHSs require capacity development and training in disaster risk applications such as hazard and impacts analysis, hazard mapping, risk zone analysis and product customization.
- Every effort should be made to ensure the 24-hourly operation of adequate hydrometeorological observation and telecommunications networks in all South American countries. Particular attention should be given to upgrading the weaker infrastructures and programmes in Andean countries.
- NMHSs' hazard warning programmes should be strengthened across South America. Priority should be given to providing round-the-clock warning services in all Andean countries and to the expansion of NMHSs' warning programmes to address all significant hydrometeorological hazards.
- Increased emphasis should be given to internal training of forecast staff, cross border training with other NMHSs, and joint training with disaster risk authorities to strengthen warnings expertise and enhance NMHSs' knowledge of disaster risk requirements, systems and procedures .
- Verification programmes for hydrometeorological hazard warnings should be implemented by all South American NMHSs to monitor warning accuracy and timeliness, assess improvements in skill and demonstrate NMHSs' warning capabilities to stakeholders.
- Official warnings for hydrometeorological hazards should emanate from a single recognized issuing authority in each country, ideally prepared by NMHSs with the required scientific and technical

capacities. In some circumstances, hazard warnings may, however, benefit from assessment and interpretation by civil defence authorities before being widely disseminated.

- Those NMHSs who do not have such back up arrangements to maintain services in emergencies, should establish such systems, possibly through partnerships with neighbouring NMHSs.
- All NMHSs should encourage the establishment of national readiness systems in their countries.
- NMHSs should increase emphasis on the provision of special products and services to key sectors such as land use planning, development and water resources. These and other important sectors do not currently receive such support in over one third of South American countries.
- Operational coordination between NMSs and NHSs and with neighbouring NMHSs and RSMCs should be improved across South America. In some countries, policy direction or partnership agreements between NMSs and NHSs may be required to clarify their respective roles, particularly in relation to warnings issue.
- Most South American NMHSs should place greater emphasis on public stakeholder education and outreach activities.
- South American NMHSs need support from WMO in the form of technical advice, specifications, and technology transfer, forecasting techniques, disaster risk reduction planning and in areas such as hazard mapping, risk assessment tools and cost-benefit analyses. They would also welcome assistance in areas such as resource mobilization, strategic partnerships and visibility enhancement.

The present chapter centres on the assessment of the survey responses from South American NMHSs (WMO RA III). Its internal structure follows the sequence outlined earlier in section 2.6.1.

6.2 The Response to the Survey

The 10 countries in South America who contributed responses to the WMO country-level survey are listed in Annex 2.

6.3 The Hazards affecting Countries in South America

Figure 52 below lists the number of responding countries in South America (WMO RA III) who identified themselves as being affected by specified hydrometeorological hazards.

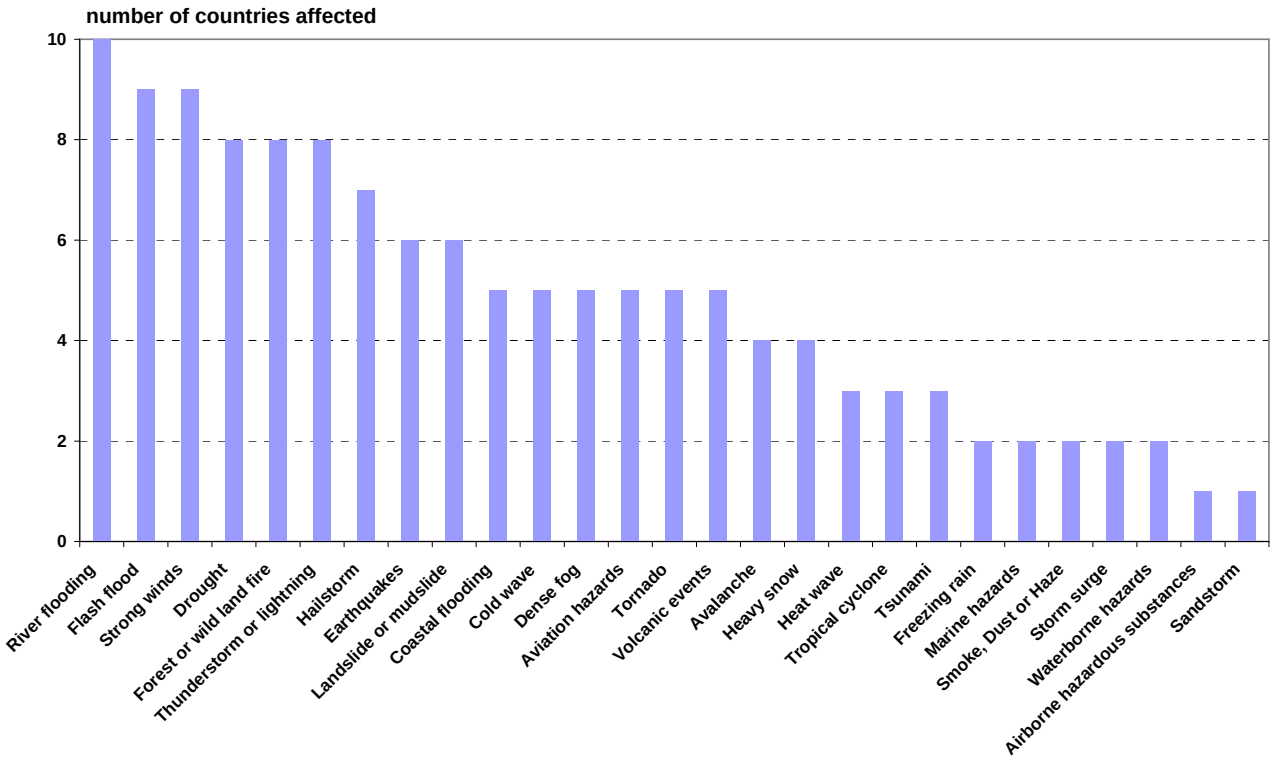


Figure 52. Number of responding countries in South America who identified themselves as being affected by the specified hazards.

6.3.1 Access to Data on Hazards and their Impacts

Annex 3 presents an overview of the hazard databases maintained by survey respondents in South America and includes some supplementary information on related metadata and impacts information. All responding South American NMHSs (100% or 10 of 10) stated that they had access to official, reliable, information on impacts but indicated that another agency was designated as responsible for providing official information on the impacts of disasters in their country. However, a few (30% or 3 of 10) respondents indicated that they maintained their own internal database of official information on the impacts of hazards that affected their countries and two of these (67%) said that they regularly updated this database[15].

[15] It is important to note, that, to date, no systematized, universally accepted, methodology or protocol has been established on a global basis for the creation and maintenance of hazard and hazard impacts databases.

6.3.2 Value Added Services based on Historical Hazard Data

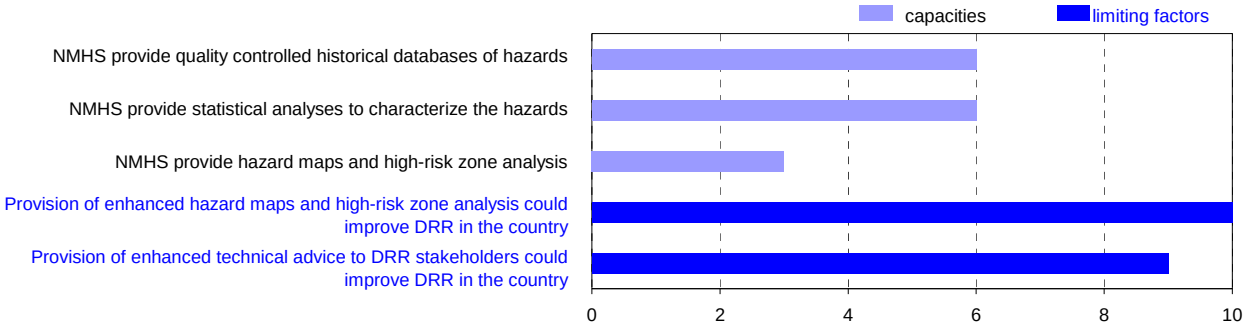


Figure 53. Provision of hazard information by NMHSs in South America.

Most South American NMHSs who responded to the country-level survey (90% or 9 of 10) stated that that they provided technical advice on hazards, with just over half (60% or 6 of 10) providing statistical analyses to characterize them. Almost two thirds (60% or 6 of 10) of respondents indicated that they maintained quality controlled historical databases of hazards. However, only half as many (30% or 3 of 10) undertook hazard mapping and high-risk zone analysis and even fewer (20% or 2 of 10) provided analyses of the potential impacts of hazards.

Over half of responding NMHSs identified factors that limited their ability to provide hazard data products. Cited as limitations were data rescue (70% or 7 of 10), professional staff with appropriate training (60% or 6 of 10), quality assurance (60% or 6 of 10), customization of data for stakeholders (50% or 5 of 10) and the ability to archive and update (40% or 4 of 10). All South American respondents (100% or 9 of 9) considered that the provision of enhanced value-added NMHS services in support of hydrometeorological risk assessment would strengthen their contributions to disaster risk reduction activities. The following specialized or value-added services were identified as particularly relevant - analyses of the potential impacts of hazards (100% or 10 of 10), hazard mapping and high-risk zone analysis (100% or 10 of 10), and provision of technical advice (90% or 9 of 10).

6.4 The National Context for Disaster Risk Reduction

National legislative, governance and organizational structures for disaster risk reduction establish the context within which NMHSs make their contributions to the safety of life and property. The following sections summarize survey responses regarding South American countries' national systems and the impact of these systems on their NMHSs.

6.4.1 Legislation and Governance

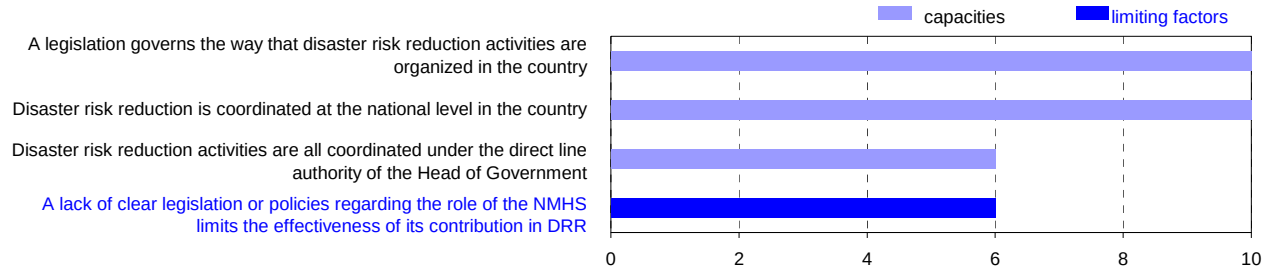


Figure 54. Legislation and coordination in support of disaster risk reduction at the national level in South America.

All South American NMHSs who responded to the survey (100% or 10 of 10) reported that disaster reduction activities were coordinated at the national level, in a majority of cases (67% or 6 of 9) under the direct line authority of the head of government. The organization of these activities was governed by legislation in all of these countries (100% or 10 of 10) and in some (40% or 4 of 10) was also coordinated under one ministry. Nevertheless, over half the respondents (60% or 6 of 10) considered that a lack of clear legislation or policies regarding the role of their NMHSs (e.g. as the sole issuers of hydrometeorological hazard warnings) limited their contributions to disaster risk reduction.

6.4.2 National Structures/Mechanisms for Disaster Risk Reduction

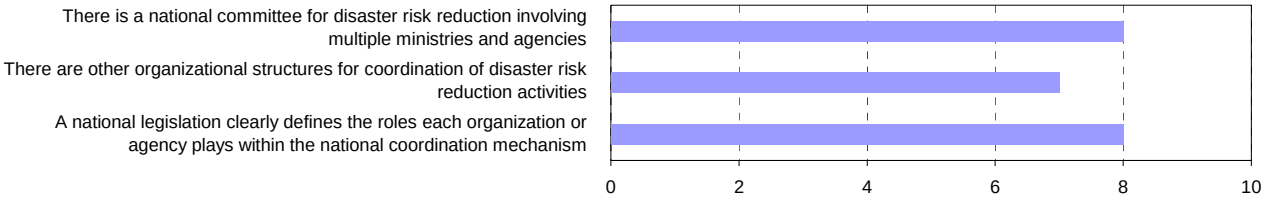


Figure 55. National structures for coordination of disaster risk reduction in South America.

Most South American respondents (80% or 8 of 10) reported that their countries had a national committee for disaster risk reduction that involved multiple ministries and agencies. All who responded to the question (100% or 9 of 9) stated that they were members of their national coordinating committees. Most of them (80% or 8 of 10) indicated that the roles of each participating agency in the national coordination mechanism were defined by legislation. Almost as many (70% or 7 of 10), however, pointed out that other organizational structures for coordination also existed in their countries. Relatively few NMHSs (20% or 2 of 10) felt that their contributions to disaster risk reduction were limited by their national disaster management structures and by a lack of linkages with other involved organizations. However, most (90% or 9 of 10) considered that implementation of a “readiness system” that ensured an appropriate response by authorities to information issued by the NMHSs would enhance their disaster risk reduction activities.

6.4.3 Contributions of NMHSs to National Disaster Risk Reduction Systems

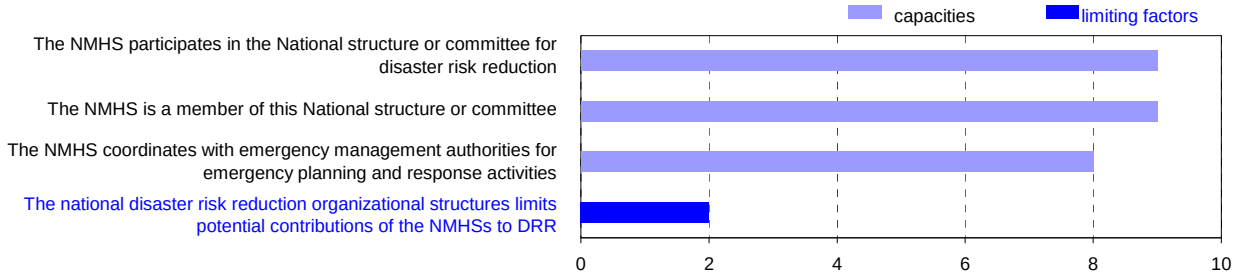


Figure 56. NMHS participation in national structures for disaster risk reduction in South America.

All responding NMHSs (100% or 10 of 10) indicated that they provided support to agencies responsible for disaster risk reduction at the national level. All respondents (100% or 10 of 10) also stated that they provided support to emergency response operations and emergency planning and preparedness and most (90%) supported disaster prevention and (80%) post-disaster reconstruction. In addition, all NMHSs (100%) provided support to provincial or state government disaster-related activities and most of them (90%) also extended this support to municipal or local levels. A significant minority of South American NMHSs (40% or 4 of 10), however, pointed to inadequate linkages with other involved organizations (e.g. emergency planners, emergency response agencies) as limiting their contributions to disaster risk reduction. Furthermore, a large majority of respondents (90% or 9 of 10) considered that their contributions would be enhanced by a "readiness system" that required appropriate responses by authorities to information issued by the NMHSs.

6.4.4 NMHS Collaboration with other Partners

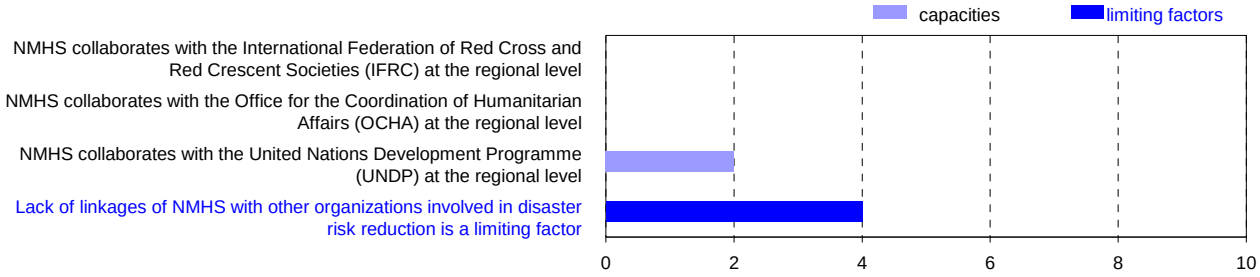


Figure 57. NMHS collaboration with partner agencies at the regional level in South America.

All South American respondents (100% or 9 of 9) to the WMO survey reported that they coordinated with emergency management authorities for emergency planning and response at the national level. However, the picture was considerably less positive where other potentially significant partners are concerned. Less than half of reporting NMHSs (40% or 4 of 10) interacted with the office of the United Nations Coordinator in their country or participated in disaster risk reduction activities on the level of a WMO Region or a regional economic grouping. The pattern was similar for other potential partners, with fewer than one third of respondents (30% (3 of 10) indicating that they collaborated with their National Red Cross and Red Crescent Societies and only two (50% or 2 of 4) participating in disaster activities of international organizations and (40% or 2 of 5) the UNDP.

6.4.5 The Organization and Priorities of NMHSs in South America

The priorities of individual NMHSs are, inevitably, influenced by the missions and priorities of their parent government ministries or departments. In consequence, the orientation of NMHSs may be more broadly focussed in some countries than in others. A parent department with a civil aviation mandate may, for example, emphasize provision of NMHS services to aviation while one with a natural resources or environment mandate might encourage its NMHS to provide warnings and other services to a broader range of sectors. Where National Meteorological Services or combined National Meteorological and Hydrological Services[16] in South America are concerned, parent ministries include: Agriculture; Defence; Civil Aviation ; Energy and Mines; Environment, Housing and Territorial Development and Water. Parent ministries of National Hydrological Services include: Environment; Public Works; Transport and Public Works; Science and Technology; and Environment and Natural Resources.

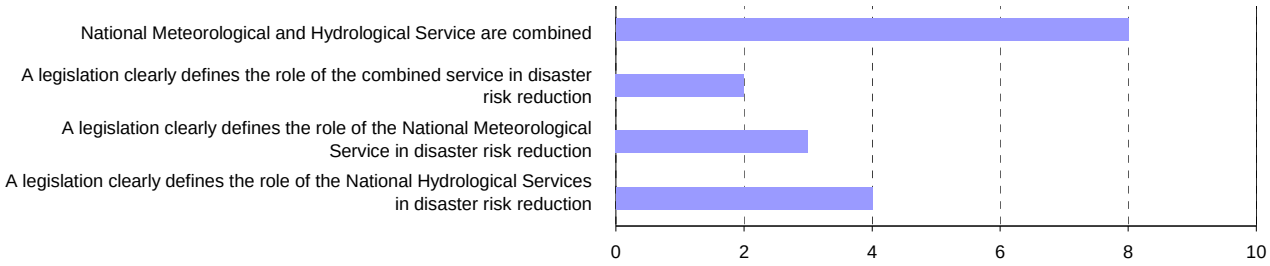


Figure 58. Organizational structure of meteorological and hydrological services in South America.

The internal organization of National Meteorological and Hydrological Services within individual countries can also influence their ability to deliver well-coordinated hydrometeorological warnings and other services in support of disaster risk reduction. In South America, most respondents (80% or 8 of 10) stated that they had a combined National Meteorological and Hydrological Service but only a minority (20% or 2 of 10) indicated that their country had national legislation that clearly defined their NMHS's role in disaster risk reduction. More than half of respondents (60% or 3 of 5) with separate NMSs and NHSs stated that they had legislation that clearly defined the role of the NMSs in disaster risk reduction. A slightly larger number (80% or 4 of 5) reported legislation that applied to the role of the NHSs. At the same time, some (40% or 2 of 5) respondents considered that legislation or partnership agreements were needed to better define the respective roles of their NMSs and NHSs in disaster risk reduction.

6.4.6 Operational Coordination between NMSs and NHSs

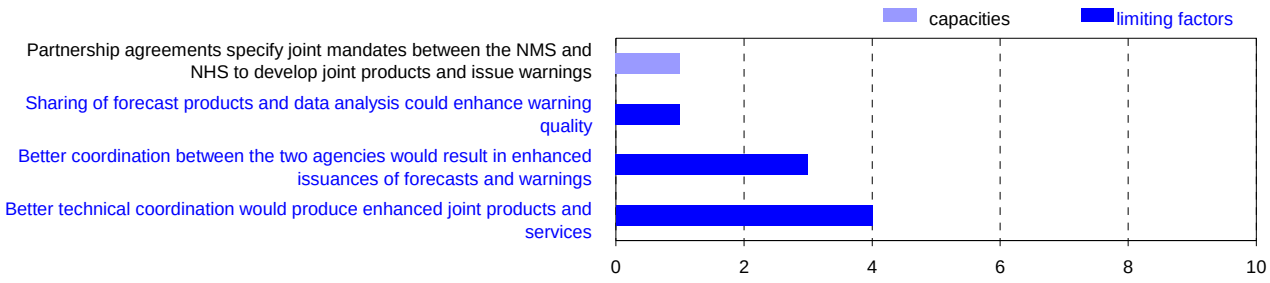


Figure 59. Coordination between NMS and NHS in South America.

[16] Parent departments of NMS and NMHS have been grouped together due to ambiguities in responses regarding the existence or otherwise of combined NMHS.

Only one (20% or 1 of 5) South American respondent from a country with a separate NMS and NHS identified that a partnership agreement was in place that specified mandates between their NMS and NHS to develop joint products and issue warnings. Moreover, only one (20% or 1 of 5) indicated that the two agencies shared forecast products and data analyses that could enhance warning quality. Two respondents (40% or 2 of 5), however, stated that coordination took place before hydrometeorological hazard warnings were issued. The remainder (60% or 3 of 5) reported that there was no coordination on warnings. A majority of respondents (60% or 3 of 5) considered that better overall coordination between the two agencies would enhance issuance of forecasts and warnings and even more (80% or 4 of 5) believed that improved technical coordination would result in enhanced joint products and services.

6.5 NMHS Infrastructure, Products and Services

The following sections summarize the information contained in survey responses relating to observational networks, telecommunications systems, warning and forecast production systems and products, dissemination systems and other aspects of the overall operational capacities of the NMHSs in South America.

6.5.1 Observation and Monitoring Networks and Systems

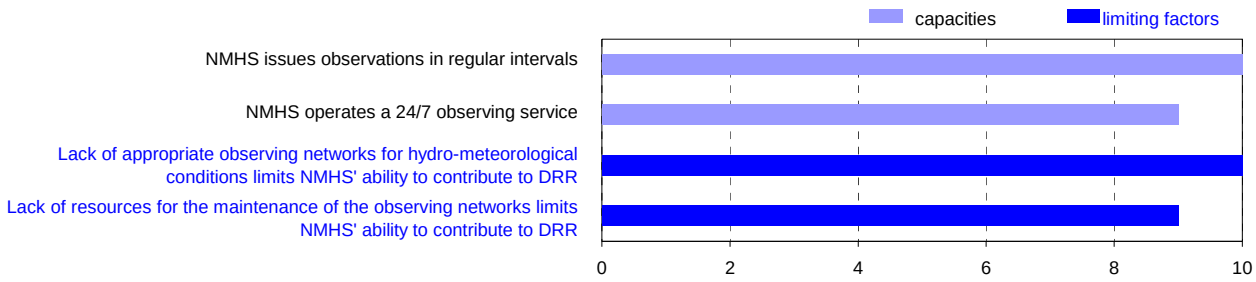


Figure 60. Observation and monitoring networks and systems in South America.

All South American NMHSs who responded to the survey (100% or 10 of 10) stated that they had an operational observing capacity that issued observations at regular intervals and most (90% or 9 of 10) reported that the observing service operated 24-hourly/year-round. A quarter or them (25% or 2 of 8) indicated that their observation network included sea level monitoring stations. Nevertheless, all respondents 100% (10 of 10) also considered that a lack of appropriate hydrometeorological observing networks limited their ability to contribute to disaster risk reduction. Half of them (50% or 5 of 10) specifically identified the availability of a dedicated 24-hour/year-round observing service as a limiting factor. The major challenges being faced in maintaining observation networks were also stressed, with all respondents (100% or 10 of 10) citing limited resources (e.g. financial, replacement parts, personnel, etc) and almost one third (30% or3 of 10) drawing attention to hazard related damage.

6.5.2 Telecommunications and Informatics

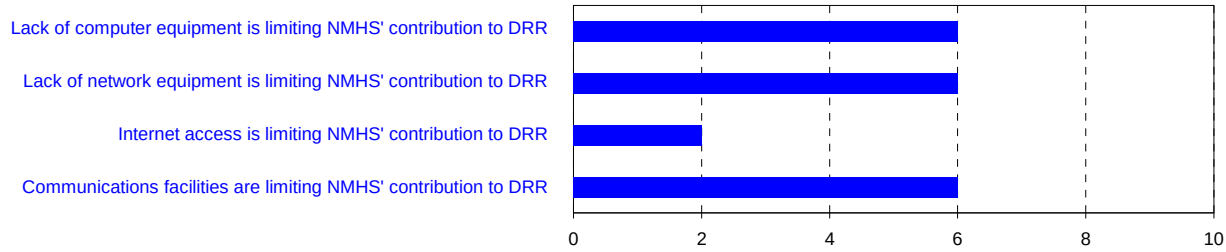


Figure 61. Telecommunication and informatics in South America.

The majority of South American NMHSs who responded to the survey (80% or 8 of 10) reported that their telecommunications systems were available 24-hourly/year-round. Some confirmation was provided by responses indicating that all forecasting staff (100% or 10 of 10) had access to real time hydrometeorological data. Nevertheless, two thirds of respondents (67% or 6 of 9) also identified that their ability to deliver critical products for disaster risk reduction was limited by communications facilities. Other limitations on NMHSs capacities were cited in major areas of informatics, with many respondents (89% or 8 of 9) highlighting a lack of application software, network equipment and computers (67% or 6 of 9) and some (22% or 2 of 9) also drawing attention to inadequate Internet access. All respondents (100% or 10 of 10) considered that upgrading the operational infrastructure for forecasting and warning services would enhance disaster risk reduction capacities in their countries.

6.5.3 Data Exchange

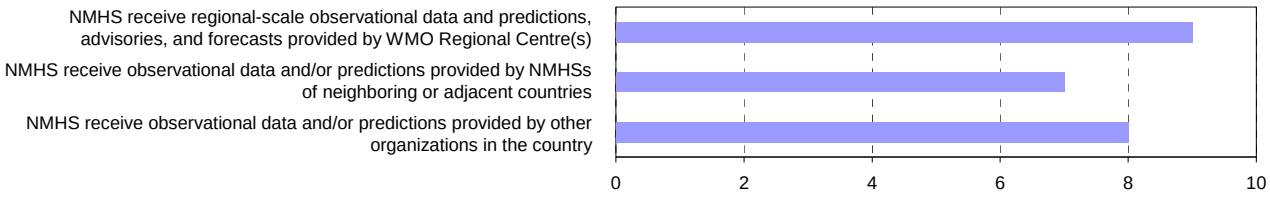


Figure 62. Data exchange in South America.

Survey responses from NMHSs in South America identified that all (100% or 10 of 10) forecasting staff had real time access to hydrometeorological data. Furthermore, most of them used regional scale observational data and forecasts provided by WMO Regional Specialized Meteorological Centres (90% or 9 of 10), data from neighbouring countries (78% or 7 of 9) and data from other organizations in their countries (80% or 8 of 10). In addition, some NMHSs (50% or 4 of 8) received real time marine observations from the GTS and one relayed sea level observations on that global network. Nevertheless, however, two thirds of South American contributors to the WMO survey (67% or 6 of 9) indicated that their NMHSs were limited in their ability to deliver critical products and services for disaster risk reduction by communications facilities. Equally, over half (60% or 6 of 10) stated that their NMHS was limited in its ability to provide hazard data products by quality assurance, half (50% or 5 of 10) by customization of data for stakeholders, and only slightly fewer (40% or 4 of 10) by ability to archive and update. Responding NMHSs (100% or 10 of 10) unanimously considered that they required better coordination with neighbouring NMHSs and most (90% or 9 of 10) with RSMCs in relation to hydrometeorological data exchange in order to enhance their countries' disaster risk reduction activities.

6.5.4 Forecast and Warning Capability

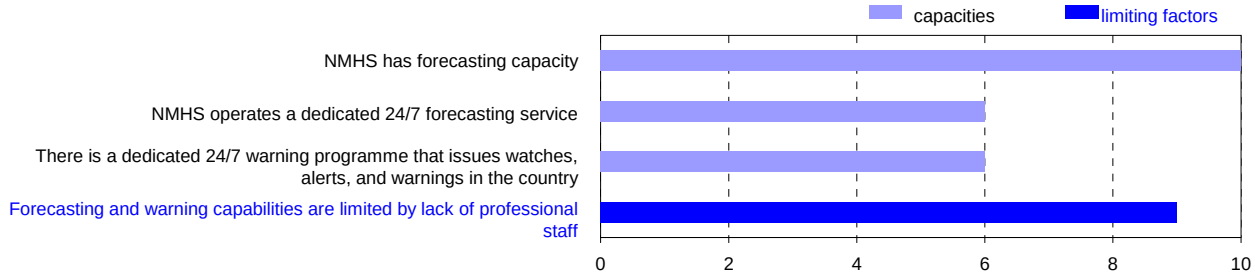


Figure 63. Forecast and warning capabilities in South America.

All South American NMHSs (100% or 10 of 10) who contributed to the country-level survey indicated that they had an operational forecasting capability. A majority (60% or 6 of 10) stated that this was a dedicated 24-hourly/year-round forecast service and that a meteorologist was required to be on-site to provide the service. Over half of the respondents (60% or 6 of 10) also reported that they had a dedicated hazard warning programme that issued watches, alerts and warnings on a 24-hourly/year-round basis. Most of them (67% or 4 of 6) indicated that a meteorologist was on site during the programme's operational hours. In addition, a few NMHSs (38% or 3 of 8) reported that they provided a marine forecast and warning service to mariners and coastal zone users and one also prepared marine forecasts for the Global Maritime Distress and Safety System (GMDSS). All respondents (100% or 10 of 10) stressed that their NMHS was limited in its ability to deliver critical products and services for disaster risk reduction by professional staff, most (89% or 8 of 9) by application software, and some (67% or 6 of 9) by computers. Respondents unanimously (100% or 9 of 9) considered that upgrading their NMHSs operational forecasting and warning services would enhance disaster risk reduction in their countries. All of them (100% or 10 of 10) advocated upgrading of operational infrastructure and most (80% or 8 of 10) identified needs for upgrading the technical training of professional staff.

6.5.5 Forecast and Warning Products

Table 5 in Annex 4 summarizes information on hazard warnings and products issued by NMHSs in South America who responded to the survey. The survey responses indicated that the hydrometeorological hazards affecting the greatest number of South American countries are, in declining order, river flooding, strong winds, flash floods, thunderstorms and lightning, drought, forest and wild land fires, and hailstorms[17]. These are followed by earthquakes, landslides or mudslides, aviation hazards, dense fog, coastal flooding, cold waves, tornadoes and volcanic events.

Examination of the data in Table 5 reveals that most affected NMHSs issued warnings for many of the most common hydrometeorological hazards, including strong winds, drought, thunderstorms or lightning, and hailstorms. Moreover, all affected NMHSs reported that they issued warnings for dense fog and for some less widely occurring hazards such as heavy snow, tropical cyclones, smoke, dust or haze, storm surges and most for aviation hazards. Fewer of them, however, issued warnings for river flooding, flash floods and forest and wild land fires. Furthermore, very few issued warnings for landslides or mudslides and coastal flooding and none issued warnings for earthquakes. In addition, a minority of affected NMHSs reported that they issued warnings of tornadoes or volcanic events. The overall pattern with respect to provision of warnings of

[17] The survey responses do not provide information on the magnitudes of the impacts associated with individual hazards, simply that they occur in the reported number of countries.

hydrometeorological hazards in South America is, therefore, somewhat uneven in that NMHSs warning programmes display evidence of varying priorities between countries affected by similar hazards. In the context of disaster risk reduction, the survey data suggest that increased emphasis might usefully be placed on the expansion of South American warning programmes for phenomena such as river and flash floods, forest and wild land fires, landslides or mudslides, and coastal flooding. All of these phenomena have significant potential for causing major disasters but they may been given insufficient warnings priority.

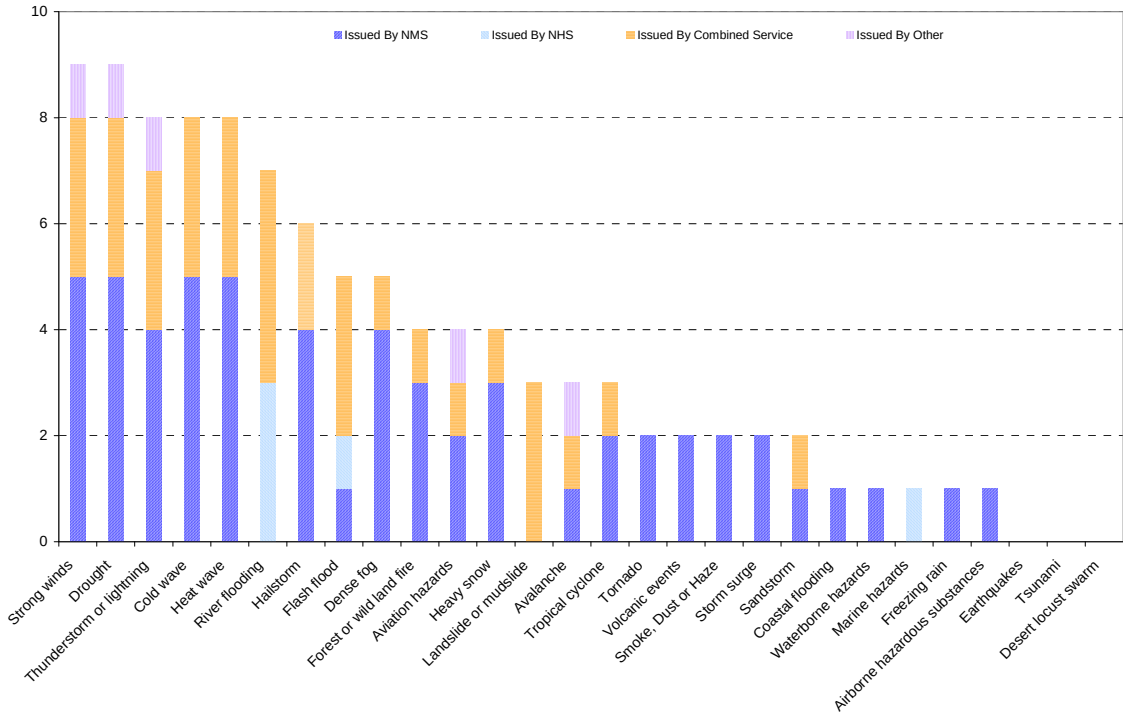


Figure 64. Agencies mandated for issuance of warnings in South America.

South American survey responses revealed that NMSs or combined NMHSs are the issuers of virtually all warnings for the major hazards. The only exceptions are river flooding, flash floods and marine hazards where, in a very few instances, NHSs issued warnings. The data also suggest that, in some responding countries, the NMHS, (or, as the case may be, NMS or NHS) is not the sole issuer of warnings for the major hydrometeorological hazards but that other competing warning services also exist. However, extremely few South American NMHSs, NMSs or NHSs who issued warnings for the major hazards indicated that they included information about the potential impacts in their warning bulletins. However, most responding NMHSs considered that further improvements to their warnings were necessary and the inclusion of impacts information could represent a useful contribution to such initiatives.

6.5.6 Coordination of Warnings

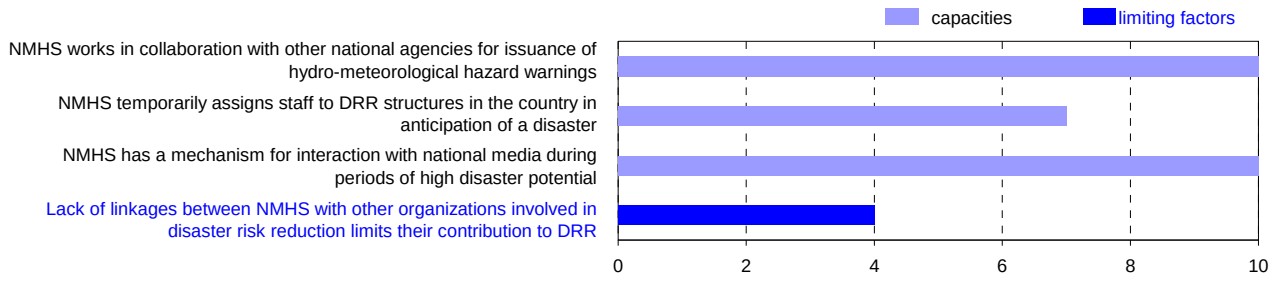


Figure 65. External coordination for issuance of warnings in South America.

Provision of early warnings of hydrometeorological hazards represents a vital contribution to disaster risk reduction. In South America, all responding NMHSs (100% or 10 of 10) reported that they worked in collaboration with other agencies (e.g. agriculture, aviation, etc) with respect to hazard warnings. Most of them (90% or 9 of 10) discussed the hazard's characteristics and potential impacts with these agencies prior to issuing a warning. In addition, all respondents (100% or 10 of 10) stated that they had a mechanism for interaction with their country's media during periods of high disaster potential. Furthermore, over two thirds of them (70% or 7 of 10) indicated that they temporarily assigned staff to disaster risk management structures in anticipation of a disaster. Over half of the NMHSs who contributed to the WMO survey (60% or 6 of 10), however, pointed out that there were other public or commercial entities that provided competing warning services in their countries. All respondents (100% or 10 of 10) considered that their NMHSs required better coordination of watches and warnings with neighbouring NMHSs and most (90% or 9 of 10) also cited the need for improved coordination with the WMO Regional Specialized Meteorological Centres (RSMCs).

6.5.7 Products and Services for Selected Socio-Economic Sectors

As a further refinement, Figure 66 illustrates the provision by NMHSs of specialized alerts, warnings and other products to significant socio-economic sectors in South America that can be seriously affected by hazardous events. In the context of disaster risk reduction, it is noteworthy from Figure 66 that less than half (44%) of responding NMHSs indicated that they provided support to development and housing, only about two thirds (67%) provided support for the land-use planning just over half (56%) provided services to the fresh water sector.

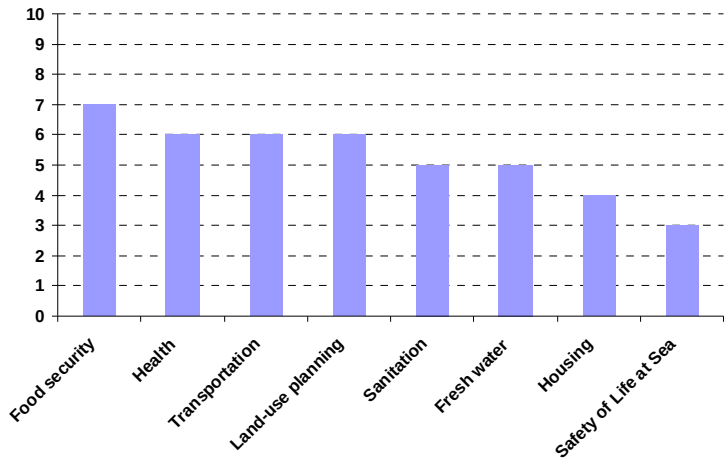


Figure 66. NMHS provision of services to selected economic sectors in South America.

6.5.8 Dissemination Systems and Target Audiences

The following Figures 67 and 68 summarize the survey responses relating to the dissemination of hazard products by NMHSs in South America. They provide information on the types of products that are disseminated, to whom they are provided and on the methods of dissemination that are used to convey the products to the recipients. The same information is also presented in numerical form in Table 4 of Annex 5 where the figures represent the number of responding NMHSs who reported that they provided the specified product to the indicated target audience or, as appropriate, utilized a particular means of dissemination.

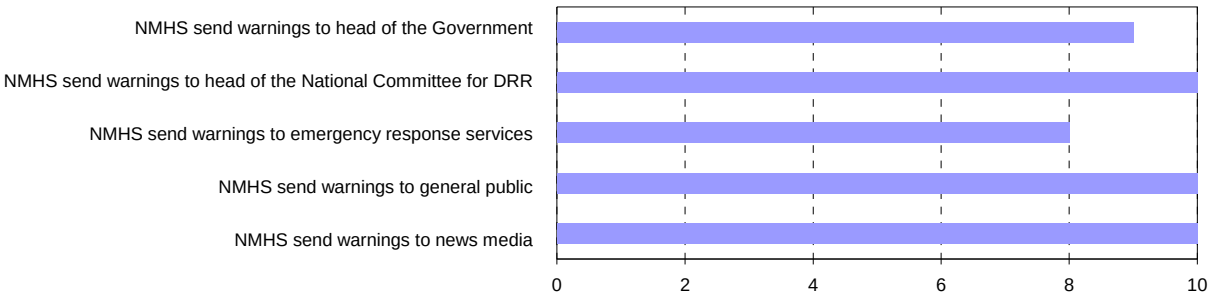


Figure 67. Warning target audience in South America.

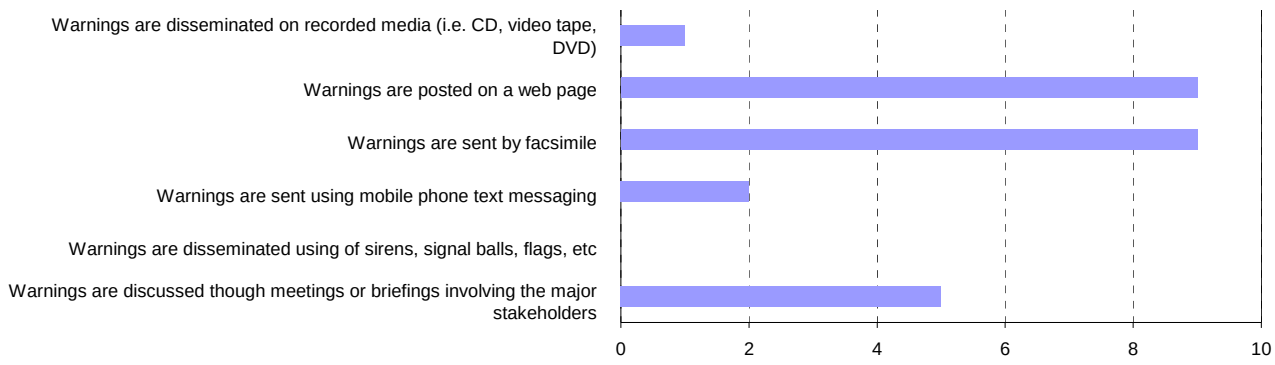


Figure 68. Warning dissemination methods in South America.

As might be expected virtually all respondents from South America indicated that they disseminated hazard warnings to the public and the media and to relevant government authorities with significant, but lower, distribution to businesses and RSMCs. However, once again, it is noticeable that a much lower percentage of responding NMHSs disseminated warnings and other products to external partners in disaster risk reduction such as the Red Cross Society, the UNDP and others. Web pages, Fax and Internet were the most common dissemination methods in South America, followed by briefings. Survey responses indicated no use of the mail, sirens, signal balls or flags for warnings dissemination in that region.

6.5.9 Product Utility and Product Improvement

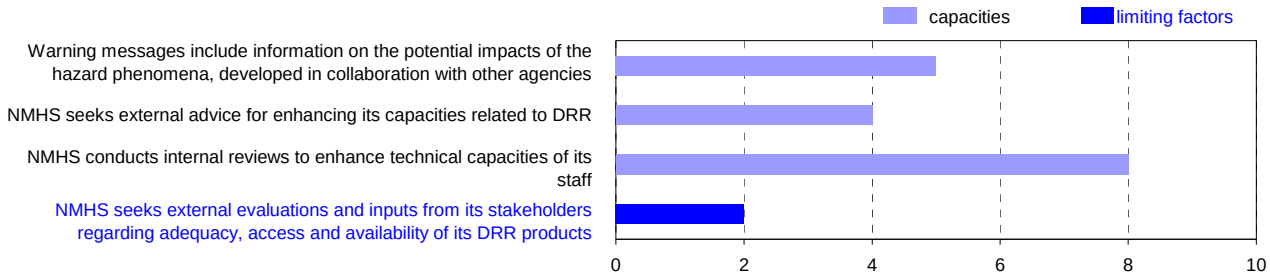


Figure 69. Ongoing feedback and improvement of products in South America.

As pointed out in earlier sections**,** all (100% or 10 of 10) respondents in South America indicated that they worked with other agencies with respect to hazard warnings and also stated that they had regular interaction with disaster risk authorities to enhance their warning capabilities and content. Half (50% or 5 of 10) of those who included information on potential risks (impacts) in warning statements stated that they collaborated with other agencies to develop risk information. In addition, almost half (44% or 4 of 9) pointed out that their NMHSs sought external advice for enhancing their capacities to support disaster risk reduction, specifically to enhance monitoring and forecasting, watches and warnings (83% or 5 of 6), or overall products and services (67% or 4 of 6). Furthermore, almost three quarters of respondents (70% or 7 of 10) reported that their NMHSs had a quality control mechanism to enhance their warning capabilities and content. All of these (100% or 7 of 7) stated that the mechanism provided for regular interaction with stakeholders (disaster risk authorities), with most of them (71% or 5 of 7) indicating that it included feedback from stakeholders and the public after an event had occurred. Some (43% or 3 of 7) also reported that it provided for training for stakeholders to understand hazards, warnings and their implications. Two NMHSs (22% or 2 of 9) specifically stated that they sought external evaluations and inputs from stakeholders regarding the adequacy, relevance, method of access and availability of their disaster risk reduction products. Nevertheless, almost all respondents (90% or 9 of 10) considered that a lack of public understanding of the effects of hazards limited the public response to them. A slightly lower number (80% or 8 of 10) felt that a lack of public understanding of watches and warnings was a further limiting factor. Most (80% or 8 of 10) respondents also felt that the lack of joint training between staff of the NMHSs and emergency authorities and managers limited their disaster risk reduction efforts. Finally, as an overall response, almost all NMHSs (90% or 9 of 10) considered that educational modules for media, public and disaster risk authorities would enhance their effectiveness in disaster risk reduction.

6.5.10 Internal NMHS Training and Capacity Enhancement

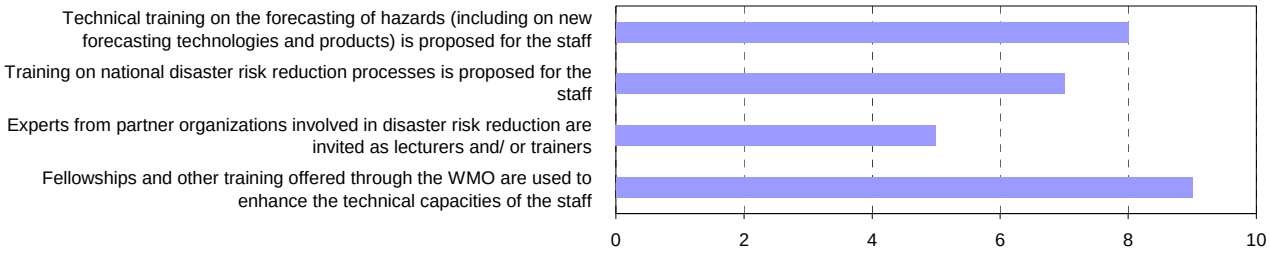


Figure 70. Training and capacity building of NMHS' staff

In South America, most, but not all, NMHSs (80% or 8 of 10) indicated that they provided ongoing technical training to staff on forecasting of hazards, including up to date training on new forecasting technologies and products. The same number conducted internal reviews and sought staff inputs to enhance their capacity building and technical training activities. Almost all (90% or 9 of 10) stated that they utilized Fellowships and other training offered through WMO to enhance the technical capacities of their staff. Roughly three quarters of contributing NMHSs (70% or 7 of 10) also provided training to staff on their country's disaster risk reduction processes and related topics and most of them (50% or 5 of 10) invited experts from partner organizations involved in disaster risk reduction as lecturers and/or trainers. Over half of respondents (60% or 6 of 10) reported that they conducted evaluations of the suitability of communications, workstations, and software. Slightly more (70% or 7 of 10) implemented upgrades to these systems to support disaster risk reduction. In addition, about half of responding NMHSs (56% or 5 of 9) stated that they held or participated in joint training activities for NMHS staff and emergency response agencies.

Balancing the preceding, most respondents (80% or 8 of 10) indicated that lack of forecaster training at their NMHSs reduced the effectiveness of their warning service. A slightly smaller number (70% or 7 of 10) reported that (lack of) professional staff with appropriate training limited their ability for real time monitoring of hazards. There was, in addition, a widely held view (80% or 8 of 10) that a lack of joint training with emergency authorities and managers limited NMHSs contributions to disaster risk reduction. More specifically, over half (60% or 6 of 10) of respondents stated that their ability to provide hazard data products was limited by lack of professional staff with appropriate training. Finally, most responding NMHSs (70% or 7 of 10) identified the lack of joint training with the media as a further limiting factor. Not surprisingly, all responding NMHSs (100% or 9 of 9) considered that upgrading and improving their operational forecasting and warning activities would enhance their disaster risk capacities. In this context, all respondents (100% or 10 of 10) advocated the conduct of cross-border training activities with neighbouring NMHSs, targeted at common hydrometeorological hazards.

6.5.11 Outreach Activities

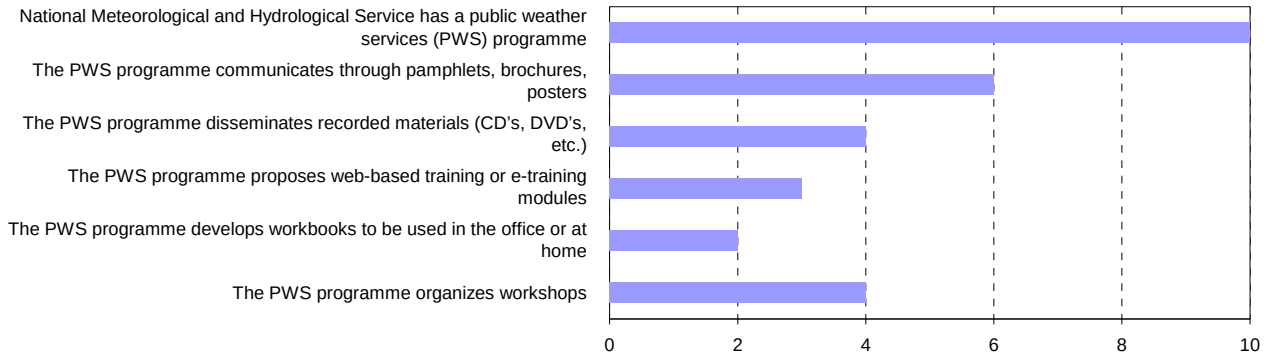


Figure 71. Outreach activities

Outreach activities aimed at the general public and other stakeholders are an important component of any effective disaster risk reduction programme. Within NMHSs, outreach activities are often part of a public weather services programme. In South America, all NMHSs (100% or 10 of 10) who contributed to the survey identified that they had a public weather services programme. However, less than half (43% or 3 of 7) stated that their quality control programme included training for the stakeholders to understand the hazards, warnings and their implications. Moreover, only a few (20% or 2 of 10) provided education and training on hazards, watches, warnings, etc to disaster risk reduction managers and authorities and operational emergency response managers. In addition, very few (10% or 1 of 10) identified that they provided training targeted at the trainers (i.e. of disaster risk authorities, emergency response staff, media, etc) or educational modules and training programmes targeted at the general public. Furthermore, under one third of respondents (30% or 3 of 10) provided training to the news media but a somewhat higher number (56% or 5 of 9) pursued joint training activities with emergency response agencies. The following materials and methods were identified as being used in NMHSs public outreach programmes in South America: - pamphlets, brochures, posters (67% or 6 of 9), workshops (44% or 17 of 24), recorded materials (44% or 4 of 9), Web-based training (33% or 3 of 9), workbooks for office or home use (22% or 2 of 9), and E-training modules (22% or 2 of 9).

Most (90% or 9 of 10) South American respondents considered that the lack of public understanding of the effects of hazards limited public response to warning services. Equally, most (80% or 8 of 10) believed that the lack of joint training with emergency authorities and managers and with disaster risk managers limited their disaster risk reduction efforts. A majority (70% or 7 of 10) also considered that the lack of joint training with the media was a limiting factor. In view of the preceding assessments, it is not surprising that almost all NMHSs (90% or 9 of 10) considered that educational modules that they could target at media, public and disaster authorities would enhance their effectiveness in disaster risk reduction.

6.6 NMHS Contingency Planning

Most responding NMHSs in South America (80% or 18 of 24) reported that they had a contingency plan to maintain the continuity of products and services in the event of organizational emergencies such as power failure or communications disruption. One NMHS (13% or 1 of 8) indicated that their contingency plan involved an agreement or protocol with a neighbouring NMHS to support them in the event of catastrophic failure. Almost two thirds (67% or 6 of 10) of respondents also stated that they conducted or participated in drills and exercises to ensure disaster preparedness. Nevertheless, all respondents (100% or 10 of 10) identified needs for improved coordination with neighbouring NMHS, specifically citing the need for support from them in the event of disruption of services.

6.7 Overarching Factors

NMHS participating in the country-level survey were asked to respond to a series of questions that centred on obtaining expressions of opinion from them regarding overarching factors or realities that either limited or could enhance their ability to make substantive contributions to disaster risk reduction. To varying degrees, NMHS responses to these questions also served to validate statements, expressions of opinion and/or recommendations contained in responses to earlier sections of the survey. The following summarizes the inputs that fall under the above broad category:

6.7.1.1 NMHS Visibility

Two thirds (67% or 6 of 9) of respondents from South America believed that their contributions to disaster risk reduction were limited by the lack of understanding by government authorities of the value provided by their NMHSs. Most (80% or 8 of 10) also felt that their NMHSs needed higher visibility and recognition within government as major contributing agencies to disaster risk reduction. All respondents (100% or 10 of 10) considered that improved ministerial level understanding of the socio-economic benefits of hydrometeorological products and services would increase the visibility of the NMHSs at the national level.

6.7.1.2 Organization and Governance

Most survey contributors (60% or 6 of 10) felt that the effectiveness of their contributions to disaster risk reduction was limited by the lack of clear legislation or policies regarding the role of the NMHS (e.g. as the sole issuer of warnings). In addition, a minority of respondents (40% or 2 of 5) from countries with separate NMSs and NHSs considered that there was a need for legislation or partnership agreements to better define the role each agency played in disaster risk reduction. Furthermore, the same number (20% or 2 of 10) indicated that their national organizational structure for disaster risk reduction limited the potential contributions of their NMHS to this priority.

6.7.1.3 Coordination and Partnership

All responding NMHSs from South America (100% or 10 of 10) believed that better coordination with neighbouring or adjacent countries would improve their contributions to their own nation's disaster risk reduction activities. Most (89% or 8 of 9) also felt that better coordination with WMO Regional Specialized Meteorological Centres would improve their contributions. Moreover, a significant percentage (40% or 4 of 10) considered that their contributions to disaster risk reduction were limited by a lack of linkages between the NMHSs and other organizations involved in disaster risk reduction.

6.7.1.4 Resources and Capacity

Most South American respondents (88% or 7 of 9) considered that resources and infrastructure limited the ability of their NMHSs to deliver critical products and services for disaster risk reduction. Furthermore, all respondents (100% or 9 of 9) from that region believed that upgrading and improving their operational forecasting and warning services would enhance the disaster risk reduction capacity within their countries. As limiting factors, all respondents (100% or 9 of 9) cited the lack of financial resources and professional staff.

6.8 WMO Support

The following list summarizes the needs for support from WMO expressed by the NMHSs in South America who contributed to the survey. Needs are identified in the order of priority assigned by the contributors.

1. Provision of technical advice and specifications (e.g. to enhance observing networks, operational infrastructures, relevant products and services for disaster risk reduction applications).
2. Assist members in the development of the national disaster risk reduction plans.

3. Technology transfer, capacity building, technical guidelines and technical training (e.g. forecasting tools and methodologies, hazard mapping, and other inputs to risk assessment tools, etc.).
4. Cost-benefit analysis of hydro-meteorological services in disaster risk reduction.
5. Strengthening strategic partnerships with stakeholders (e.g. disaster risk managers, media, etc.).
6. Education, training and public outreach programmes in disaster risk reduction (e.g. targeted at National Meteorological and Hydrological Service and their stakeholders).
7. Advocacy for enhanced visibility of National Meteorological and Hydrological Service' in the area of disaster risk reduction.
8. Strengthening strategic partnerships with other technical organizations and agencies (e.g. meteorology, hydrology, ocean services, etc.).
9. Establishment of regional emergency protocols for the National Meteorological and Hydrological Services in support of each other in case of disruption of services due to the impact of a disaster.
10. Resource mobilization.

6.9 Sub-regional Considerations

South American climates are significantly influenced by topography as well as by latitude and exposure to the oceans. The following sections examine two sub-areas of South America – the Andean and non-Andean regions. Countries falling within these sub-regions are listed in Annex 2.

6.9.1 Survey Responses from Andean Countries

For the purposes of this analysis, the members of the Andean Country grouping have been identified as: Bolivia, Chile, Colombia, Ecuador and Peru. The NMHSs from all five out of these countries responded to the WMO Country-level survey. The following paragraphs briefly assess the responses from this sub-group of NMHSs against the backdrop of the preceding analysis of all survey responses from all South American NMHSs.

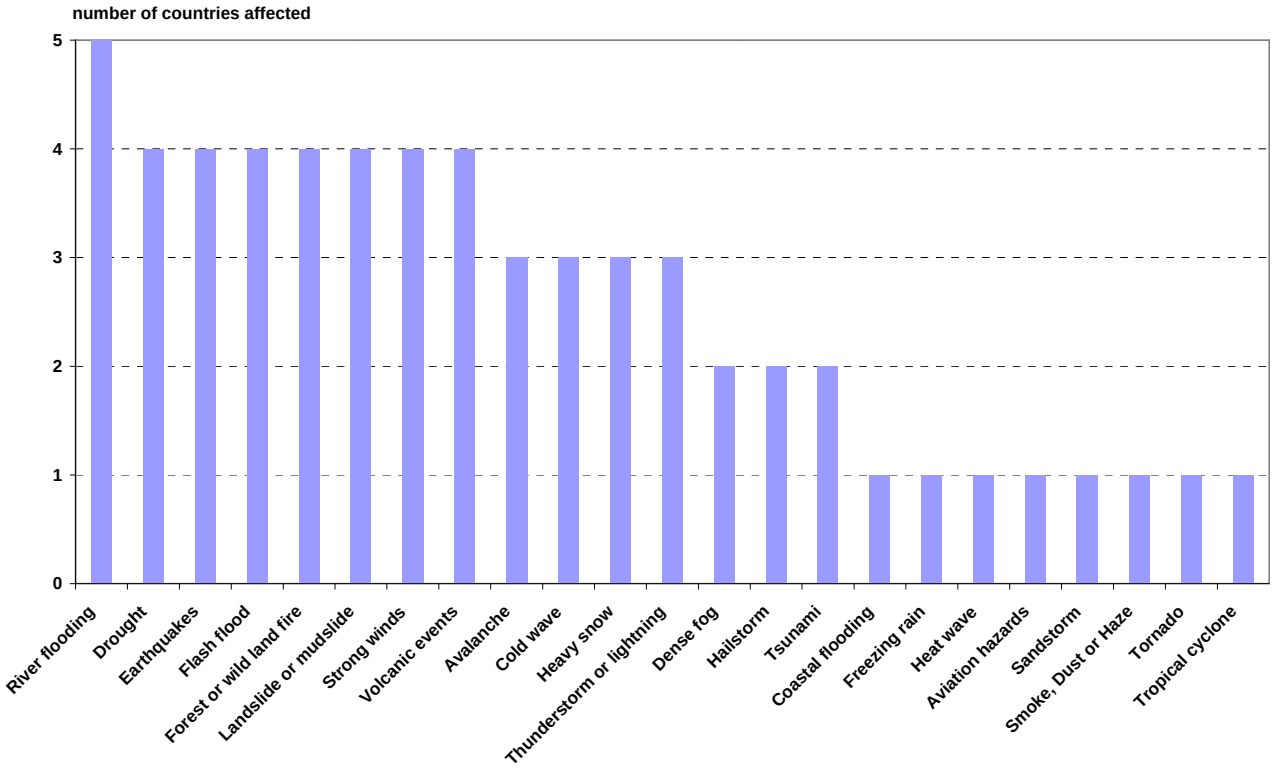


Figure 72. Number of responding Andean Countries who identified themselves as being affected by specified hazards.

The hydrometeorological hazards that affect most Andean Countries are river flooding, earthquakes and volcanic events along with flash floods, drought, strong winds, landslide or mudslide and forest or wild land fire. Additionally, in the Andean countries, volcanic events and, to a lesser extent, earthquakes and avalanches have noticeably higher prominence in the list of hazards than was the case for South America as a whole.

Taken overall, the broad pattern of responses from Andean countries broadly parallels that from South American respondents as a whole but with some variations in the responses to certain questions. Proportionately fewer Andean NMHS, for example, have national coordinating committees for disaster risk reduction. Moreover, all Andean NMHS indicated that they provided support to post disaster reconstruction phase as opposed to a lower percentage for all of South America.

Where NMHS infrastructure, warning and forecast capacity, and products and services are concerned, the Andean Country picture differed in several respects from that for South America as a whole. Only three out of five NMHSs from the Andean area stated that their telecommunications system was operational on a 24-hourly/year-round basis. Furthermore, only two NMHSs in the sub-region stated that they maintained a 24-hourly / year-round forecast and warning service, again a lower percentage than for South America as a whole. While survey responses presented a somewhat uneven picture with respect to training, capacity building and outreach activities, they again conveyed the impression that somewhat less emphasis was given to these aspects. Andean responses relating to overarching factors addressed in the survey questionnaire displayed a broadly similar pattern to those from South America as a whole but with a few notable exceptions. In particular, Andean respondents displayed a somewhat lower level of concern regarding their visibility and, relatively speaking, felt less limited by a lack of clear legislation or policies regarding their NMHSs role. On the other hand, however, they felt more constrained by a lack of linkages with other organizations involved in disaster risk reduction.

6.9.2 Survey Responses from non-Andean Countries

The following paragraphs briefly assess the responses from the remaining, or non-Andean, NMHSs in South America against the backdrop of the preceding analysis of all survey responses from South America. The responding NMHSs in this grouping were: Argentina, Brazil, Paraguay, Uruguay and Venezuela. Figure 73 below illustrates the number of responding members of non-Andean countries who stated that they were affected by specified hazards.

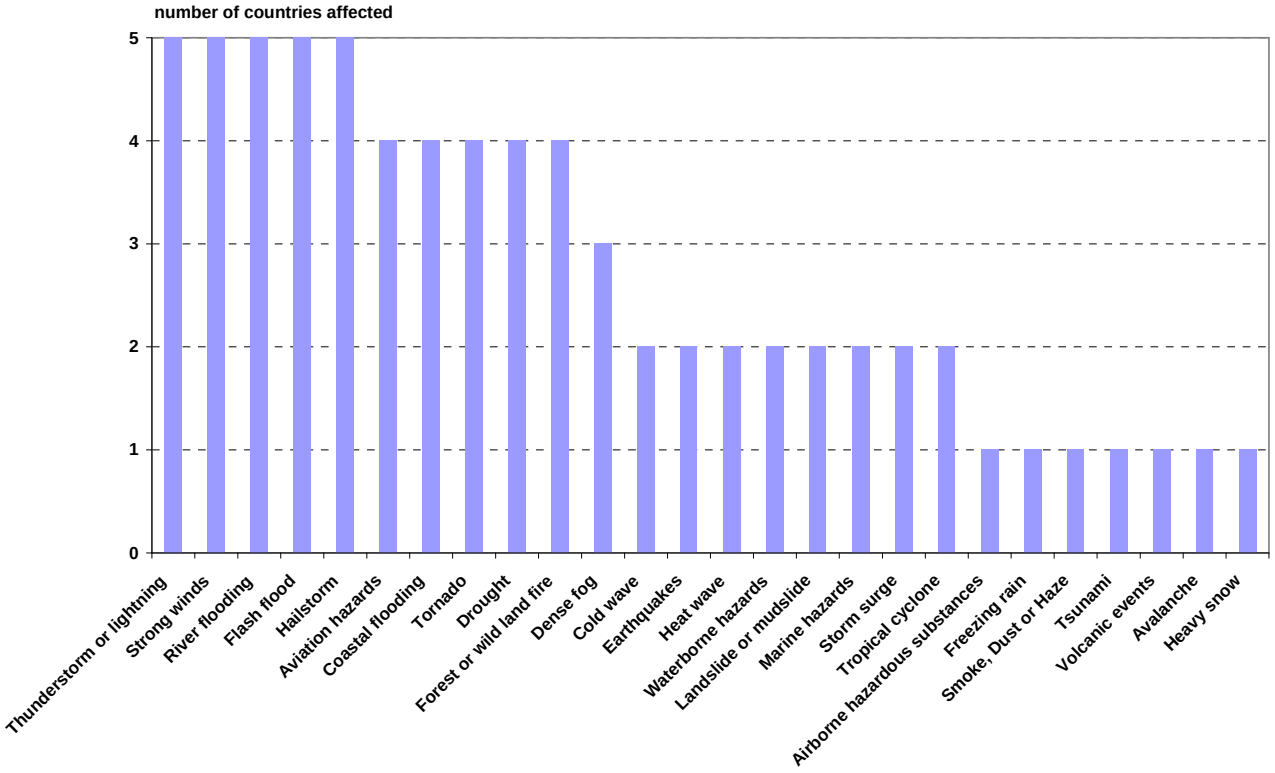


Figure 73. Number of responding non-Andean Countries who identified themselves as being affected by specified hazards.

As might be expected, the pattern of hydrometeorological hazards that affect most non-Andean South American countries is noticeably different from that for the Andean group and significantly closer to the overall South American pattern. In particular, volcanic events, landslides and mudslides, earthquakes, avalanches and heavy snow have moved down in geographic breadth of occurrence while aviation hazards and marine and waterborne hazards have gained in prominence.

The broad pattern of responses from non-Andean countries was, again, similar to the South American picture as a whole. There were, however, some noticeable variations in emphasis or strength of the collective responses to certain questions. In particular, a somewhat higher proportion on non-Andean respondents felt that their NMHSs contributions to disaster risk reduction were limited by the absence of clear legislation or policies regarding their role. Moreover, somewhat fewer non-Andean NMHSs indicated that they provided support to the post disaster reconstruction phase than was the case for South America overall.

Where NMHS infrastructure, warning and forecast capacity, and products and services are concerned, the non-Andean respondents painted a somewhat more positive picture than that for South America as a whole. All indicated that they maintained 24-hourly/year-round observational programmes and that telecommunications were also available round the clock. The latter reality was reflected in responses relating to data exchange, where less than half of non-Andean countries indicated that their ability to deliver critical disaster risk reduction products was limited by

telecommunications, as opposed to over two thirds for South America as a whole. Furthermore, a significantly higher proportion of non-Andean countries maintained 24-ourly/year-round warning and forecast programmes. Survey responses from NMHSs in non-Andean countries presented a broadly similar picture with respect to training, capacity building and outreach activities to those from all of South America but with slightly stronger emphasis evident on aspects such as forecaster training, the provision of educational modules and other outreach activities.

6.10 Concluding Assessments and Recommendations for South America

The following summarizes assessments and conclusions related to the analysis of the survey responses from South American NMHSs that has been presented in this chapter. In order to facilitate identification of subject areas, the titles associated with individual assessments and conclusions presented below match those used during the analyses of South American survey responses outlined in the preceding pages.

6.10.1 Access to Data on Hazards and their Impacts

As Annex 3 illustrates, while many NMHSs in South America maintain data archives relating to a variety of hydrometeorological hazards, some do not maintain records of even the most common hazards such as strong winds or thunderstorms and lightning. As the agencies responsible for monitoring and prediction of hydrometeorological hazards within their countries, NMHSs (or NMSs and NHSs) may, reasonably, be expected to maintain records of occurrences of those hazards. Such records are important for various applications ranging from verification of warnings and forecasts to hazard mapping and analysis. Consequently, NMHSs need to have easy access to official information on hazards and on the impacts of disasters in order to provide support for planning activities and to facilitate monitoring the effectiveness of their own services in support of disaster risk reduction.

6.10.2 Value Added Services based on Historical Hazard Data

The respondents' recommendation regarding provision of enhanced value-added data services is supported by earlier survey responses. Taken overall, the responses strongly indicate that NMHSs in South America would benefit from capacity development and training related to disaster risk applications, including hazard and impact analysis, hazard mapping and risk zone analysis. It is also clear that quality controlled, regularly updated, hazard data archives remain to be established in about one third of the NMHSs and these countries will have associated requirements for capacity development and training in areas such as data rescue, quality assurance, archival techniques and customization of data.

6.10.3 Legislation and Governance

The responses suggest that NMHS should press for clear policy direction from their governments regarding their roles and responsibilities in those countries where a lack of clarity undercuts their potential contributions to disaster risk reduction.

6.10.4 National Structures/Mechanisms for Disaster Risk Reduction

The degree to which NMHSs are integrated into national disaster risk reduction coordination structures and their operational relationships with civil protection agencies, planning authorities and important non-governmental partners exercise a significant influence on their ability to contribute effectively to disaster risk reduction. For optimum effectiveness, state of the art NMHS scientific, technical and operational capacities must be mainstreamed into national planning, decision-making and disaster response structures and systems and, in addition, be well connected to important non-governmental partners. South American responses to the survey indicate that most NMHSs in the region are part of their national disaster risk reduction system, though they also suggest that, in at least some instances, there is room for improvement in operating processes and in working relationships with other involved agencies.

6.10.5 Contributions of NMHS to National Disaster Risk Reduction Systems

The survey responses indicate that NMHSs in South America should devote continuing attention to building effective working relationships with national disaster authorities by providing timely, accurate and relevant products and services for disaster risk reduction. The responses also suggest that efforts are needed in some countries to expand and reinforce partnerships with other agencies and organizations involved in disaster related activities. Experience elsewhere indicates that the respondents' recommendation for the establishment of a "readiness system" could, if implemented, enhance NMHSs contribution to disaster risk reduction and increase their visibility as contributing organizations.

6.10.6 NMHS Collaboration with other Partners

Responses indicate that not all NMHS aggressively pursue coordination and collaboration with significant national, regional and international partners in the disaster community. Expanded collaboration and partnership can benefit NMHS through broader utilization of their products and services, enhanced visibility, and more effective contributions to disaster risk reduction.

6.10.7 The Organization and Priorities of NMHS in South America

There were some inconsistencies in the reporting of organizational status by NMHSs in South America that need to be clarified. In particular, eight of ten respondents identified that they had a combined NMHSs but five indicated that they had separate NMS and NHS. The survey responses suggest, however, that legislation, policy direction or partnership agreements are needed in some countries in South America to clarify the roles and responsibilities of their NMSs and NHSs in relation to disaster risk reduction and, in particular, the issue of early warnings for hydrometeorological hazards. Where this is the case, clarification will need to be sought at the national level.

6.10.8 Operational Coordination between NMS and NHS

The survey responses clearly indicate that needs exist for enhanced operational coordination between NMSs and NHSs in a number of countries in South America. The survey respondents' majority recommendation should, therefore, be pursued at the country level through immediate action to achieve more effective operational coordination between the meteorological and hydrological communities, particularly with respect to hazard warnings and other critical products.

6.10.9 Observation and Monitoring Networks and Systems

Reliable, round-the-clock, observations, available in real time, are the essential raw material needed for the production of early warnings of hydrometeorological hazards, forecasts and other products to support disaster risk reduction. Consequently, every effort must be made to ensure that adequate observational networks and systems are operational on a 24-hourly/year-round basis. This is evidently a major challenge for NMHSs in South America since survey responses universally identify the lack of appropriate hydrometeorological observation networks as a factor limiting their ability to support disaster risk reduction.

6.10.10 Telecommunications and Informatics

The respondents' universal recommendation regarding the desirability of upgrading their operational forecasting and warning infrastructure is validated by the survey responses. The responses confirm deficiencies in telecommunications, network equipment and computer hardware, applications software and Internet access. These deficiencies undercut the abilities of South American NMHSs to contribute optimally to disaster risk reduction. As in the case of observational networks, rectifying these deficiencies will require up-front investments in telecommunications and informatics systems and in staff training. In addition, however, it will also necessitate continuing commitment by national governments of adequate funding to sustain the ongoing operation and maintenance of their telecommunications networks and informatics systems over the long term.

6.10.11 Data Exchange

The respondents' virtually unanimous recommendation for enhanced coordination to improve data exchange is solidly supported. In addition, however, the survey responses indicate that significant requirements for enhancements to telecommunications, quality assurance and archiving systems are needed in more than half of the NMHSs in South America, along with training in data processing, quality assurance and data customization techniques.

6.10.12 Forecast and Warning Capability

The respondents' strong recommendations for upgrading of forecasting infrastructure and personnel are validated by the survey responses where general needs for upgrading of professional staff and operational infrastructure were identified. However, it also appears that a number of NMHSs in South America do not operate warning and forecast services on a round the clock basis. This represents a significant deficiency in the context of disaster risk reduction since natural disasters can occur at any time of the day or night.

6.10.13 Forecast and Warning Products

The respondents' recommendation regarding the need to improve their warning products and services is well founded.

6.10.14 Coordination of Warnings

The respondents' recommendation for improved coordination with RSMCs and neighbouring NMHSs in relation to watches and warnings is well supported. Such coordination reduces the risk of ambiguous or, in the worst case, conflicting warning messages from different sources reaching the same audience. A compounding issue here is the increased potential for confusion that arises when commercial or other entities also issue hazard warnings, as is the case in some South American countries. As a general principle, therefore, it is desirable to work towards a situation where official warnings for hydrometeorological hazards emanate from a single recognized issuing authority within each country**.** Ideally being prepared by NMHSs with the scientific and technical capacity to make such predictions, hydrometeorological warnings may, in some circumstances, benefit from assessment and interpretation by civil defence authorities as to their likely impacts before being relayed to local communities, perhaps accompanied by advice on actions that people should take to minimize loss of life and property.

6.10.15 Products and Services for Selected Socio-Economic Sectors

Experience around the globe demonstrates that the socio-economic sectors discussed earlier can benefit significantly from the incorporation of hydrometeorological information and products into their planning and decision-making processes. Sensible land-use planning to minimize risk of flooding and other hazards, rational planning and engineering design of housing and other developments to withstand expected wind loads or heavy rains and other similar measures contribute to hardening societies and communities against disastrous hydrometeorological events. Equally, early warnings of hazards enable people to take avoidance or mitigating actions to prevent disasters. The survey responses indicate that the target sectors do not receive special services in from one third to one half of South American countries. Consequently, considerable room exists to contribute significantly to disaster risk reduction by enhancing the provision of relevant products and services planning, development, water resources and other key socio- economic sectors.

6.10.16 Dissemination Systems and Target Audiences

Reliable and timely dissemination of early warnings of hazards to stakeholders and the public at large is among the most useful services that NMHSs can provide in support of disaster risk reduction. Consequently, every effort should be made to ensure that warnings and other relevant products reach all important target audiences. In the context of disaster risk reduction, national Red Cross Societies and similar non-government bodies should be targeted for receipt of hazard

warnings on virtually the same level as government disaster authorities. NMHSs should seek to encourage and support such bodies to access and utilize early warnings of hazards and other relevant NMHS products.

6.10.17 Product Utility and Product Improvement

The respondent's recommendation regarding the value of educational modules makes good sense in view of the general perception of inadequacies in public and stakeholder awareness and understanding in South American countries. However, the main conclusion is that much greater emphasis must be placed on public outreach and obtaining feedback from the public and specialized stakeholders to ensure that improvements are made to products and services and that these translate into clear understanding at the recipient level. The survey responses suggest that many NMHSs in South America could enhance efforts in these areas to considerable advantage.

6.10.18 Internal NMHS Training and Capacity Enhancement

The respondents' recommendations for upgrading of operational forecasting and warning capabilities and for cross-border operational training of forecasters are strongly validated by the survey responses. These responses indicate that some NMHS do not provide ongoing training to forecaster staff and that most others advocate increased emphasis on this aspect. More broadly, however, the responses indicate that most NMHSs would benefit from much closer collaboration with disaster risk authorities and emergency managers in relation to both internal training programmes for NMHS staff and joint training programmes with disaster risk and emergency response agencies.

6.10.19 Outreach Activities

The respondents' recommendation that educational modules would be helpful is valid and strongly supported by survey responses. It is evident from the survey responses that most NMHSs in South America have not given a sufficiently high priority to public outreach activities, with a majority identifying that a lack of public and stakeholder understanding of hazards and NMHS products seriously limited their effectiveness in supporting disaster risk reduction. In view of this situation, it seems clear that South American NMHSs should increase emphasis to outreach activities aimed at both the public at large, disaster authorities and decision makers since even timely and accurate early warnings and other high quality products will be of little value if the users do not understand their contents and implications. Failure of recipients to understand these fundamentals will render meaningless any advances in warning and forecast skill or in product quality and content.

6.10.20 NMHS Contingency Planning

All NMHSs should establish back-up capability to maintain critical hazard warning services in the event of disruption of their operations. Establishment of partnership agreements with neighbouring NMHS can be an effective approach to ensuring continuity of warnings and related services in support of disaster risk reduction.

6.10.21 WMO Support

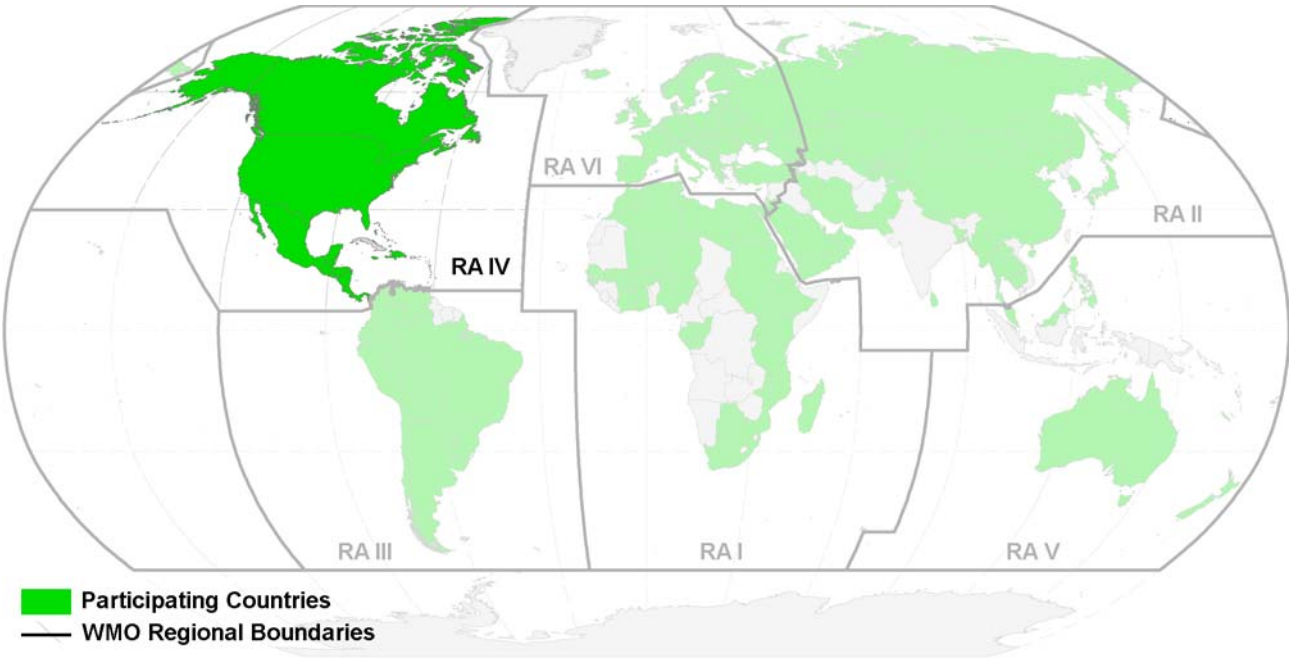
South American NMHSs who responded to the survey identified their highest priority needs for support from WMO as being in relation to technical advice and specifications and the development of national disaster risk reduction plans areas. As slightly lower priorities, they also cited technology transfer, capacity building, and training, not only in relation to traditional areas such as forecasting techniques but also to hazard mapping, other inputs to risk assessment tools and the conduct of cost-benefit analyses. This mix of traditional and newer areas will challenge WMO to review and, possibly, modify the orientation of its training and development programmes to accommodate the new needs arising out of the disaster risk reduction priority. As in other regions, less tangible, but nevertheless real, needs related to visibility enhancement, strategic partnerships and establishment of protocols have also been raised. Equally, the issue of assistance in resource mobilization is, as always, still visible, albeit at the bottom of the priority list.

6.11 Region-wide Capacities and Resources in South America

South American NMHS can draw upon the WMO system and on regional institutions to reinforce their individual capacities to contribute to disaster risk reduction. WMO Regional Specialized Meteorological Centres (RSMCs) at Brasilia and Buenos Aires RSMCs provide the NMHSs of the region with guidance products derived from regional numerical models. As particular services, the Buenos Aires RSMC supports regional-level disaster risk management through its Volcanic Ash Advisory Centre (VAAC Buenos Aires) while the Hurricane Center in Miami provides warnings and predictions for hurricanes that can affect Caribbean coastal areas. In addition, the Brazilian National Institute for Space Research (INPE) disseminates satellite imagery and products and regional scale weather and climate data and forecasts to NMHSs and other clients across South America. The RSMCs are also participating in the establishment of a Virtual Monitoring and Warning Centre for Severe Weather Phenomena in the River Plate Basin, an initiative to improve monitoring of severe weather events in the Basin by expanding the automatic station network. The WMO Regional Association, through its Working Groups, is also pursuing initiatives in a number of areas that are directly relevant to disaster risk reduction. These include observational thrusts such as improving satellite remote sensing capacity, application of numerical models for early detection of extreme events and optimization of radar and surface station observation networks. They also include strengthening capabilities to provide medium to long-range warnings of adverse conditions. The Southern Cone Climate Outlook Forum, involving representatives from Argentina, Brazil, Paraguay, and Uruguay and support from the International Research Institute for Climate Prediction (IRI) and the Inter American Institute for Global Change Research (IAI), for example, have been held since 1997. The Variability of American Monsoon Systems (VAMOS) Programme, a component of the WCRP Programme on Climate variability and predictability (CLIVAR), focuses on improving understanding and prediction of the second largest monsoon system on Earth and involves widespread regional participation. In addition, the nations of the Andean region are addressing the socio-economic opportunities and adverse impacts associated with climatic events under the aegis of the "Regional Andean Programme for Risk Reduction and Disaster Prevention (PREANDINO). WMO's Regional Association III, the Permanent Commission of the South Pacific (CPPS), the International Centre for Research on the El Niño Phenomenon (CIIFEN), and other regional bodies contribute to enhancing regional coordination and encouraging and implementing relevant initiatives. Finally, WMO Regional Meteorological Training Centres in Argentina, Brazil and Venezuela represent valuable training resources that can enhance capacities in disaster risk reduction through the provision of workshops and courses.

Though much of South America is rich in freshwater systems, large portions of Argentina, Bolivia, Chile, Peru, North Eastern Brazil, Ecuador, and Colombia are arid or semi-arid. Consequently both floods and droughts represent significant hazards while the retreat of Andean glaciers is raising longer term sub-regional concerns. South American nations currently operate extensive hydrometeorological observation networks and programmes to address these and other water-related challenges. To further develop their hydrological capacities, the region is also contributing to WMO’s World Hydrologic Cycle Observing System (WHYCOS) through a CARIB-HYCOS involving Colombia and Venezuela and proposals for an Amazon-HYCOS and a La Plata-HYCOS. In addition, a Latin America and the Caribbean FRIEND/AMIGO (Flow Regimes from International Experimental and Network Data) project has been initiated as a component of UNESCO’s International Hydrological Programme (IHP). These and other initiatives will assist in developing hydrological infrastructures and capacities to support disaster risk reduction throughout South America.

CHAPTER 7



NORTH AND CENTRAL AMERICA AND THE CARIBBEAN

WMO REGIONAL ASSOCIATION IV

7 NORTH AND CENTRAL AMERICA AND THE CARIBBEAN (WMO Regional Association IV)

7.1 Abstract

Survey responses from 18 North and Central American and Caribbean NMHSs identify widespread deficiencies in NMHSs' observational and telecommunications and informatics infrastructures and operations including, in a few instances, less than 24-hourly availability. Most of the region's NMHSs have access to data on hazard impacts but about a third do not maintain archives of hydro meteorological hazards. Most identify related needs for training in data rescue, data management and data customization to support the provision of enhanced data products. Most advocate better coordination with neighbouring NMHSs and Regional Specialized Meteorological Centres (RSMCs) and between National Meteorological Services (NMSs) and National Hydrological Services (NHSs), also pointing to inadequate links with other disaster stakeholders. Though most NMHSs have hazard warning programmes and emergency contingency plans, several do not provide round the clock warnings service. Key sectors such as land-use planning and development do not receive targeted services in about half of the countries. Widespread support exists for upgrading of warning capacities and for expansion of warnings to address all relevant hazards. In addition, virtually all NMHSs suggest that increased emphasis be given to public outreach and on joint training with disaster risk partners. All of them draw attention to limited human and financial resources as significant constraints. While most North and Central American and Caribbean NMHSs participate in national disaster coordination committees, all of them express desires for greater recognition and clearer definition of their roles. Some variations from the preceding picture are evident at sub-regional levels. Broadly speaking, North American NMHSs have the strongest infrastructures and capacities and are well integrated into their disaster coordination systems. Central American and Caribbean NMHSs, in contrast, tend to have weaker infrastructures, capacities and programmes, though coordination with disaster stakeholders and emergency contingency plans seem to be relatively well established in Central America. These survey results substantiate the following conclusions and recommendations that are aimed at enhancing the contributions to disaster risk reduction of NMHSs in North and Central American and Caribbean:

- The North and Central American and NMHSs that are not already active participants should seek membership in their national disaster coordination mechanisms. Clearer policy direction may be needed in some countries to clarify the NMHSs' roles and responsibilities.
- Most NMHSs in the region require capacity development and training related to disaster risk applications, including hazard and impact analysis, hazard mapping and risk zone analysis.
- Every effort should be made to the establishment and operation of adequate hydrometeorological observation and telecommunications networks in all countries in the region. A high priority should be given to ensuring the 24-hourly operation of these networks.
- Region-wide needs are identified for upgrading forecast and warning capacities and programmes. Particular effort should be devoted to ensuring the 24-hourly availability of hazard warning services in those few countries where meteorologists are not on duty round the clock.
- Increased emphasis should be given to internal training of forecast staff, cross border training with other NMHSs, and joint training with disaster risk authorities to strengthen warnings expertise and expand NMHSs' understanding of disaster risk requirements and procedures.
- Official warnings for hydrometeorological hazards should emanate from a single recognized issuing authority in each country, ideally being prepared by NMHSs with the necessary scientific and technical capacities. In some circumstances, hazard warnings may benefit from assessment and interpretation by civil defence authorities before being widely disseminated.
- Those NMHSs who do not have back up systems to maintain services in emergencies, should establish such systems, possibly through partnerships with neighbouring NMHSs.
- All NMHSs should encourage the establishment of national readiness systems in their countries.

- Many NMHSs in the region should give higher priority to the provision of special products and services to key socio-economic sectors such as land use planning, development and water resources. These sectors do not currently receive targeted support in about half of the countries in North and Central America and the Caribbean.
- Operational coordination between NMSs and NHSs and with neighbouring NMHSs and RSMCs should be improved in most countries across the region. In some instances, policy direction or partnership agreements between NMSs and NHSs may be required to clarify their respective roles, particularly in relation to warnings issue.
- Most NMHSs in North and Central America and the Caribbean should give higher priority to outreach activities aimed at education of the public and key stakeholders.
- NMHSs need support from WMO across a broad spectrum spanning infrastructure development, technology transfer, capacity building and training. Special targets include public outreach, forecasting techniques, disaster risk planning, hazard mapping, risk assessment tools and cost-benefit analyses. Assistance is also desired in relation to resource mobilization, strategic partnerships and visibility enhancement.

The present chapter centres on the assessment of the survey responses from NMHSs in North and Central America and the Caribbean (WMO RA IV). Its internal structure follows the sequence outlined earlier in section 2.6.1.

7.2 The Response to the Survey

The 18 countries in North and Central America and the Caribbean who contributed responses to the WMO country-level survey are listed in Annex 2.

7.3 The Hazards affecting Countries in North and Central America and the Caribbean

Figure 74 below lists the number of responding countries in North and Central America and the Caribbean (WMO RA IV) who identified themselves as being affected by the specified hazards.

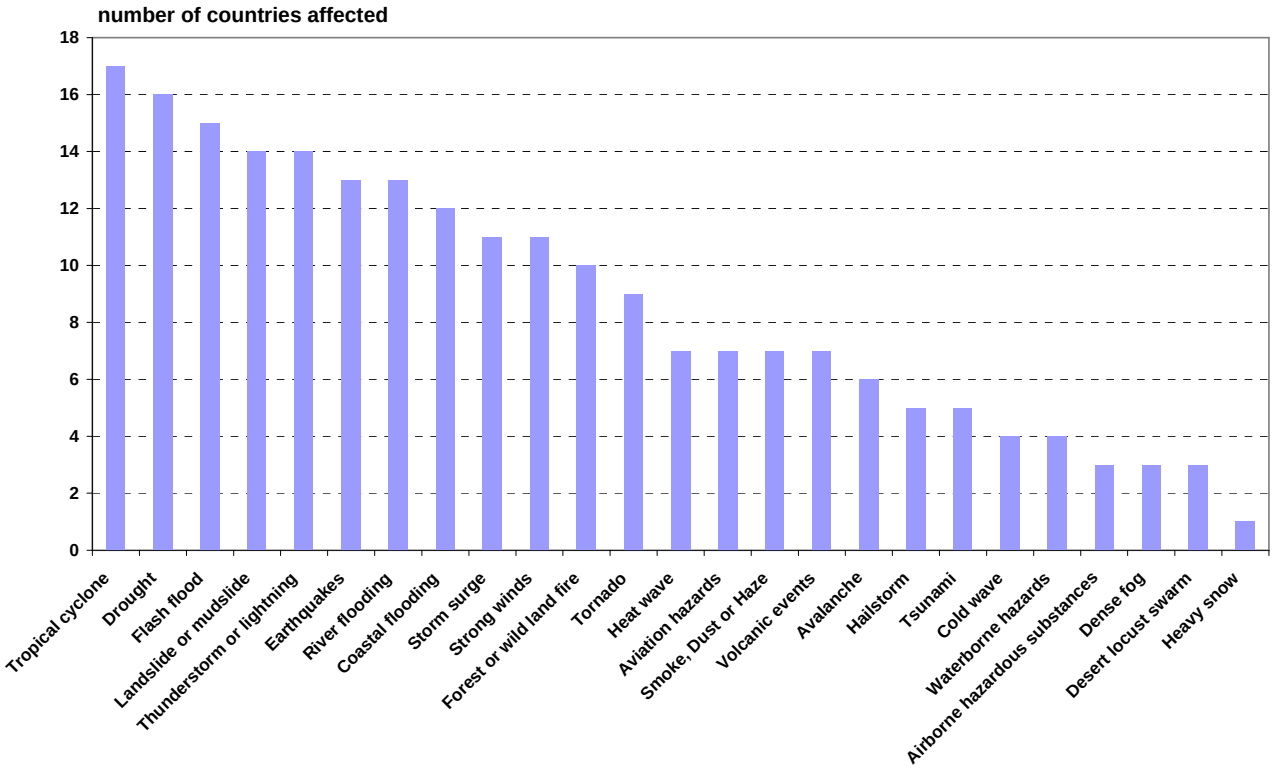


Figure 74. Number of responding countries in North and Central America and the Caribbean who identified themselves as being affected by specified hazards.

7.3.1 Access to Data on Hazards and their Impacts

Annex 3 presents an overview of the hazard databases maintained by survey respondents in North and Central America and the Caribbean and includes some supplementary information on related metadata and impacts information. Most responding NMHSs in the region (83% or 15 of 18) stated that they had access to official, reliable, information on impacts and a slightly larger number (94% or 17 of 18) indicated that another agency was responsible for providing official information on the impacts of disasters in their country. A few NMHSs (37% or 7 of 18), however, reported that they maintained their own internal database of official information on the impacts of hazards that affected their countries and all of these said that they regularly updated this database[18].

[18] It is important to note, that, to date, no systematized, universally accepted, methodology or protocol has been established on a global basis for the creation and maintenance of hazard and hazard impacts databases.

7.3.2 Value Added Services based on Historical Hazard Data

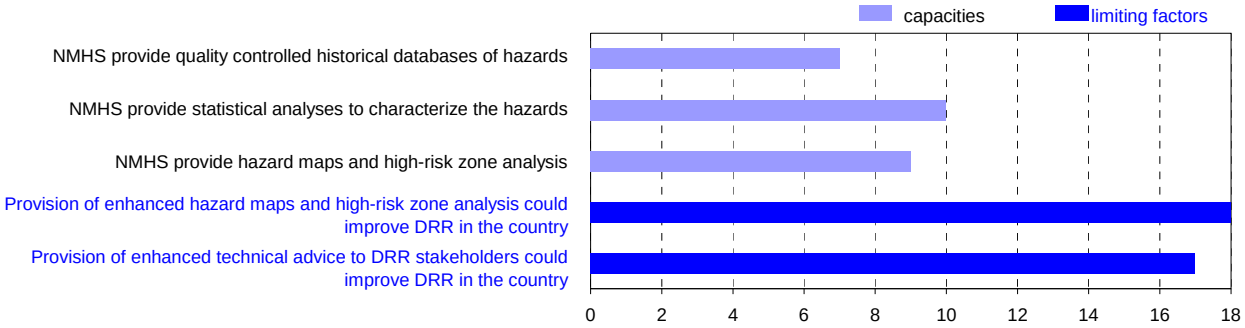


Figure 75. Provision of hazard information by NMHSs in North and Central America and the Caribbean.

Most North and Central American and Caribbean NMHSs who contributed to the country-level survey (78% or 14 of 18) stated that that they provided technical advice on hazards and roughly half of them (56% or 10 of 18) provided statistical analyses to characterize the hazards. In addition, just over a third (39% or 7 of 18) reported that they maintained quality controlled historical databases of hazards. Half the respondents (50% or 9 of 18) indicated that they provided hazard mapping and high-risk zone analysis and a solid one third (33% or 6 of 18) stated that they provided analyses of the potential impacts of hazards.

Most responding NMHSs identified factors that limited their ability to provide hazard data products, citing as limitations data rescue (89% or 16 of 18), professional staff with appropriate training (89% or 16 of 18), customization of data for stakeholders (78% or 14 of 18), the ability to archive and update (78% or 14 of 18) and quality assurance (67% or 12 of 18). All respondents (100% or 17 of 17) considered that the provision of enhanced value added NMHS services in support of hydrometeorological risk assessment would strengthen their contributions to disaster risk reduction activities. The following specialized or value-added services were identified as enhancements - analyses of the potential impacts of hazards (100% or 17 of 17), hazard mapping and high-risk zone analysis (100% or 18 of 18), and provision of technical advice (94% or 17 of 18).

7.4 The National Context for Disaster Risk Reduction

National legislative, governance and organizational structures for disaster risk reduction establish the context within which NMHSs make their contributions to safety of life and property. The following sections summarize survey responses from North and Central America and the Caribbean regarding their countries' national systems and the impact of these systems on their NMHSs.

7.4.1 Legislation and Governance

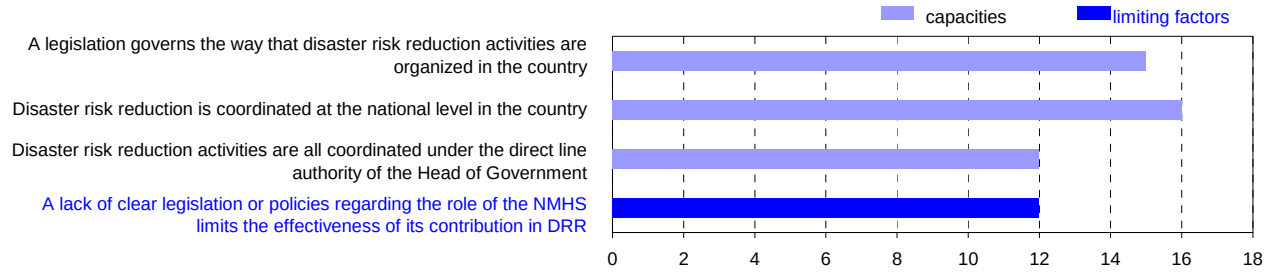


Figure 76. Legislation and coordination in support of disaster risk reduction at the national level in North and Central America and the Caribbean.

Most North and Central America and Caribbean NMHSs who responded to the survey (94% or 16 of 17) reported that disaster reduction activities were coordinated at the national level, in a majority of cases (71% or 12 of 17) under the direct line authority of the head of government. The organization of these activities was also governed by legislation in most of these countries (83% or 15 of 18) and in about half (53% or 9 of 17) was coordinated under one ministry. At the same time, over two thirds of respondents (67% or 12 of 18) considered that a lack of clear legislation or policies regarding the role of their NMHS (e.g. as the sole issuer of hydrometeorological hazard warnings) limited their contributions to disaster risk reduction.

7.4.2 National Structures/Mechanisms for Disaster Risk Reduction

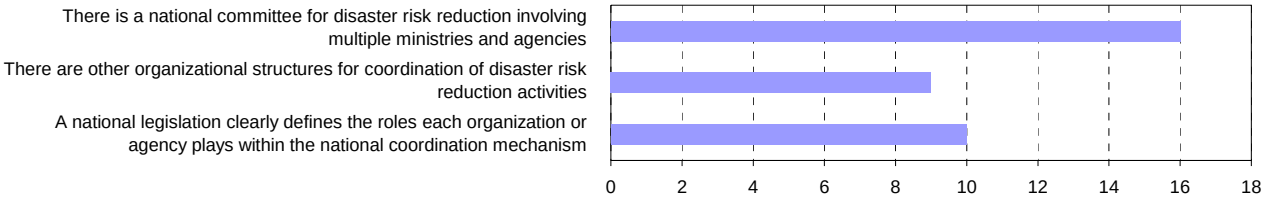


Figure 77. National structures for coordination of disaster risk reduction in North and Central America and the Caribbean.

Almost all North and Central American and Caribbean contributors to the WMO survey (94% or 16 of 17) reported that their countries had a national committee for disaster risk reduction that involved multiple ministries and agencies. Moreover, all who responded to the question (100% or 16 of 16) stated that they were members of their national coordinating committees. A majority of them (63% or 10 of 16) indicated that the roles of each participating agency in the national coordination mechanism were defined by legislation. However, over half (53% or 7 of 17) pointed out that other organizational structures for coordination also existed in their countries. A substantial number of NMHSs (61% or 11 of 18) felt that their contributions to disaster risk reduction were limited by their national disaster management structure and a similar number (65% or 11 of 17) by a lack of linkages with other involved organizations. Most (94% or 16 of 17) considered that implementation of a “readiness system” that ensured an appropriate response by authorities to information issued by the NMHSs would enhance their disaster risk reduction activities.

7.4.3 NMHS Contributions to National Disaster Risk Reduction Systems

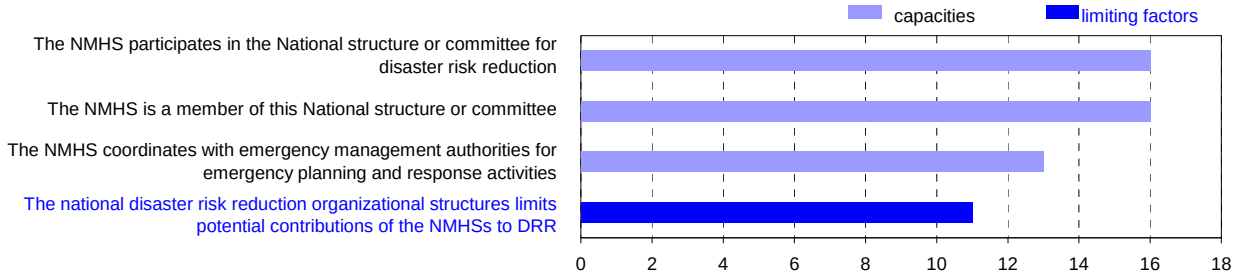


Figure 78. NMHS participation in national structures for disaster risk reduction in North and Central America and the Caribbean.

Almost all contributing NMHSs (94% or 17 of 18) reported that they provided support to agencies responsible for disaster risk reduction at the national level. All respondents (100%) stated that they provided support to emergency response operations and emergency planning and preparedness and most (88%) also supported disaster prevention and post-disaster reconstruction (75%). In addition, most NMHSs (94%) provided support to provincial or state government disaster-related activities and many of these (76%) extended this support to municipal or local levels. Nevertheless, a significant majority of North and Central American and Caribbean NMHSs(65% or 11 of 17) pointed to inadequate linkages with other involved organizations (e.g. emergency planners, emergency response agencies) as limiting their contributions to disaster risk reduction. Furthermore, a large majority (94% or 16 of 17) considered that their contributions would be enhanced by a "readiness system" that required appropriate responses by authorities to information issued by the NMHS.

7.4.4 NMHSs Collaboration with other Partners

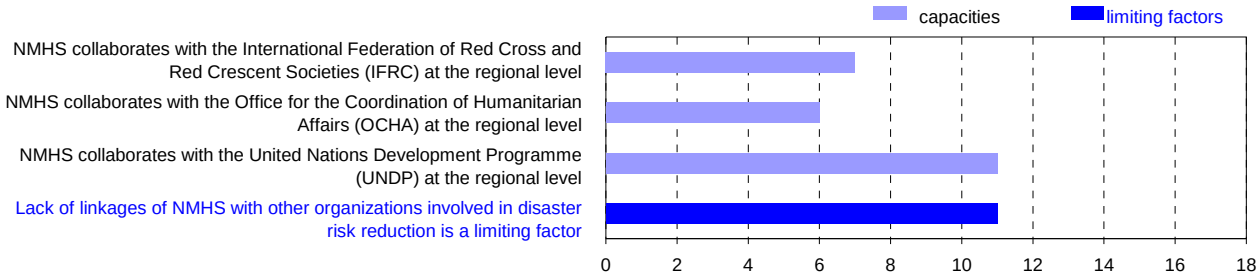


Figure 79. NMHS collaboration with partner agencies at the regional level in North and Central America and the Caribbean.

Three quarters of responding NMHSs (76% or 13 of 17) in North and Central America and the Caribbean reported that they coordinated with emergency management authorities for emergency planning and response at the national level. Similar numbers (78% or 14 of 18) collaborated with their National Red Cross Societies, interacted with the office of the United Nations Coordinator (71% or 12 of 17) in their country or participated in disaster reduction activities of the UNDP (79% or 11 of 14). Other international organizations received less collaboration, with fewer than half the respondents (47% or 7 of 15) reporting that they participated in activities of the International Federation of Red Cross and Red Crescent Societies (IFRC) or in activities of the Office for the Coordination of Humanitarian Affairs (43% or 6 of 14)

7.4.5 The Organization and Priorities of NMHSs

The priorities of individual NMHSs are, inevitably, influenced to some degree by the missions and priorities of their parent government ministries or departments. In consequence, the orientation of NMHSs may be more broadly focussed in some countries than in others. A parent department with a civil aviation mandate may, for example, emphasize provision of NMHS services to aviation while one with a natural resources or environment mandate might encourage its NMHS to provide warnings and other services to a broader range of sectors. Where National Meteorological Services, or combined National Meteorological and Hydrological Services[19], in North and Central America and the Caribbean are concerned, parent ministries include: Environment and Natural Resources; Communications, Infrastructure and Housing; Environment and Energy; Civil Aviation; Agriculture, Natural Resources and Rural Development; Traffic and Communication; Public Works, Transport and Housing; Commerce; Environment; Agriculture and Rural Development; Local Government and the Environment; Transport and Aviation; and Public Utilities and the Environment. Parent ministries of National Hydrological Services include: Agriculture, Forestry and Fisheries; Housing, Transport Works and Water; Public Utilities and the Environment; Environment and Natural Resources; Water and Sewage Corporation; Interior; and Commerce.

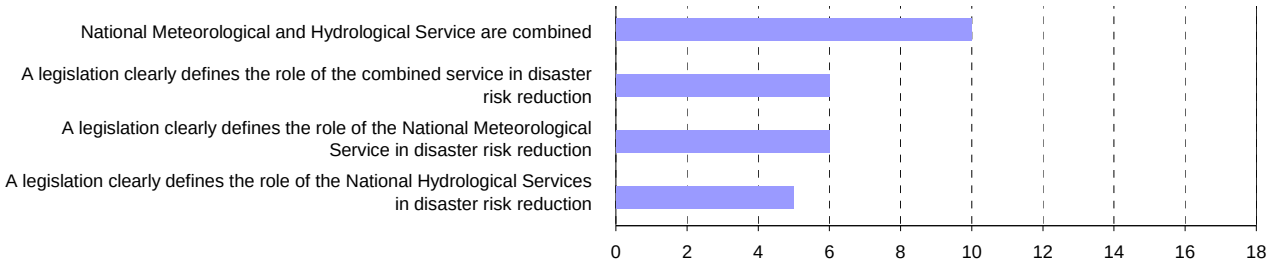


Figure 80. Organizational structure of meteorological and hydrological services in North and Central America and the Caribbean.

The internal organization of National Meteorological and Hydrological Services within individual countries can also influence their ability to deliver well-coordinated hydrometeorological warnings and other services in support of disaster risk reduction. In North and Central America and the Caribbean, a majority of respondents (63% or 10 of 16) stated that they had a combined National Meteorological and Hydrological Service. However, less than half (46% or 6 of 13) indicated that their country had national legislation that clearly defined the NMHS role in disaster risk reduction. More than half the contributors (60% or 6 of 10) with separate NMSs and NHSs stated that they had legislation that clearly defined the role of the NMS in disaster risk reduction and a slightly smaller number (56% or 5 of 9) reported legislation that applied to the role of the NHS. At the same time, some (80% or 8 of 10) respondents considered that legislation or partnership agreements were needed to better define the respective roles of their NMSs and NHSs in disaster risk reduction.

[19] Parent departments of NMS and NMHS have been grouped together due to ambiguities in responses regarding the existence or otherwise of combined NMHS.

7.4.6 Operational Coordination between NMSs and NHSs

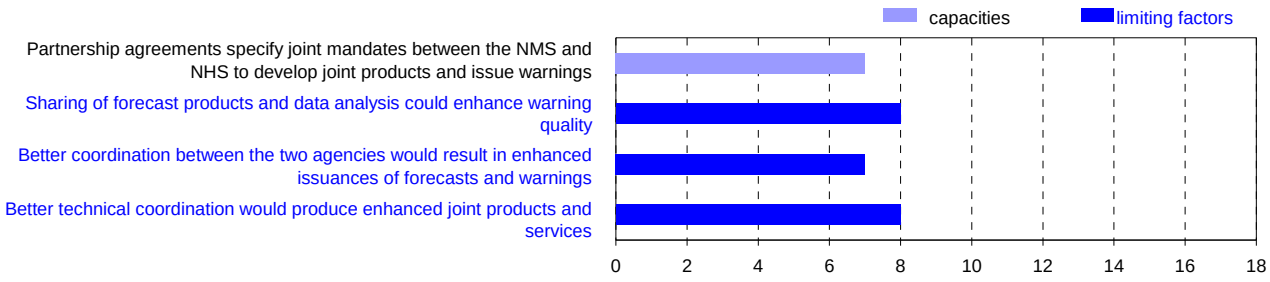


Figure 81. Coordination between NMS and NHS in North and Central America and the Caribbean.

A majority (64% or 7 of 11) of respondents from North and Central American and Caribbean countries with separate NMSs and NHSs identified that partnership agreements were in place specifying mandates between their NMS and NHS to develop joint products and issue warnings. A similar number (64% or 8 of 12) indicated that the two agencies shared forecast products and data analyses that could enhance warning quality and most of these (58% or 7 of 12) stated that coordination took place before hydrometeorological hazard warnings were issued. A few (20% or 2 of 10), however, stated that there was no coordination on warnings. A majority of respondents (88% or 7 of 8) considered that better overall coordination between the two agencies would enhance issuance of forecasts and warnings and even more (100% or 8 of 8) believed that improved technical coordination would result in enhanced joint products and services.

7.5 NMHS Infrastructure, Products and Services

The following sections summarize the information contained in survey responses related to observational networks, telecommunications systems, warning and forecast production systems and their products, dissemination systems and related aspects of the overall operational capacities of the NMHSs in North and Central America and the Caribbean.

7.5.1 Observation and Monitoring Networks and Systems

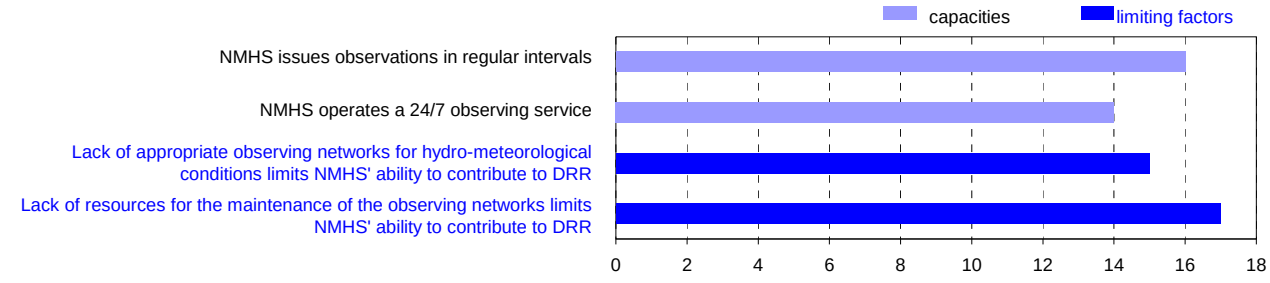


Figure 82. Observation and monitoring networks and systems in North and Central America and the Caribbean.

Most North and Central American and Caribbean NMHSs who contributed to the survey (89% or 16 of 18) stated that they had an operational observing capacity that issued observations at regular intervals. Most (88% or 14 of 16) also reported that the observing service operated 24-hourly/year-round and half of them (50% or 9 of 18) indicated that their observation network included sea level monitoring stations. However, almost all respondents (94% or 15 of 16) also considered that a lack of appropriate hydrometeorological observing networks limited their ability to contribute to disaster

risk reduction. Furthermore, over half of them (56% or 10 of 18) identified the availability of a dedicated 24-hourly/year-round observing service as a limiting factor. Major challenges in maintaining observation networks were also stressed, with almost all respondents (94% or 17 of 18) citing limited resources (e.g. financial, replacement parts, personnel, etc), most (83% or 15 of 16 citing professional staff with appropriate training, and over half (59% or 10 of 17) highlighting hazard related damage.

7.5.2 Telecommunications and Informatics

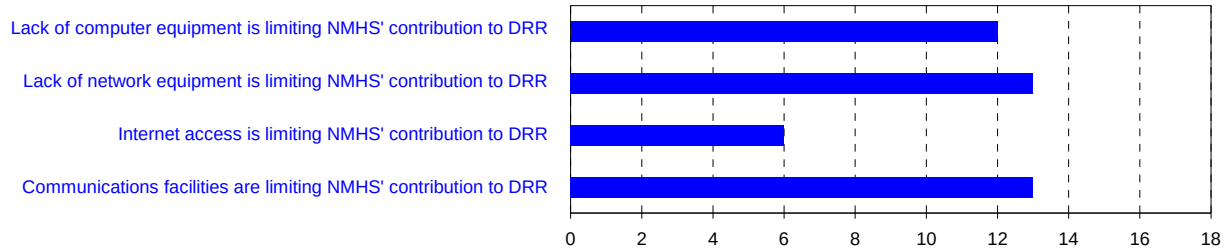


Figure 83. Telecommunication and informatics in North and Central America and the Caribbean.

The overwhelming majority of NMHSs who contributed to the survey (94% or 17 of 18) reported that their telecommunications systems were available 24-hourly/year-round. Partial confirmation was provided by responses indicating that most forecasting staff (89% or 16 of 18) had access to real time hydrometeorological data. However, all respondents (100% or 15 of 15) also identified that their ability to deliver critical products for disaster risk reduction was limited by communications facilities. Other limitations on NMHSs capacities were cited in major areas of informatics, with many respondents (94% or 16 of 17) highlighting the lack of application software, network equipment (81% or 13 of 16), computers (71% or 12 of 17) and inadequate Internet access (38% or 6 of 16). Consequently, almost all respondents (94% or 17 of 18) considered that upgrading the operational infrastructure for forecasting and warning services would enhance disaster risk reduction capacities in their countries.

7.5.3 Data Exchange

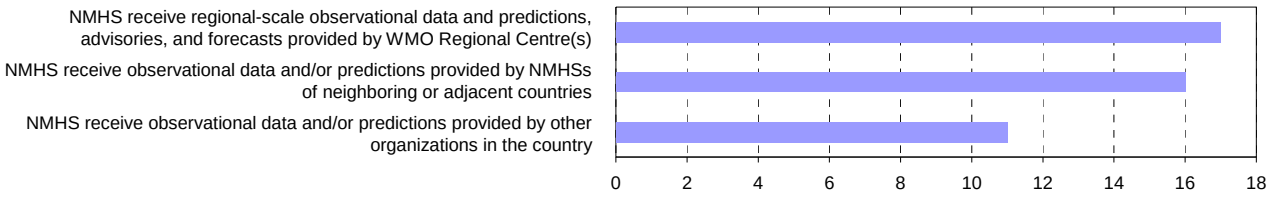


Figure 84. Data exchange in North and Central America and the Caribbean.

Survey responses from NMHSs in North and Central America and the Caribbean (WMO RA IV) identified that most (89% or 16 of 18) forecasting staff had real time access to hydrometeorological data. Most (90% or 17 of 17) also used regional scale observational data and forecasts provided by WMO Regional Specialized Meteorological Centres along with data from neighbouring countries (89% or 16 of 18) and from other organizations within their countries (61% or 11 of 18). In addition, most (76% or 13 of 17) received real time marine observations from the GTS and some (50% or 5 of 10) relayed sea level observations on that global network. Conversely, however, three quarters of respondents (76% or 13 of 17) indicated that their NMHSs were limited in their ability to deliver critical products and services for disaster risk reduction by communications facilities. In particular, over three quarters of them (78% or 14 of 18) stated that their NMHS were limited by customization of data for stakeholders and by ability to archive and update. Roughly two thirds of contributors

(67% or 12 of 18) also cited quality assurance as a limiting factor. Almost all responding NMHSs (94% or 15 of 16) considered that they required better coordination on hydrometeorological data exchange with neighbouring NMHSs and with RSMCs (86% or 12 of 14).

7.5.4 Forecast and Warning Capability

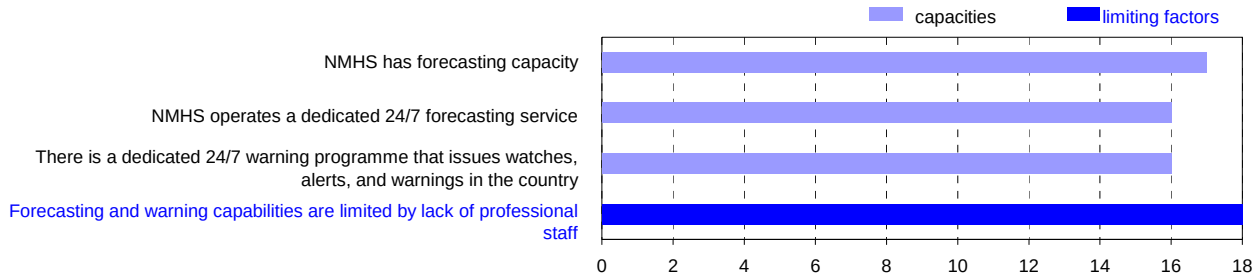


Figure 85. Forecast and warning capabilities in North and Central America and the Caribbean.

All NMHSs (100% or 17 of 17) in North and Central America and the Caribbean who responded to the WMO country-level survey indicated that they had an operational forecasting capability. Most (94% or 16 of 17) stated that this was a dedicated 24-hourly/year-round forecast service and that a meteorologist was required to be on-site to operate the service. Most contributors (89% or 16 of 18) also reported that they had a dedicated hazard warning programme that issued watches, alerts and warnings on a 24 hourly/year round basis. Most of these (93% or 14 of 15) indicated that a meteorologist was on site during the operational hours of the warning programme. In addition, most NMHSs (82% or 14 of 17) stated that they provided a marine forecast and warning service to mariners and coastal zone users and two also prepared marine forecasts for the Global Maritime Distress and Safety System (GMDSS).

On the negative side, all respondents (100% or 18 of 18) stated that their NMHSs were limited in their ability to deliver critical products and services for disaster risk reduction by professional staff, most (94% or 16 of 17) cited application software as limiting and many (71% or 12 of 17) cited computers. All survey contributors (100% or 16 of 16) considered that upgrading their NMHS operational forecasting and warning services would enhance disaster risk reduction in their countries. More specifically, all of them (100% or 18 of 18) advocated the upgrading or technical training of professional staff and most (89% or 16 of 18) also drew attention to needs for access to tools and latest forecasting technologies.

7.5.5 Forecast and Warning Products

Table 6 in Annex 4 summarizes information on hazard warnings and products issued by NMHSs in North and Central America and the Caribbean. The survey responses indicated that the hydrometeorological hazards affecting the greatest number of North and Central American and Caribbean countries were tropical cyclones, drought, flash floods, thunderstorms and lightning, landslides or mudslides, earthquakes, river flooding, coastal flooding, storm surge and strong winds[20]. These were closely followed by forest or wild land fires and tornadoes and by heat waves, aviation hazards, smoke, dust or haze, and volcanic events.

Examination of the data in Table 6 reveals that most affected NMHSs issued warnings for the majority of the most common hazards. Exceptions were that just over half of the affected NMHS

[20] The survey responses do not provide information on the magnitudes of the impacts associated with individual hazards, simply that they occur in the reported number of countries.

reported that they issued warnings for landslides or mudslides and only four of them issued warnings for earthquakes. Similarly, just over half of affected contributors issued warnings for the somewhat less widely experienced hazards such as tornadoes, forest and wild land fires, volcanic events, avalanches and tsunamis. The survey data, therefore, suggest that an opportunity exists to provide more effective support for disaster risk reduction in some North and Central American and Caribbean countries by rationalizing or expanding NMHSs hazard warning programmes to ensure that these include all hydrometeorological hazards that have high disaster-causing potential.

The survey responses from North and Central America and the Caribbean revealed that NMSs or combined NMHSs were the issuers of virtually all warnings for the major hydrometeorological hazards. There is only one reported exception where an NHS issues warnings for flash floods, coastal flooding and river flooding. The survey data also indicated that, in a few countries, NMHSs (or, as the case may be, NMSs or NHSs) are not the sole issuers of warnings for some major hazards and that other competing warning services also exist there. Respondents reported that, in most cases, official warnings for the major hazards in North and Central America and the Caribbean included information on the potential impacts of the hazards. Finally, the fact that most responding NMHSs in the region considered that further improvements to their warnings were necessary provides an opportunity to review and, where appropriate, broaden or re-prioritize these programmes to ensure that they provide optimal support to disaster risk reduction within the countries in question.

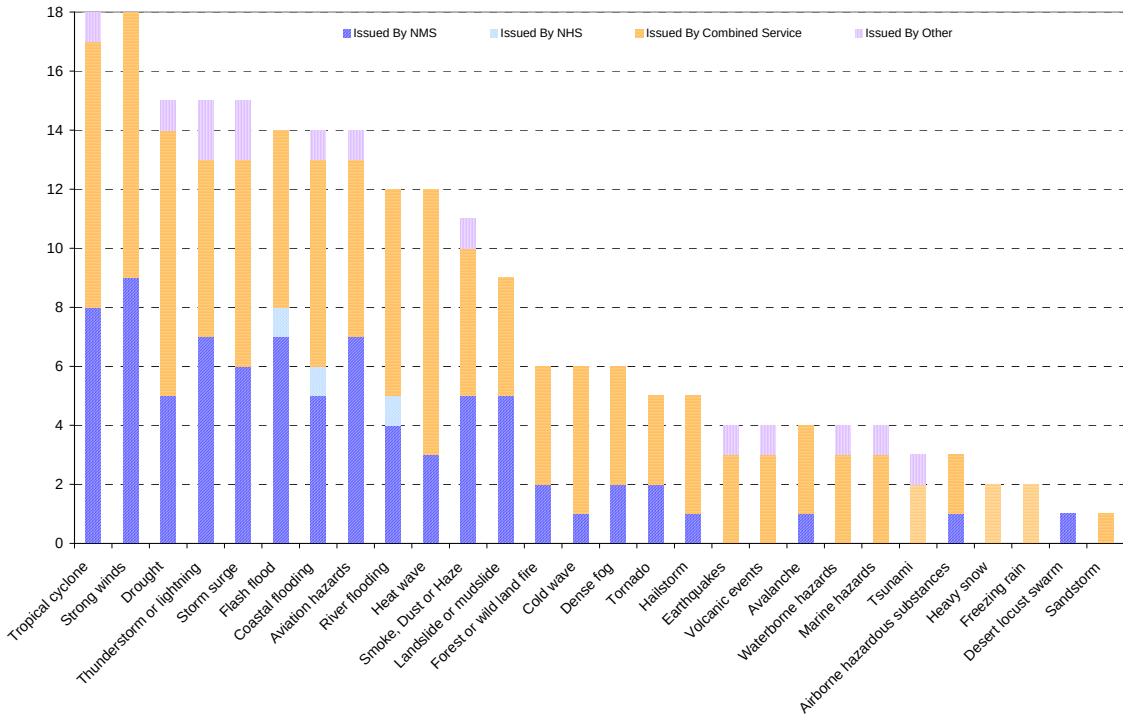


Figure 86. Agencies mandated for issuance of warnings in North and Central America and the Caribbean.

7.5.6 Coordination of Warnings

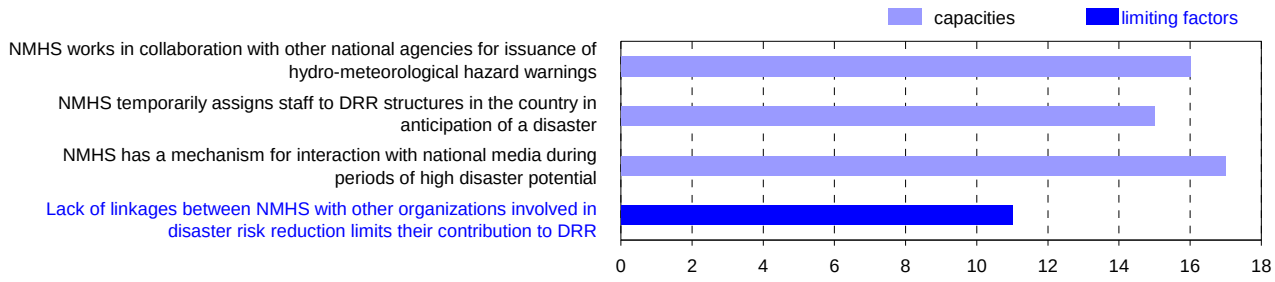


Figure 87. External coordination for issuance of warnings in North and Central America and the Caribbean.

Early warnings of hydrometeorological hazards represent a vital contribution to disaster risk reduction. In North and Central America and the Caribbean, most contributing NMHSs (89% or 16 of 18) reported that they worked in collaboration with other agencies (e.g. agriculture, aviation, etc) with respect to hazard warnings. Most of these (81% or 13 of 16) discussed the hazard's characteristics and potential impacts with these agencies prior to issuing a warning. In addition, most respondents (94% or 17 of 18) stated that they had a mechanism for interaction with their country's media during periods of high disaster potential. Many of them (83% or 15 of 18) also indicated that they temporarily assigned staff to disaster risk management structures in anticipation of a disaster. However, several NMHSs (28% or 5 of 18) pointed out that there were other public or commercial entities that provided competing warning services in their countries. All survey respondents (100% or 14 of 14) considered that their NMHSs required better coordination of watches and warnings with neighbouring NMHSs and most (69% or 11 of 16) with the WMO Regional Specialized Meteorological Centres.

7.5.7 Products and Services for Selected Socio-Economic Sectors

As a further refinement, Figure 88 illustrates the provision by NMHSs of specialized alerts, warnings and other products to significant socio-economic sectors in North and Central America and the Caribbean that can be seriously affected by hazardous events. In the context of disaster risk reduction, it is noteworthy from Figure 88 that only half (50%) the contributing NMHSs indicated that they provided support to development and housing, less than half (44%) provided support for the land-use planning and under two thirds (61%) provided services to the fresh water sector.

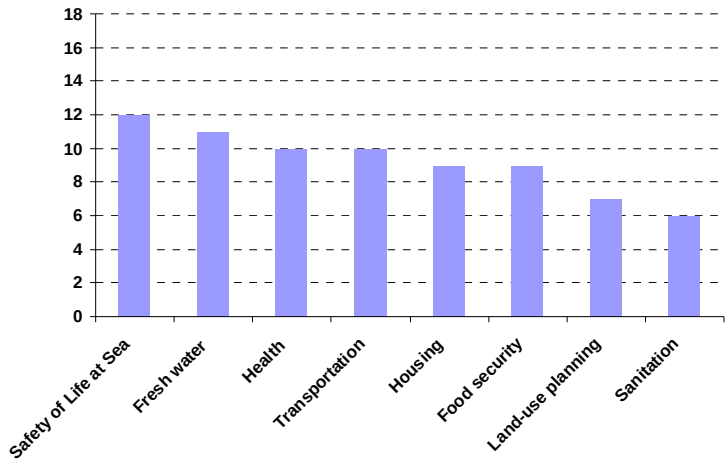


Figure 88. NMHSs provision of services to selected economic sectors in North and Central America and the Caribbean.

7.5.8 Dissemination Systems and Target Audiences

The following Figures 89 and 90 summarize the survey responses relating to the dissemination of hazard products by NMHSs in North and Central America and the Caribbean. They provide information on the types of products that are disseminated, to whom they are provided and on the methods of dissemination that are used to convey the products to the recipients. The same information is also presented in numerical form in Table 5 of Annex 5 where the figures represent the number of responding NMHSs who reported that they provided the specified product to the indicated target audience or, as appropriate, utilized a particular means of dissemination.

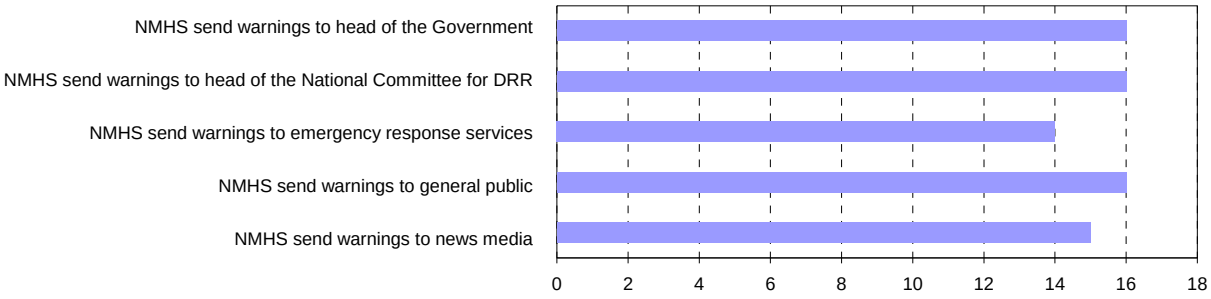


Figure 89. Warning target audience in North and Central America and the Caribbean.

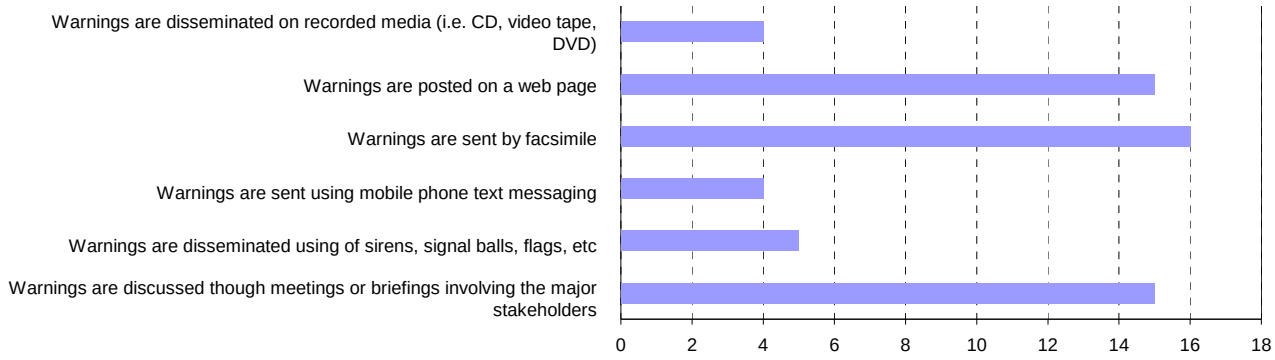


Figure 90. Warning dissemination methods in North and Central America and the Caribbean.

As might be expected, virtually all survey contributors from North and Central America and the Caribbean indicated that they disseminated hazard warnings to the public and the media and to relevant government authorities. It is striking, however, that a much higher percentage of responding NMHSs in this region also disseminated warnings and other products to external partners in disaster risk reduction such as national Red Cross Societies and others. The major dissemination methods in North and Central America and the Caribbean were via briefings, facsimile, web page and Internet with sirens and other signal devices also being used fairly widely.

7.5.9 Product Utility and Product Improvement

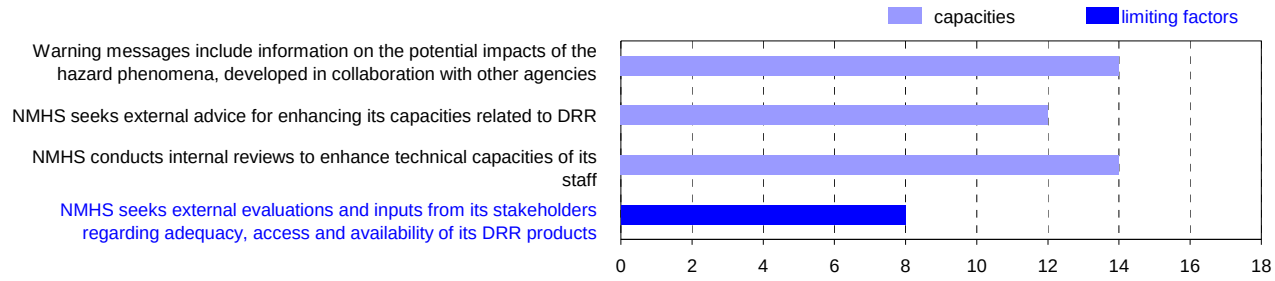


Figure 91. Ongoing feedback and improvement of products in North and Central America and the Caribbean.

As pointed out in earlier sections**,** most (89% or 16 of 18) survey respondents in North and Central America and the Caribbean indicated that they worked with other agencies with respect to hazard warnings. Most (87% or 13 of 15) also stated that they had regular interaction with disaster risk authorities to enhance their warning capabilities and content. Over three quarters (78% or 14 of 18) of those who included information on potential risks (impacts) in warning statements indicated that they collaborated with other agencies to develop risk information. In addition, most respondents (80% or 12 of 15) sought external advice for enhancing their capacities to support disaster risk reduction, specifically to enhance monitoring and forecasting, watches and warnings (100% or 15 of 15), or overall products and services (94% or 15 of 16). Over three quarters of contributors (78% or 14 of 18) also indicated that their NMHSs had a quality control mechanism to enhance their warning capabilities and content. Most of these (87% or 13 of 15) stated that the mechanism provided for regular interaction with stakeholders (disaster risk authorities) with most (73% or 11 of 15) indicating that it included feedback from stakeholders and the public after an event had occurred. Furthermore, most of them (71% or 10 of 14) also reported that it provided for training for stakeholders to understand hazards, warnings and their implications. In addition, several NMHSs (44% or 8 of 18) stated that they sought external evaluations and inputs from stakeholders

regarding the adequacy, relevance, method of access and availability of their disaster risk reduction products.

Despite the preceding efforts, however, most contributors to the WMO survey (83% or 15 of 18) considered that the lack of public understanding of the effects of hazards and of watches and warnings limited the public response to them. Most (76% or 13 of 17) respondents also considered that the lack of joint training between staff of the NMHSs and disaster risk managers and emergency authorities and managers (71% or 12 of 17) limited their disaster risk reduction efforts. In response, all NMHSs (100% or 18 of 18) in North and Central America and the Caribbean felt that educational modules for media, public and disaster risk authorities would enhance their effectiveness in disaster risk reduction.

7.5.10 Internal NMHS Training and Capacity Enhancement

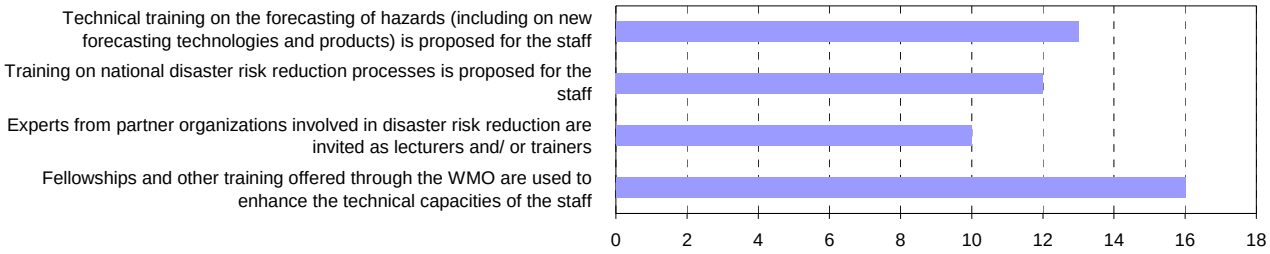


Figure 92. Training and capacity building of NMHS' staff in North and Central America and the Caribbean.

Most, but not all, NMHSs (72% or 13 of 18) in the region indicated that they provided ongoing technical training to staff on forecasting of hazards, including up to date training on new forecasting technologies and products. Most of them (82% or 14 of 17) also reported that they conducted internal reviews and sought staff inputs to enhance their capacity building and technical training activities. In addition, most (89% or 16 of 18) stated that they utilized Fellowships and other training offered through WMO to enhance the technical capacities of their staff. Most (89% or 16 of 18) also provided training to staff on their country's disaster risk reduction processes and related topics and many of them (56% or 10 of 18) invited experts from partner organizations involved in disaster risk reduction as lecturers and/or trainers. Almost two thirds of survey respondents (65% or 11 of 17) conducted evaluations of the suitability of communications, workstations, and software and most of these (53% or 9 of 17) implemented upgrades to these systems to support disaster risk reduction. In addition, over three quarters of contributing NMHSs (78% or 14 of 18) reported that they held or participated in joint training activities for NMHSs staff and emergency response agencies.

Balancing the preceding, most survey contributors (71% or 12 of 17) indicated that lack of forecaster training at the NMHSs reduced the effectiveness of their warning service. A larger number (83% or 15 of 18) reported that (lack of) professional staff with appropriate training limited their ability for real time monitoring of hazards. There was also a widely held view (71% or 12 of 17) that a lack of joint training with emergency authorities and managers limited NMHSs contributions to disaster risk reduction. Moreover, a large majority (89% or 16 of 18) of respondents stated that their ability to provide hazard data products was limited by absence of professional staff with appropriate training. Finally, some NMHSs (70% or 7 of 10) in North and Central America and the Caribbean identified the lack of joint training with the media as a further limit on their contributions to disaster risk reduction. Not surprisingly, all responding NMHSs from the region (100% or 16 of 16) considered that upgrading and improving their operational forecasting and warning activities would enhance their disaster risk capacities. Most of them (88% or 14 of 16) advocated the conduct of cross-border training activities with neighbouring NMHSs, targeted at common hydrometeorological hazards.

7.5.11 Outreach Activities

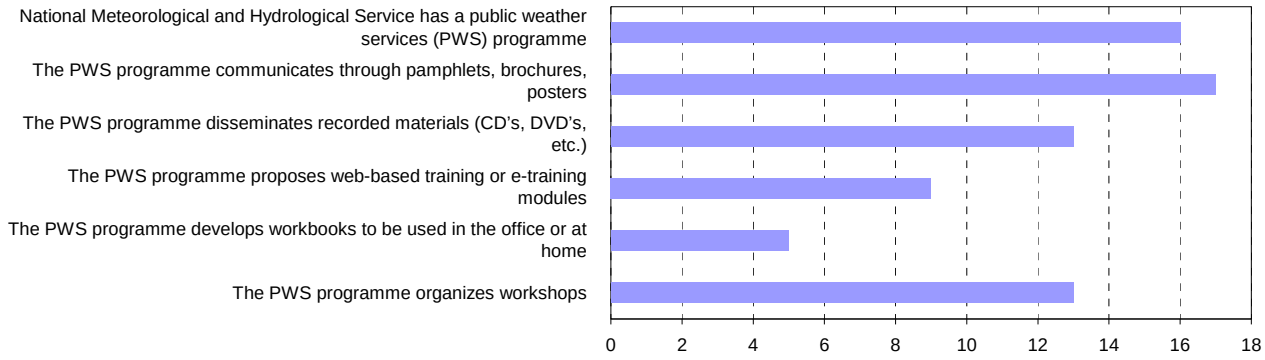


Figure 93. Outreach activities in North and Central America and the Caribbean.

Outreach activities aimed at the general public and other stakeholders are an important component of any effective disaster risk reduction programme. Within NMHSs, outreach activities are often part of a public weather services programme. In North and Central America and the Caribbean (WMO RA IV), most NMHSs (89% or 16 of 18) who contributed to the survey identified that their NMHSs had a public weather services programme. Two thirds (67% or 10 of 15) of respondents stated that their NMHSs quality control programmes included training for the stakeholders to understand the hazards, warnings and their implications. More than three quarters (78% or 14 of 18) provided education and training on hazards, watches, warnings, etc to disaster risk reduction managers and authorities and operational emergency response managers and also pursued joint training activities with emergency response agencies. Half (50% or 9 of 18) the respondents identified that they provided training targeted at the trainers and almost half (44% or 8 of 18) stated that they provided educational modules and training programmes targeted at the general public. A minority (28% or 5 of 18) provided training to the news media. The following materials and methods were identified as being used in NMHSs public outreach programmes in North and Central America and the Caribbean: - pamphlets, brochures, posters (94% or 17 of 18), workshops (72%), recorded materials (72%), Web-based training (50%), workbooks for office or home use (28%) and E-training modules (6%).

Despite the preceding efforts, however, most (83% or 15 of 18) survey contributors considered that the lack of public understanding of the effects of hazards limited the public response to warning services and that the lack of joint training with the media was a further limiting factor. Equally, most (76% or 13 of 17) believed that the lack of joint training with disaster risk managers limited their disaster risk reduction efforts, as did the lack of joint training with emergency authorities and managers (71% or 12 of 17). In consequence, all NMHSs (100% or 18 of 18) in North and Central America and the Caribbean considered that educational modules that they could target at media, public and disaster authorities would enhance their effectiveness in disaster risk reduction.

7.6 NMHS Contingency Planning

Most contributing NMHSs in North and Central America and the Caribbean (76% or 13 of 17) reported that their NMHSs had a contingency plan to maintain the continuity of products and services in the event of organizational emergencies such as power failure or communications disruption. Many of these NMHSs (64% or 9 of 14) indicated that their contingency plans involved an agreement or protocol with neighbouring NMHS to support them in the event of catastrophic failure. Almost all (94% or 17 of 18) also stated that they conducted or participated in drills and exercises to ensure disaster preparedness. However, all respondents (100% or 16 of 16) identified needs for improved coordination with neighbouring NMHSs, specifically citing the need for support from them in the event of disruption of services.

7.7 Overarching Factors

NMHSs participating in the country-level survey were asked to respond to a series of questions directed at obtaining expressions of opinion from them regarding overarching factors or realities that either limited or could enhance their ability to make optimal contributions to disaster risk reduction. To varying degrees, the responses to these questions also served to validate statements, expressions of opinion and/or recommendations contained in responses to earlier sections of the survey. The following summarizes the inputs that fall under the above broad category:

7.7.1.1 NMHS Visibility

Most NMHSs in North and Central America and the Caribbean (83% or 15 of 18) who contributed to the WMO survey considered that they needed higher visibility and recognition within their governments as a major contributing agency to disaster risk reduction. Most (72% or 13 of 18) also felt that their contributions to disaster risk reduction were limited by the lack of understanding by government authorities of the value provided by the NMHSs. All respondents from the region (100% or 18 of 18) considered that improved ministerial level understanding of the socio-economic benefits of hydrometeorological products and services would increase the visibility of the NMHSs at the national level.

7.7.1.2 Organization and Governance

Over half of NMHSs in North and Central America and the Caribbean (61% or 11 of 18) considered that their national organizational structure for disaster risk reduction limited their potential contributions in this area. A similar number (67% or 12 of 18) considered that the effectiveness of their contributions to disaster risk reduction was limited by the lack of clear legislation or policies regarding the role of the NMHS (e.g. as the sole issuer of warnings). In addition, most survey contributors (80% or 8 of 10) from countries with separate NMSs and NHSs considered that there was a need for legislation or partnership agreements to better define the role each agency played in disaster risk reduction.

7.7.1.3 Coordination and Partnership

Almost two thirds (65% or 11 of 17) of NMHSs considered that their contributions to disaster risk reduction were limited by a lack of linkages between the NMHSs and other involved organizations. In addition, most survey contributors (89% or 16 of 18) considered that better coordination with neighbouring or adjacent countries would improve their contributions to their own nation's disaster risk reduction activities while many (69% or 11 of 16) also considered that better coordination with WMO Regional Specialized Meteorological Centres would improve their contributions.

7.7.1.4 Resources and Capacity

All North and Central American and Caribbean survey contributors (100% or 15 of 15) indicated that resources and infrastructure limited the ability of the NMHSs to deliver critical products and services for disaster risk reduction, specifically identifying professional staff (100% or 18 of 18) and financial resources (100% or 17 of 17) as key limiting factors. In consequence, all (100% or 16 of 16) of them considered that upgrading and improving NMHSs operational forecasting and warning services would enhance the disaster risk reduction capacity within their country.

7.8 WMO Support

The following list summarizes the needs for support from WMO identified by the NMHSs in North and Central America and the Caribbean who contributed to the WMO Disaster Risk Reduction Country-level Survey. The order in which they are presented reflects the relative priority assigned to them by survey respondents.

1. Provision of technical advice and specifications (e.g. to enhance observing networks, operational infrastructures, relevant products and services for disaster risk reduction applications).

2. Technology transfer, capacity building, technical guidelines and technical trainings (e.g. forecasting tools and methodologies, hazard mapping, and other inputs to risk assessment tools, etc.).
3. Education, training and public outreach programmes in disaster risk reduction (e.g. targeted at National Meteorological and Hydrological Service and their stakeholders).
4. Resource mobilization.
5. Advocacy for enhanced visibility of National Meteorological and Hydrological Service' in the area of disaster risk reduction.
6. Strengthening strategic partnerships with stakeholders (e.g. disaster risk managers, media, etc.).
7. Strengthening strategic partnerships with other technical organizations and agencies (e.g. meteorology, hydrology, ocean services, etc.).
8. Cost-benefit analysis of hydro-meteorological services in disaster risk reduction.
9. Assist members in the development of the national disaster risk reduction plans.
10. Establishment of regional emergency protocols for the National Meteorological and Hydrological Services in support of each other in case of disruption of services due to the impact of a disaster.

7.9 Sub-Regional Considerations

Significant differences in climates and hazard regimes exist between the component sub-regions of North and Central America and the Caribbean. The following sections summarize the survey responses from the three major sub-regions– Central America, the Caribbean and North America. Annex 2 lists the countries grouped under each of these sub-regions.

7.9.1 Central America

The following paragraphs briefly assess the responses from NMHSs in Central America against the backdrop of the preceding analysis of all survey responses from North and Central America and the Caribbean. The responding NMHSs in the Central American grouping were: Belize, Costa Rica, El Salvador, Guatemala, Nicaragua, Honduras and Panama. Figure 94 below shows the number of responding members of Central American countries who stated that they were affected by the specified hazards.

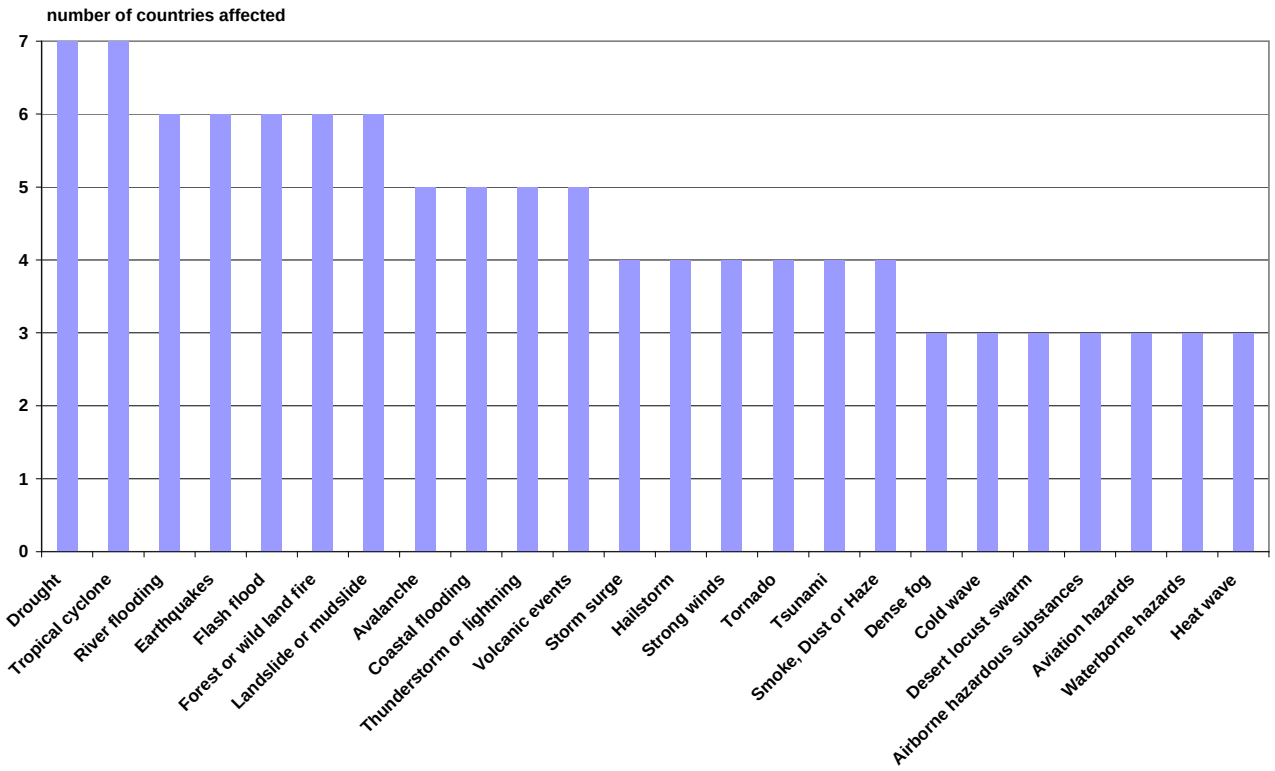


Figure 94. Number of responding countries in Central America who identified themselves as being affected by specified hazards.

As Figure 94 illustrates, the hazards that affect most Central American countries are tropical cyclones, droughts, flash floods, river floods, landslides or mudslides, forest and wild land fires, earthquakes, volcanic events and coastal flooding. Other hazards, though serious in some countries, are less widely experienced.

The Central American situation with respect to hazard databases, access to impacts information and provision of value added services based on data archives was broadly similar to that for North and Central America and the Caribbean as a whole. However, a higher percentage of Central American NMHSs reported that they maintained hazard databases and used these data sets to provide value-added services for disaster risk reduction. Legislative, governance and disaster risk coordination structures in Central America also broadly paralleled those for the region as a whole. However, proportionately fewer Central American respondents identified the lack of linkages with national disaster risk reduction partners as limiting their contributions. In addition, they reported a noticeably higher degree of collaboration with partners in addressing that priority. However, all countries in the sub-region identified that they had combined National Meteorological and Hydrological Services, though there was some ambiguity in the survey responses relating to this aspect. The picture with respect to observational networks, telecommunications and informatics closely paralleled that for the whole region. In the data management/data exchange area, a significantly higher proportion of Central American respondents, however, indicated that they were limited by their quality assurance, archiving and updating and data customization capacities and by professional staff with appropriate training. Equally, a noticeably lower proportion of NMHSs in Central America maintained a 24-hourly/year-round hazard warning service than was the case for the region as a whole. On the other hand, all Central American respondents reported that they had a coordination mechanism with the media and all assigned staff to their national disaster management structures in emergency situations. Efforts devoted to improving the quality and utility of products in support of disaster risk reduction broadly reflected those elsewhere in the region. However, only about half of Central American NMHSs indicated that they provided ongoing technical training on forecasting of hazards to their staff, a significantly lower percentage than the

regional figure. In relation to public outreach, fewer Central American survey contributors, though still a majority, cited inadequate public and stakeholder understanding of hazards, watches, warnings and other products as limiting the response to them. Similarly, fewer Central American NMHSs identified that the lack of joint training with emergency authorities was a limiting factor. All but one NMHS in Central America had a contingency plan in place to maintain operations in emergency situations and, in two instances, these plans involved partnership agreements with neighbouring NMHSs. Finally, Central American NMHSs universally expressed concern regarding the impact of lack of understanding by government authorities of the value of their contributions to disaster risk reduction.

7.9.2 The Caribbean

The following paragraphs briefly assess the responses from NMHSs in the Caribbean against the backdrop of the preceding analysis of all survey responses from North and Central America and the Caribbean. The responding NMHSs in the Caribbean grouping were: Bahamas, Barbados, Dominican Republic, Haiti, Jamaica, Netherlands Antilles and Aruba, Saint Lucia and Trinidad and Tobago. Figure 95 below illustrates the number of responding members of Caribbean countries who stated that they were affected by specified hazards

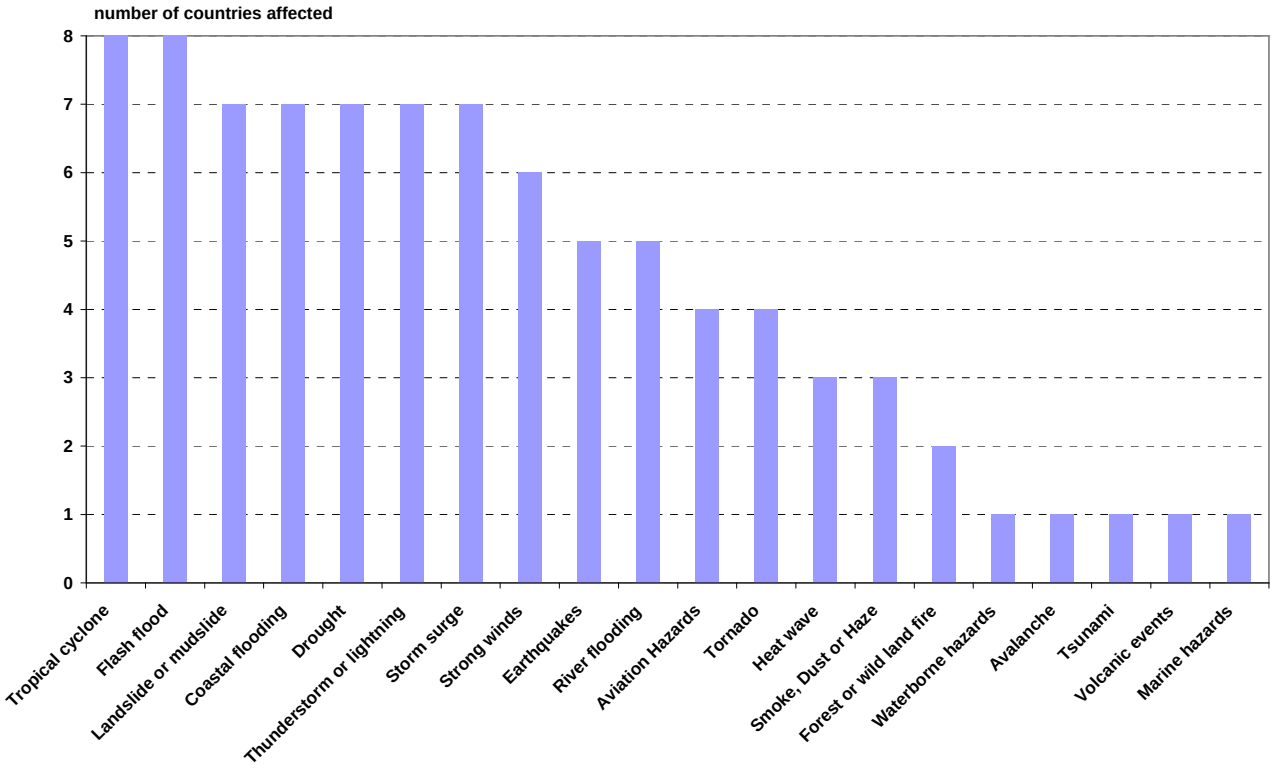


Figure 95. Number of responding countries in the Caribbean who identified themselves as being affected by specified hazards.

As Figure 95 illustrates, the hazards that affect most Caribbean countries are tropical cyclones, flash floods, thunderstorms or lightning, storm surges, coastal flooding, droughts, landslides or mudslides, strong winds, river flooding and earthquakes. Other hazards, though serious in some countries, are less widely experienced.

The following overview draws attention to those areas where the sub-regional picture for the Caribbean differs significantly from that for North and Central America and the Caribbean (WMO RA IV) as a whole. The Caribbean situation with respect to hazard data, access to impacts information and provision of value added services based on data archives was broadly similar to

the regional picture. However, a lower percentage of Caribbean NMHSs reported that they maintained hazard databases. Legislative, governance and disaster risk coordination structures in the Caribbean also broadly paralleled those for the region as a whole. Only three Caribbean contributors to the survey, however, identified that they had combined National Meteorological and Hydrological Services. Furthermore, survey responses indicated that operational coordination between the NMSs and NHSs in the Caribbean sub-region was somewhat less developed than in North and Central America and the Caribbean as a whole. The picture with respect to observational networks, telecommunications and informatics was, again, similar to that for the region as a whole. However, one NMHS in the Caribbean indicated that it did not have observational and telecommunications networks that were operational on a 24-hourly/year-round basis. In the data management/data exchange area, a somewhat uneven picture prevailed with Caribbean respondents being, relatively speaking, less constrained by their quality assurance, archiving and updating and data customization capacities but more limited by telecommunications. Caribbean responses to the survey indicated that forecast and hazard warning services roughly matched those for North and Central America and the Caribbean as a whole. However, all Caribbean NMHSs cited application software and computers as limiting their capacities to contribute in this area. All Caribbean respondents had a coordination mechanism with the media but, relatively speaking, fewer assigned staff to their national disaster management structures in emergency situations. Efforts devoted to improving the quality and utility of products in support of disaster risk reduction matched those elsewhere in the region in most aspects. However, a significantly lower proportion of Caribbean NMHSs indicated that they collaborated with other agencies to develop risk or impacts information for inclusion in hazard warnings. Where staff training was concerned, the Caribbean picture also matched the regional one with the exception of the following areas. A significantly lower percentage of Caribbean NMHSs, about half, provided training to staff on their national disaster risk reduction systems and processes and invited experts from partner agencies as trainers. Moreover, fewer Caribbean NMHSs cited the lack of forecaster training as limiting their contributions to disaster risk reduction. Relatively fewer NMHSs (five) in the Caribbean had a contingency plan in place to maintain operations in emergency situations but in all of these cases the plans involved partnership agreements with neighbouring NMHSs. Caribbean contributors to the WMO survey, universally, felt less constrained by the lack of understanding by government authorities of the value of their contributions to disaster risk reduction and fewer of them felt restricted by their national organizational structure for disaster risk reduction. Equally, they expressed relatively less requirement for improved coordination with neighbouring NMHSs and only a minority of them cited requirements for enhanced coordination with RSMCs. Finally, Caribbean NMHSs like others in the region considered, without exception, that their ability to deliver critical products and services for disaster risk reduction was limited by resources and by professional staff.

7.9.3 North America

The following paragraphs briefly assess the responses from NMHSs in North America against the backdrop of the preceding analysis of all survey responses from North and Central America and the Caribbean. The responding NMHS in the North America grouping were: Canada, Mexico and the United States. Figure 96 below illustrates the number of responding WMO Members in North American countries who stated that they were affected by specified hazards.

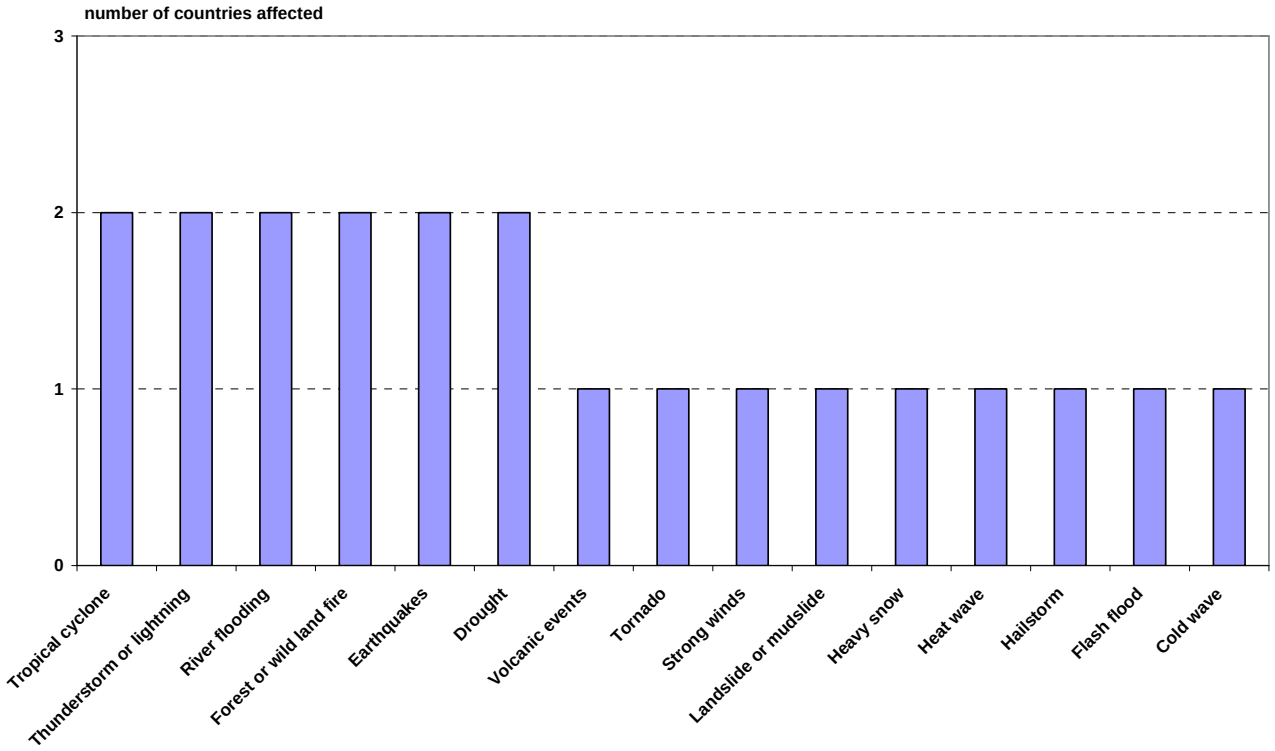


Figure 96. Number of responding countries in North America who identified themselves as being affected by specified hazards.

The following overview draws attention to those areas where the survey responses from the North American countries differed significantly from the overall picture for North and Central America and the Caribbean (WMO RA IV).

All three North American NMHS had access to hazard and impacts information and their provision of value added services was broadly similar to the overall regional pattern. Legislative, governance and disaster risk coordination structures in North America also broadly paralleled those for the region as a whole, with all countries participating in national coordinating committees. All NMHSs contributed to their countries' disaster risk reduction efforts and survey responses suggested that their collaboration with emergency management and external partners was better developed than in the region as a whole. However, all three NMHSs in North America cited inadequate linkages with other disaster risk reduction organizations as limiting their contributions to that priority area. Two of the three contributors to the survey identified that they had combined National Meteorological and Hydrological Services while the third endorsed the need for improved coordination between the meteorological and hydrological communities in relation to warnings and overall products for disaster risk reduction. The picture presented by survey responses with respect to observational networks, telecommunications and informatics reflected well-developed infrastructures in North American countries. In the data management/data exchange area, responses indicated that the three North American NMHSs were less limited by their infrastructures and human capacities. Forecast and hazard warning services were in place on a 24-hourly/round-the-clock basis, coordination with the media was solidly established, and all three NMHSs deployed staff to their national disaster management structures in emergency situations. The survey responses also identified that "best practices" approaches were in place in all three countries in relation to enhancing the quality and utility of products in support of disaster risk reduction. These involved consultation, coordination and input from stakeholders. All North American NMHSs provided training to staff on forecasting of hazards and on their national disaster risk reduction systems and processes and invited experts from partner agencies as trainers. While only one contributor identified the forecast training area as an issue, all three NMHSs endorsed the

desirability of upgrading their operational forecasting capabilities. All of them also considered that the lack of joint training with disaster risk reduction authorities limited their contributions to that priority area. While outreach programmes were well developed in all three countries, two survey contributors considered that lack of public understanding of hazards, watches and warnings limited the response to them and all three endorsed the value of educational modules and training programmes targeted at the public. All three Services had contingency plans in place to maintain services in emergencies and two of these involved arrangements with neighbouring NMHSs. In overarching areas, the sub-regional picture in North America paralleled that across the region. However, survey responses reflected somewhat stronger identification of needs for higher NMHS visibility and for improved understanding by government authorities of the contributions of NMHSs to disaster risk reduction. All respondents also identified that they were limited in their ability to deliver critical disaster risk reduction products by resources and professional staff. Their responses indicated that improving operational forecasting and warning services would enhance their countries' disaster risk reduction capacities, with professional staff capacities being a primary target. Moreover, the survey responses reflected unanimous agreement on the need for improved coordination with neighbouring NMHS and for better linkages with key partners.

7.10 Concluding Assessments and Recommendations for North and Central America and the Caribbean

The following summarizes assessments and conclusions related to the analysis of the survey responses from North and Central American and Caribbean NMHSs that has been presented in this chapter. In order to facilitate identification of subject areas, the titles associated with individual assessments and conclusions presented below match those used during the analyses of North and Central American and Caribbean survey responses presented in the preceding pages.

7.10.1 Access to Data on Hazards and their Impacts

As Annex 3 illustrates, while many NMHSs in North and Central America and the Caribbean maintain data archives relating to a variety of hydrometeorological hazards, roughly a third of them do not maintain records of even the most common hazards such as strong winds. As the agencies responsible for monitoring and prediction of hydrometeorological hazards within their countries, NMHSs (or NMSs and NHSs) may, reasonably, be expected to maintain such records that are important for various applications ranging from verification of warnings and forecasts to hazard mapping and analysis. Equally, while it is not essential that NMHSs maintain an internal database of official information on the impacts of disasters, it is important that they have ready access to such information to underpin planning and facilitate monitoring the effectiveness of NMHS services in support of disaster risk reduction. The responses indicate that this is not the case in a few countries in North and Central America and the Caribbean.

7.10.2 Value Added Services based on Historical Hazard Data

Overwhelmingly, the survey respondents recommended that increased provision of value added or specialized services based on hazard data archives would strengthen their contributions to disaster risk reduction and identified needs for capacity enhancement to provide them with the capability to do so. The respondents' recommendation regarding enhanced value-added data services is clearly supported by survey responses. These responses indicate that NMHSs in North and Central America and the Caribbean would benefit significantly from capacity development and training related to disaster risk applications, including hazard and impact analysis, hazard mapping and risk zone analysis. It is also clear that quality controlled, regularly updated, hazard data archives remain to be established in about one third of the NMHSs. If that requirement is to be pursued, these countries will have additional requirements for capacity development and training in areas such as data rescue, quality assurance, archival techniques and customization of data.

7.10.3 Legislation and Governance

The responses suggest that NMHSs should press for clear policy direction from their governments regarding their roles and responsibilities in those countries where a lack of clarity undercuts their potential contributions to disaster risk reduction.

7.10.4 National Structures/Mechanisms for Disaster Risk Reduction

The degree to which NMHSs are integrated into national disaster risk reduction coordinating structures and their operational relationships with civil protection agencies, planning authorities and important non-governmental partners exercise a significant influence on their ability to contribute effectively to disaster risk reduction. For optimum effectiveness, state of the art NMHS scientific, technical and operational capacities must be mainstreamed into national planning, decision-making and disaster response structures and systems and, in addition, be well connected to important non-governmental partners. Responses to the survey indicate that most NMHSs in North and Central America and the Caribbean are part of their national disaster risk reduction system but also suggest that, in many instances, there is significant room for improvement in operating processes and in working relationships with other involved agencies. Consequently, efforts should be made to promote the contributions that NMHSs can make to disaster risk reduction and to encourage disaster authorities to build on NMHS capacities. The respondents' recommendation is consistent with this assessment and should be pursued at the national level.

7.10.5 NMHSs Contributions to National Disaster Risk Reduction Systems

The survey responses indicate that NMHSs in North and Central America and Caribbean should devote continuing attention to building effective working relationships with national disaster authorities by providing timely, accurate and relevant products and services for disaster risk reduction. The responses also suggest that, in many countries, efforts are needed to expand and reinforce partnerships with other agencies and organizations involved in disaster related activities. Experience elsewhere indicates that the respondents' recommendation for the establishment of a "readiness system" could, if implemented, enhance NMHSs contributions to disaster risk reduction and increase their visibility as contributing organizations. This should be pursued at the national level.

7.10.6 NMHS Collaboration with other Partners

Survey responses indicate that not all NMHS aggressively pursue coordination and collaboration with significant national, regional and international partners in the disaster community. Expanded collaboration and partnership can benefit NMHS through broader utilization of their products and services, enhanced visibility, and more effective contributions to disaster risk reduction.

7.10.7 The Organization and Priorities of NMHSs

The survey responses suggest that legislation, policy direction or partnership agreements are needed in some countries in North and Central America and the Caribbean to clarify the roles and responsibilities of their NMSs and NHSs in relation to disaster risk reduction and, in particular, in relation to the issue of early warnings for hydrometeorological hazards. Where this is the case, clarification will need to be sought at the national level.

7.10.8 Operational Coordination between NMS and NHS

The survey responses summarized earlier clearly indicate that needs exist for enhanced operational coordination between NMSs and NHSs in a number of countries in North and Central America and the Caribbean. The survey respondents' recommendation should, therefore, be pursued at the country level through immediate action to achieve more effective operational coordination between the meteorological and hydrological communities, particularly with respect to hazard warnings and other critical products.

7.10.9 Observation and Monitoring Networks and Systems

Responses indicate that several countries in the region do not have a dedicated 24-hourly/year-round observational programme. More generally, challenges have been identified in relation to availability of resources and trained staff to maintain observational networks and programmes. These are compounded in many countries by hazard related damage to observation stations. Reliable, round the clock, observations, available in real time, are the essential raw material needed for the production of early warnings of hydrometeorological hazards, forecasts and other products to support disaster risk reduction. Consequently, every effort must be made to ensure that adequate observational networks and systems are put in place and maintained in operation on a 24-hourly/year-round basis.

7.10.10 Telecommunications and Informatics

Responses indicate that 24-hourly/year-round telecommunications systems are in place in all but one or two countries. However, deficiencies have been widely identified in relation to networks, computer hardware and software in most countries in North and Central America and the Caribbean and Internet access poses a problem in a significant number of them. The survey responses validate the respondents' recommendation that upgrading of these systems is required in many NMHSs.

7.10.11 Data Exchange

The respondents' almost unanimous recommendations for enhanced coordination to improve data exchange are well founded. In addition, however, the survey responses suggest that improved data exchange will require enhancements to telecommunications, quality assurance and archiving systems and to data customization capabilities in many of the NMHSs in the region.

7.10.12 Forecast and Warning Capability

The respondents' unanimous recommendations for upgrading of forecasting infrastructure and personnel are validated by the responses summarized earlier in this section. Clearly, there are quite general needs for upgrading of professional staff, computing capacity and supporting applications software and for access to latest forecasting techniques and tools. However, it also appears that several NMHS in the region do not operate warning and forecast services on a round-the-clock basis and meteorologists are not always on site. This represents a significant deficiency in the context of disaster risk reduction since natural disasters can occur at any time of the day or night.

7.10.13 Forecast and Warning Products

The respondents' recommendation regarding the need to improve their warning products and services is well founded.

7.10.14 Coordination of Warnings

The respondents' recommendation for improved coordination with RSMCs and neighbouring NMHS in relation to watches and warnings makes good sense. Such coordination reduces the risk of ambiguous or, in the worst case, conflicting warning messages from different sources reaching the same audience. A compounding issue here is the increased potential for confusion that arises when commercial or other entities also issue hazard warnings, as is the case in some North and Central American and Caribbean countries. As a general principle, therefore, it is desirable to work towards a situation where official warnings for hydrometeorological hazards emanate from a single recognized issuing authority within each country**.** Ideally being prepared by NMHSs with the scientific and technical capacity to make such predictions, hydrometeorological warnings may, in some circumstances, benefit from assessment and interpretation by civil defence authorities as to their likely impacts before being relayed to local communities, perhaps accompanied by advice on actions that people should take to minimize loss of life and property.

7.10.15 Products and Services for Selected Socio-Economic Sectors

Experience around the globe demonstrates that the socio-economic sectors discussed earlier can benefit significantly from the incorporation of hydrometeorological information and products into their planning and decision-making processes. Sensible land-use planning to minimize risk of flooding and other hazards, rational planning and engineering design of housing and other developments to withstand expected wind loads or heavy rains and other similar measures contribute to hardening societies and communities against disastrous hydrometeorological events. Equally, early warnings of hazards enable people to take avoidance or mitigating actions to prevent disasters. The survey responses indicate that the target sectors do not receive special hydrometeorological services in roughly half of North and Central American and Caribbean countries. Consequently, considerable room exists to contribute substantively to disaster risk reduction by enhancing the provision of relevant products and services planning, development, water resources and other key socio-economic sectors.

7.10.16 Dissemination Systems and Target Audiences

Reliable and timely dissemination of early warnings of hazards to stakeholders and the public at large is among the most useful services that NMHSs can provide in support of disaster risk reduction. Consequently, every effort should be made to ensure that warnings and other relevant products reach important target audiences. In the context of disaster risk reduction, national Red Cross Societies and similar non-government bodies should be targeted for receipt of hazard warnings on virtually the same level as government disaster authorities. It is encouraging to note that this approach has clearly been taken in North and Central America and the Caribbean, at least where the Red Cross is concerned. Efforts to enable such important external partners to access and utilize early warnings of hazards and other relevant NMHS products should be encouraged.

7.10.17 Product Utility and Product Improvement

The survey responses indicate that the vast majority of NMHSs in the region have adopted and are using best practices in relation to assessing and attempting to improve the utility of their products. They also suggest that much remains to be done to bring public and other stakeholders' knowledge and understanding of hazards and warnings and other NMHS products up to an acceptable level. The respondent's unanimous recommendation regarding the value of educational modules makes good sense in view of the general perception of the inadequacies in public and stakeholder awareness and understanding in North and Central American and Caribbean countries.

7.10.18 Internal NMHS Training and Capacity Enhancement

The respondents' recommendations for upgrading of operational forecasting and warning capabilities and for cross-border operational training of forecasters are strongly validated by the survey responses which indicate that some NMHS do not provide ongoing training to forecaster staff while most others advocate increased emphasis on this aspect. More broadly, however, the responses also indicate that most NMHSs would benefit from much closer collaboration with disaster risk authorities and emergency managers in relation to both internal training programmes for NMHS staff and joint training programmes with disaster agencies.

7.10.19 Outreach Activities

The respondents' recommendation that educational modules would be helpful is valid and strongly supported by the survey results. Based on the survey responses, the major weaknesses in outreach activities in North and Central America and the Caribbean relate to the need to increase emphasis on enhancing public awareness and understanding and on joint training activities for NMHS staff and those from disaster risk/emergency response agencies. The respondents' recommendation regarding the value of educational modules, therefore, makes good sense though it is somewhat narrowly focussed on a single outreach tool or mechanism. From an overall perspective, the responses indicate that a significantly higher priority should be assigned to

outreach activities by most NMHSs. As a useful first step, those NMHSs that do not have a public weather service programme should give serious consideration to establishing such a programme.

7.10.20 NMHS Contingency Planning

Establishment of back-up capability to maintain critical hazard warning services in the event of emergencies is a prudent step for all NMHSs. In many instances, a partnership agreement with neighbouring NMHSs can be an effective and low cost approach to ensuring back-up capability.

7.10.21 WMO Needs

North and Central American and Caribbean NMHSs who responded to the survey identified their highest priority needs for support from WMO as being in relation to infrastructure development, capacity building and technology transfer, followed by education, training and public outreach related to disaster risk reduction. Resource mobilization also stood high in their priorities and, as elsewhere, brings its own special challenges. Visibility enhancement, partnership development and other areas such as cost-benefit analysis, national disaster risk reduction plans and emergency protocols stood notably lower down the list. The inclusion of needs for assistance with education, training and public outreach specifically related to disaster risk reduction further reinforces the similar requirements identified by other regions. Consequently, it validates the challenge to WMO to review and, where necessary, modify the orientation of its training and development programmes to accommodate the new needs arising out of the disaster risk reduction priority.

7.11 Region-wide Capacities and Resources in North and Central America and the Caribbean

National Meteorological and Hydrological Services in North and Central America and the Caribbean have access to data, operational products, training and other support from an extensive regional network of centres of excellence and data sources to bolster their individual capacities to support disaster risk reduction. The WMO World Meteorological Centre in Washington and the Regional Specialized Meteorological Centres (RSMCs) at Washington, Miami and Montreal supply a range of forecast guidance and products along with supporting services and expertise. The RSMCs in Washington and Montreal provide atmospheric transport model products for use in environmental emergencies such as toxic releases to the atmosphere or nuclear accidents. The RSMC located at the US National Hurricane Center in Miami represents a particularly valuable resource for many countries in view of the threat posed by hurricanes and tropical storms, providing predictions of storm tracks, intensities and storm surges, reinforced by advice on avoidance or mitigation measures. The national capacities of the major NMHSs in the United States, Canada and Mexico represent readily accessible sources of expertise and assistance through provision of model outputs, forecast products and support in developing NMHS infrastructures and capacities. Regional Meteorological Training Centres at the Caribbean Institute of Meteorology and Hydrology, the University of the West Indies in Barbados and the University of Costa Rica provide training programmes for professional and technical staff. These are reinforced by the many university programmes in meteorology and hydrology in the United States, Canada and Mexico and by the internal training facilities of NMHSs in the larger countries in the region. In addition to the extensive hydrological resources of the major countries, centres of hydrological expertise exist in the UNESCO-sponsored Water Centre for the Humid Tropics of Latin America and the Caribbean (CATHALAC) in Panama and Water Centre for Arid and Semi-arid Zones of Latin America and the Caribbean (CAZALAC) in Chile. A CARIB-HYCOS project, centered in Martinique with support from the Caribbean Institute of Meteorology and Hydrology in Barbados, is being developed under the umbrella of the World Hydrological Cycle Observing System (WHYCOS) and represents a further potential source of relevant information and advice.

CHAPTER 8

SOUTH-WEST PACIFIC

WMO REGIONAL ASSOCIATION V

8 THE SOUTH-WEST PACIFIC (WMO Regional Association V)

8.1 Abstract

Survey responses from 14 NMHSs in the South-West Pacific who contributed to the WMO country-level survey indicate that most NMHSs have observational networks but feel that these are inadequate. Three of them do not operate on a 24-hourly basis. Moreover, while all NMHSs have 24-hourly telecommunications systems these also have many deficiencies including one or two countries without 24-hourly operation. Though all but one operate forecasting and hazard warning programmes, mostly on a 24-hourly basis with emergency backup systems in place, they identify widespread needs for improvements in infrastructure and capacity. Furthermore, in many countries, hazard warning services do not encompass all significant hazards. Roughly a third of the NMHSs do not maintain hazard archives or have access to information on their impacts. All of them, however, endorse the provision of enhanced data services but identify associated needs for training and capacity building. About half point to inadequate linkages with disaster partners and advocate better coordination with neighbouring NMHSs, Regional Specialized Meteorological Centers (RSMCs) and other key stakeholders. A majority does not have combined NMHSs and also draws attention to needs for closer collaboration between their National Meteorological Services (NMSs) and National Hydrological Services (NHSs). Only about a third of NMHSs in the region provide special services to key economic sectors such as land-use planning, development and water. Though most provide some training on forecast techniques and other topics to their staff, only half of them pursue joint training activities with disaster stakeholders. Moreover, most advocate increased emphasis on outreach activities. Finally, all South-West Pacific NMHSs identify inadequate resources and infrastructure as constraints, laying particular stress on budgets and professional staff. In a large majority of cases, the NMHSs participate in national disaster risk coordination committees but many of them feel restricted by these structures and by a lack of clarity regarding their roles. Furthermore, roughly half of them cite needs to expand and reinforce partnerships with other disaster stakeholders. Taken as a group, the NMHSs in the seven Pacific Small Island Developing States (SIDS), identify weaker infrastructures and capacities than the regional norm, are less well integrated into their national disaster risk coordination mechanisms, and are more poorly resourced. Conversely, the seven non-SIDS NMHSs possess somewhat better than average infrastructures and scientific and technical capacities but share the overall regional view that inadequate resources and infrastructure represent serious constraint. The preceding survey results underpin the following conclusions and recommendations directed at enhancing the capacities of South West Pacific NMHSs to contribute to disaster risk reduction:

- All South-West Pacific NMHSs should be integrated into their national disaster risk reduction systems. Those who are not already members should seek membership in their national disaster risk coordinating committees and all should, where necessary, press for clear direction regarding their roles and responsibilities.
- All South-West Pacific NMHSs should pursue strengthened partnerships with other organizations involved in disaster risk management, including key external partners such as Red Cross/Crescent.
- Some South-West Pacific NMHSs need to establish hazard data archives and most of them need to improve their archiving and access systems for hazard and impact data. There are associated needs for capacity building in data rescue, quality assurance and data management and archiving.
- Most South-West Pacific NMHSs need capacity development in disaster risk applications such as hazard and impact analysis, hazard mapping, risk zone analysis and product customization.
- Every effort should be made to establish and maintain adequate hydrometeorological observation and telecommunications infrastructures across the region. Priority should be given to ensuring their 24-hourly operation and to enhancing weak capacities in SIDS.
- NMHSs' hazard warning infrastructures and capacities should be strengthened across the South-West Pacific. Warning capacities should be established in those NMHS without such capacities and

warnings should be provided on a 24-hourly basis in all countries. Warning programmes should address all significant hazards with warnings routed to all important stakeholders. There are associated requirements for improved training of forecasters, access to latest forecasting techniques, and strengthened computing and applications capacities.

- Official warnings of hydrometeorological hazards should emanate from a single competent issuing authority in each country, ideally the NMHS. In some circumstances, warnings may benefit from assessment and interpretation by civil defence authorities before being widely disseminated.
- All South-West Pacific NMHSs should implement verification programmes for hydrometeorological hazard warnings to monitor warning accuracy and timeliness, assess improvements in skill, and demonstrate their warning capabilities to stakeholders.
- Those South-West Pacific NMHSs who have not already done so should establish back-up arrangements to maintain hazard warning services in emergency situations, perhaps through partnership agreements with neighbouring NMHS.
- South-West Pacific NMHSs NMHSs should encourage the establishment of national readiness systems within their countries.
- Operational coordination should be improved between NMSs and NHSs and with neighbouring NMHSs and RSMCs. In some cases, this may require policy direction or partnership agreements between NMSs and NHSs to clarify respective responsibilities, particularly in relation to warnings.
- South-West Pacific NMHSs should target products and services to sensitive economic sectors such as land-use planning and development.
- Most South-West Pacific NMHSs should give much higher priority to education and outreach activities directed at key stakeholders and the public at large.
- Many South-West Pacific NMHSs need particular support from WMO in infrastructure development, technology transfer and capacity building and in relation to strategic partnerships, education and training and public outreach.

The present chapter centres on the assessment of the survey responses from NMHSs in the South-West Pacific (WMO RA V). Its internal structure follows the sequence outlined earlier in section 2.6.1.

8.2 The Response to the Survey

The 14 countries in the South-West Pacific who contributed responses to the WMO country-level survey are listed in Annex 2.

8.3 The Hazards affecting Countries in the South-West Pacific

Figure 97 below lists the number of contributing countries in the South-West Pacific (WMO RA V) who identified themselves as being affected by the specified hazards.

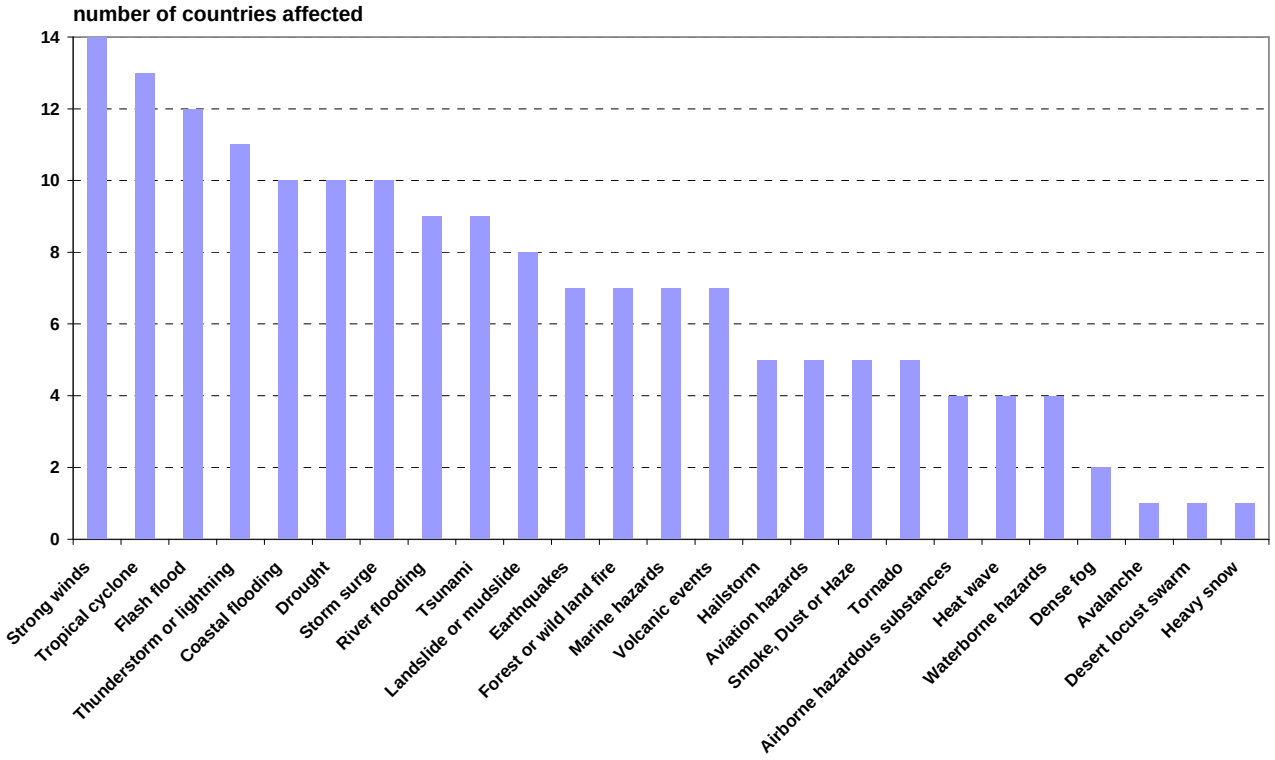


Figure 97. Number of responding countries in the South-West Pacific who identified themselves as being affected by specified hazards.

8.3.1 Access to Data on Hazards and their Impacts

Annex 3 presents an overview of the hazard databases maintained by survey contributors in the South-West Pacific (RA V) and includes some supplementary information on related metadata and impacts information. Almost two thirds of responding NMHSs in the region (64% or 9 of 14) stated that another agency was responsible for providing official information on the impacts of disasters in their country and that they had access to such official, reliable, information. However, almost half (43% or 6 of 14) also reported that they maintained their own internal database of official information on the impacts of hazards that affected their countries and, moreover, regularly updated this database[21].

[21] It is important to note, that, to date, no systematized, universally accepted, methodology or protocol has been established on a global basis for the creation and maintenance of hazard and hazard impacts databases.

8.3.2 Value Added Services based on Historical Hazard Data

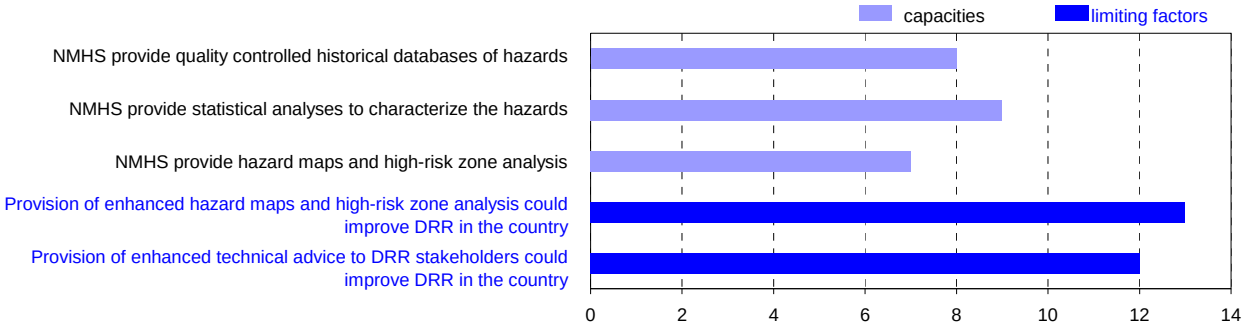


Figure 98. Provision of hazard information by NMHSs in the South-West Pacific.

The following draws attention to the extent of value added services provided by NMHSs in the South-West Pacific who maintain historical archives of hydrometeorological hazards. Just over two thirds of NMHSs who contributed to the country-level survey (71% or 10 of 14) stated that that they provided technical advice on hazards and almost as many (64% or 9 of 14) provided statistical analyses to characterize them. Over half the respondents (57% or 8 of 14) reported that they maintained quality controlled historical databases of hazards and most of these (50% or 7 of 14) indicated that they undertook hazard mapping and high-risk zone analysis with slightly fewer (43% or 6 of 14) providing analyses of the potential impacts of hazards.

Over half of the contributing NMHSs identified factors that limited their ability to provide hazard data products. Identified as constraints were professional staff with appropriate training (62% or 8 of 13), customization of data for stakeholders (62% or 8 of 13), data rescue (54% or 7 of 13), quality assurance (46% or 6 of 13) and the ability to archive and update (38% or 5 of 13). All survey respondents (100% or 13 of 13) considered that the provision of enhanced value added services in support of hydrometeorological risk assessment would strengthen their contributions to disaster risk reduction activities. The following specialized services were identified as valuable enhancements - analyses of the potential impacts of hazards and hazard mapping and high-risk zone analysis (100% or 13 of 13), and provision of technical advice (92% or 12 of 13).

8.4 The National Context for Disaster Risk Reduction

National legislative, governance and organizational structures for disaster risk reduction establish the context within which NMHSs make their contributions to safety of life and property. The following sections summarize survey responses regarding South-West Pacific countries' national systems for disaster risk reduction and the impact of these systems on the NMHS.

8.4.1 Legislation and Governance

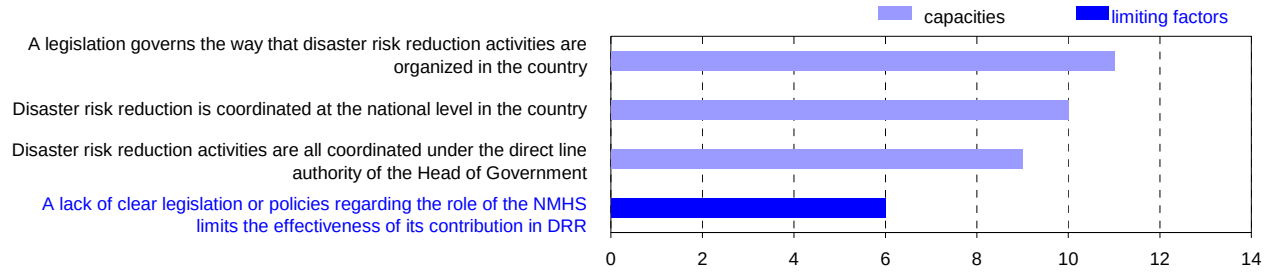


Figure 99. Legislation and coordination in support of disaster risk reduction at the national level in the South-West Pacific.

Over three quarters of South-West Pacific (RA V) NMHSs who contributed to the survey (77% or 10 of 13) reported that disaster reduction activities were coordinated at the national level, in most instances (64% or 9 of 14) under the direct line authority of the head of government. The organization of these activities was governed by legislation in most countries (79% or 11 of 14). In slightly over half (57% or 8 of 14), coordination was centred under one ministry. At the same time, a sizeable minority of respondents (43% or 6 of 14) considered that a lack of clear legislation or policies regarding the role of their NMHS (e.g. as the sole issuer of hydrometeorological hazard warnings) limited their contributions to disaster risk reduction.

8.4.2 National Structures/Mechanisms for Disaster Risk Reduction

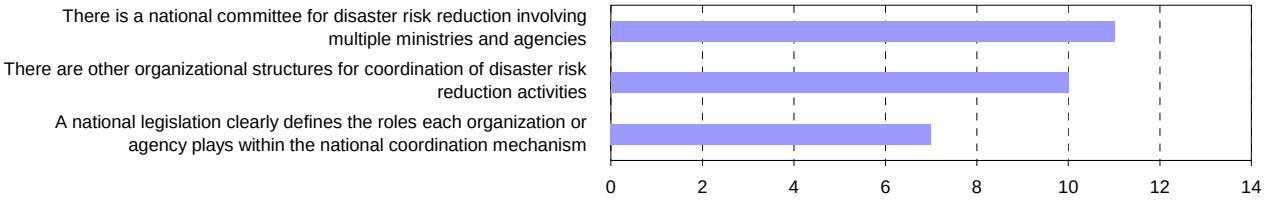


Figure 100. National structures for coordination of disaster risk reduction in the South-West Pacific.

Most South-West Pacific survey contributors (79% or 11 of 14) indicated that their countries had a national committee for disaster risk reduction that involved multiple ministries and agencies and three quarters of them (75% or 9 of 12) stated that they were members of their national coordinating committee. Half the respondents (50% or 7 of 14) reported that the roles of each participating agency in the national coordination mechanism were defined by legislation. Over two thirds (71% or 10 of 14) also pointed out that other organizational structures for coordination also existed in their countries. Almost one half of the responding NMHSs (46% or 6 of 13) felt that their contributions to disaster risk reduction were limited by their national disaster management structure and a similar number (50% or 7 of 14) by a lack of linkages with other involved organizations.

8.4.3 NMHSs Contributions to National Disaster Risk Reduction Systems

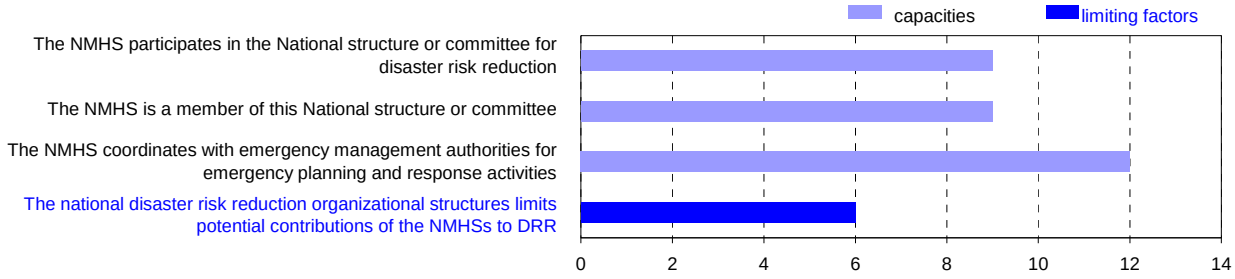


Figure 101. NMHS participation in national structures for disaster risk reduction in the South-West Pacific.

All South-West Pacific NMHSs (100% or 14 of 14) who contributed to the WMO survey indicated that they provided support to agencies responsible for disaster risk reduction at the national level including support to emergency response operations and emergency planning and preparedness. Most (86%) supported disaster prevention (e.g. hazard mapping, advice, historical hazard data) and a smaller number (64%) supported post-disaster reconstruction (e.g. hazard data as input to reconstruction decisions). In addition, most respondents to the survey (92%) extended their support to provincial or state government disaster-related activities and municipal or local levels. However, half (50% or 7 of 14) the responding NMHSs pointed to inadequate linkages with other involved organizations (e.g. emergency planners, emergency response agencies) as limiting their contributions to disaster risk reduction. Finally, most respondents (85% or 11 of 13) considered that their contributions would be enhanced by a “readiness system” that required appropriate responses by authorities to information issued by the NMHS.

8.4.4 NMHS Collaboration with other Partners

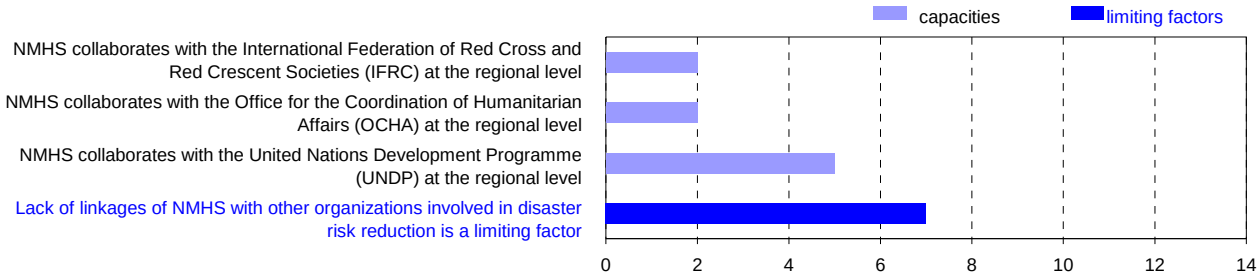


Figure 102. NMHS collaboration with partner agencies at the regional level in the South-West Pacific.

Almost all contributors to the survey (92% or 12 of 13) in the South-West Pacific reported that they coordinated with emergency management authorities for emergency planning and response and the same number (86% or 12 of 14) stated that coordination was at the national level. A significant number (80% or 8 of 10) participated in activities of international organizations and/or on the level of a WMO Region or a regional economic grouping (62% or 8 of 13). Fewer of them (43% or 6 of 14), however, collaborated with their National Red Cross and Red Crescent Societies, interacted with the office of the United Nations Coordinator (29% or 4 of 14) in their country or participated in disaster reduction activities of the UNDP (45% or 5 of 11), the Office for the Coordination of Humanitarian Affairs (22% or 2 of 9) or the IFRC (20% or 2 of 10).

8.4.5 The Organization and Priorities of NMHSs

The priorities of individual NMHSs are, inevitably, influenced by the missions and priorities of their parent government ministries or departments. In consequence, the orientation of NMHSs may be more broadly focussed in some countries than in others. A parent department with a civil aviation mandate might, for example, emphasize provision of NMHS services to aviation while one with a natural resources or environment mandate might encourage its NMHS to provide warnings and other services to a broader range of sectors. Where National Meteorological Services, or combined National Meteorological and Hydrological Services[22], in the South-West Pacific are concerned parent ministries include: Environment and Heritage; Science and Technology; Natural Resources, Environment and Meteorology; Works and Police Department; Civil Aviation; Transport, Civil Aviation and Meteorological Services; Environment and Water Resources; Infrastructure and Public Utilities; Science, Technology and Innovation; Transport; Transport, Communication and Tourism Development; Police; State Owned Enterprises; and National Weather Service. Parent departments of the National Hydrological Services include: Agriculture; Lands and Natural Resources; and Environment and Water Resources.

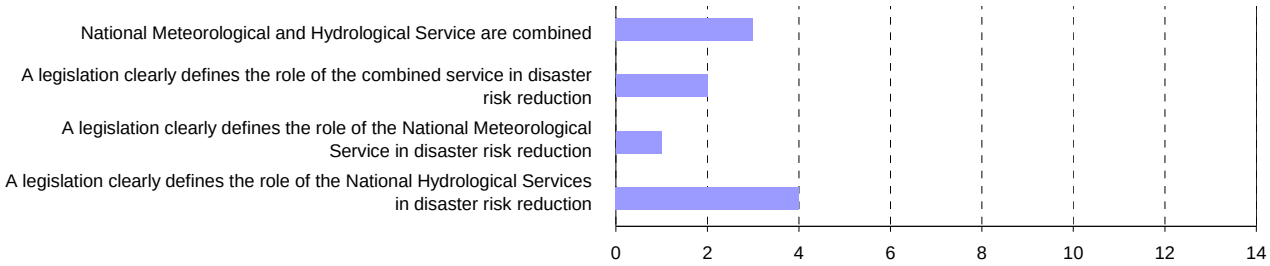


Figure 103. Organizational structure of meteorological and hydrological services in the South-West Pacific.

The internal organization of National Meteorological and Hydrological Services within individual countries can also influence their ability to deliver well-coordinated hydrometeorological warnings and other services in support of disaster risk reduction. In the South-West Pacific, only a few survey respondents (21% or 3 of 14) stated that they had a combined National Meteorological and Hydrological Service and even fewer (22% or 2 of 9) indicated that their country had national legislation that clearly defined the NMHS role in disaster risk reduction. Only one survey contributor (10% or 1 of 10) with a separate NMS and NHS stated that they had legislation that clearly defined the role of the NMS in disaster risk reduction. A somewhat larger number (36% or 4 of 11) reported legislation that applied to the role of the NHS. At the same time, a majority (60% or 6 of 10) of respondents considered that legislation or partnership agreements were needed to better define the respective roles of their NMSs and NHSs in disaster risk reduction.

[22] Parent departments of NMS and NMHS have been grouped together due to ambiguities in responses regarding the existence or otherwise of combined NMHS.

8.4.6 Operational Coordination between NMSs and NHSs

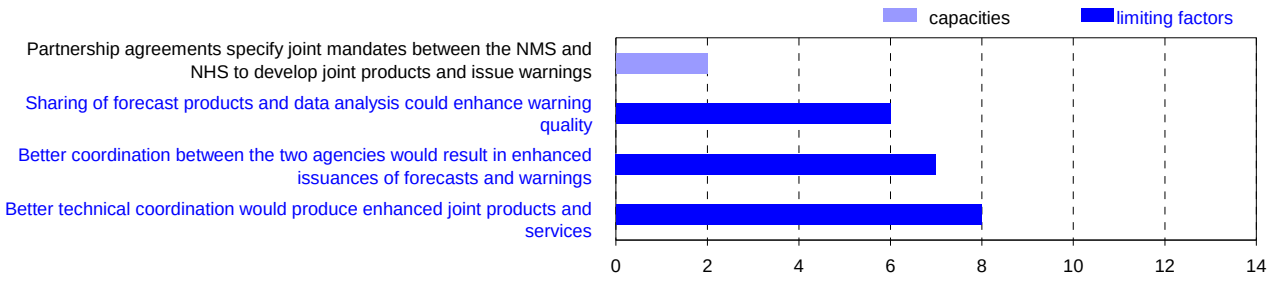


Figure 104. Coordination between NMS and NHS in the South-West Pacific.

Only a few (18% or 2 of 11) respondents from South-West Pacific countries with separate NMSs and NHSs identified that a partnership agreement was in place specifying mandates between their NMSs and NHSs to develop joint products and issue warnings. A somewhat larger number (50% or 6 of 12) indicated that the two agencies shared forecast products and data analyses that could enhance warning quality. Most of these (45% or 5 of 11) stated that coordination took place before warnings were issued for hazards of mutual concern with two indicating that coordination also took place for any hazard warning was issued. However, a few contributing NMHSs (38% or 3 of 8) reported that there was no coordination on warnings. Over two thirds of respondents (70% or 7 of 10) considered that better overall coordination between the two agencies would enhance issuance of forecasts and warnings and slightly more (69% or 8 of 9) considered that improved technical coordination would result in enhanced joint products and services.

8.5 NMHS Infrastructure, Products and Services

The following sections summarize the information contained in survey responses related to observational networks, telecommunications systems, warning and forecast production systems and their products, dissemination systems and related aspects of the overall operational capacities of the NMHSs in the South-West Pacific region.

8.5.1 Observation and Monitoring Networks and Systems

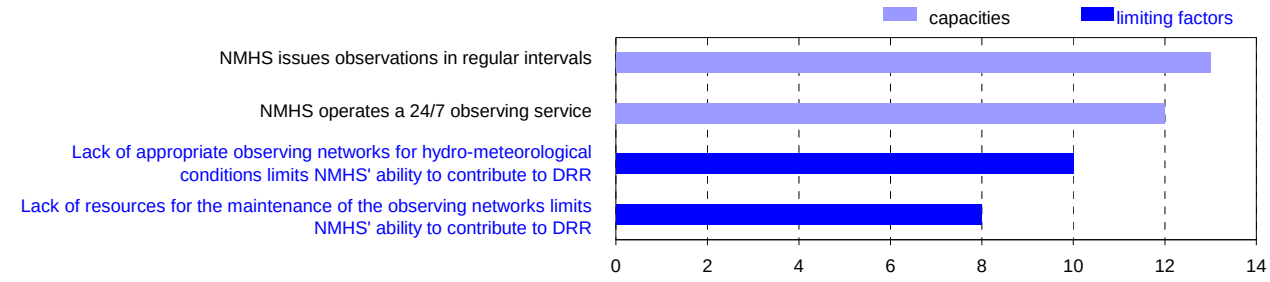


Figure 105. Observation and monitoring networks and systems in the South-West Pacific.

Most South-West Pacific NMHSs who contributed to the survey (93% or 13 of 14) stated that they had an operational observing capacity that issued observations at regular intervals. Most of these (100% or 12 of 12) reported that the observing service operated 24-hourly/year-round. Over half (57% or 8 of 14) indicated that their observation network included sea level monitoring stations. However, most respondents (71% or 10 of 14) also considered that a lack of appropriate hydrometeorological observing networks limited their ability to contribute to disaster risk reduction

and some (21% or 3 of 14) identified the availability of a dedicated 24-hourly/year-round observing service as an additional limiting factor. Major challenges in maintaining observation networks were also stressed. Among these, with most NMHSs (77% or 10 of 13) cited limited resources (e.g. financial, replacement parts, personnel, etc), many (69% or 9 of 13) cited a lack of professional staff with appropriate training, and over half (62% or 8 of 13) pointed to hazard related damage.

8.5.2 Telecommunications and Informatics

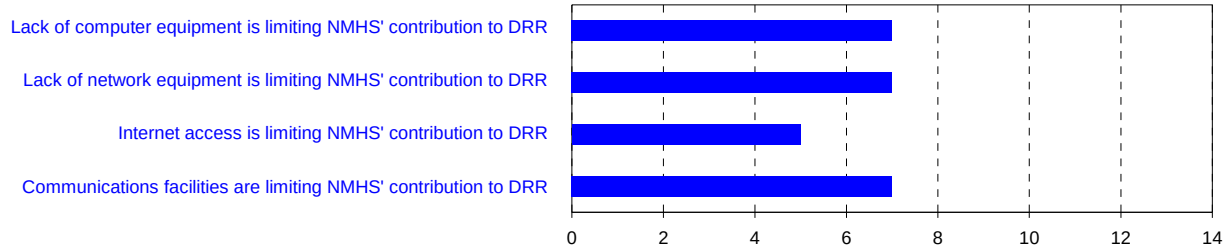


Figure 106. Telecommunication and informatics in the South-West Pacific.

All South-West Pacific NMHSs who contributed to the survey (100% or 14 of 14) reported that their telecommunications systems were available 24-hourly/year-round. Partial confirmation was provided by responses indicating that most forecasting staff (86% or 12 of 14) in the region had access to real time hydrometeorological data. However, almost two thirds of respondents (64% or 7 of 11) went on to identify that their ability to deliver critical products for disaster risk reduction was limited by communications facilities. Other limitations on NMHS capacities were cited in major areas of informatics, with many NMHSs (91% or 10 of 11) highlighting the lack of application software, network equipment (64% or 7 of 11), computers (64% or 7 of 11) and inadequate Internet access (50% or 5 of 10). Finally, all responding NMHSs (100% or 11 of 11) considered that upgrading the operational infrastructure for forecasting and warning services would enhance disaster risk reduction capacities in their countries.

8.5.3 Data Exchange

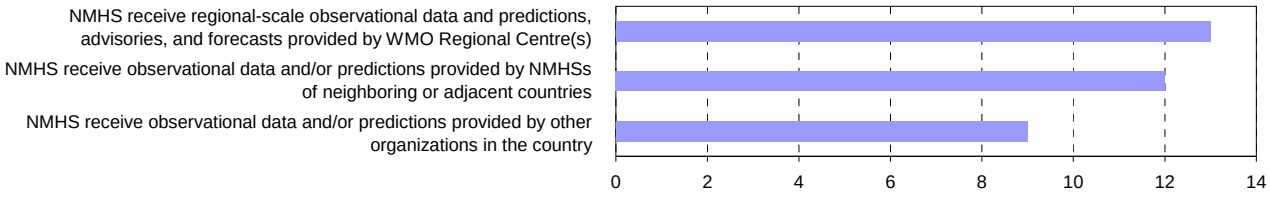


Figure 107. Data exchange in the South-West Pacific.

Survey contributions from NMHSs in the South-West Pacific (RA V) identified that most (86% or 12 of 14) forecasting staff had real time access to hydrometeorological data. All respondents (100% or 13 of 13) also used regional scale observational data and forecasts provided by WMO Regional Specialized Meteorological Centres, data from neighbouring countries (92% or 12 of 13) and from other organizations in their countries (69% or 9 of 13). In addition, more than half (64% or 9 of 14) received real time marine observations from the GTS and some (44% or 4 of 9) relayed sea level observations on that global network. Conversely, however, almost two thirds of contributors to the suevey (64% or 7 of 171) indicated that their NMHSs were limited in their ability to deliver critical products and services for disaster risk reduction by communications facilities. Equally, a significant number (62% or 8 of 13) stated that their NMHS was limited by customization of data for stakeholders. Almost half the respondents in the South-West Pacific (46% or 6 of 13) cited quality assurance and more than a third (38% or 5 of 13) identified ability to archive and update as limiting

factors on their ability to deliver hazard data products. A majority of these NMHSs (79% or 11 of 14) considered that they required better coordination with neighbouring NMHSs on hydrometeorological data exchange and, in the same context, over half (64% or 9 of 14) advocated improved coordination with RSMCs.

8.5.4 Forecast and Warning Capability

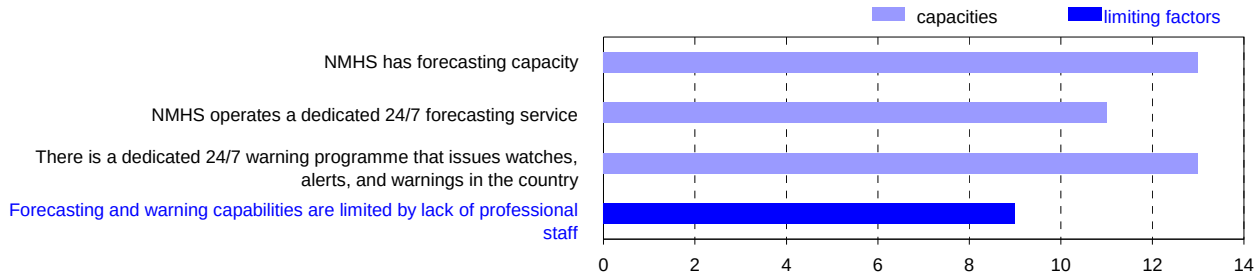


Figure 108. Forecast and warning capabilities in the South-West Pacific.

Almost all NMHSs (93% or 13 of 14) in the South-West Pacific indicated that they had an operational forecasting capability. Most (85% or 11 of 13) of them stated that this was a dedicated 24-hourly/year-round forecast service and that a meteorologist was required to be on-site to operate this service. The same number (93% or 13 of 14) also reported that they had a dedicated hazard warning programme that issued watches, alerts and warnings on a 24-hourly/year-round basis. All of them (100% or 13 of 13) indicated that a meteorologist was on site during the operational hours of the warning programme.[23] In addition, most NMHSs in the region (93% or 13 of 14) stated that they provided a marine forecast and warning service to mariners and coastal zone users and a few (29% or 4 of 14) also prepared marine forecasts for the Global Maritime Distress and Safety System (GMDSS).

On the negative side, three quarters of the South-West Pacific contributors to the WMO survey (75% or 9 of 12) indicated that their NMHS was limited in its ability to deliver critical products and services for disaster risk reduction by professional staff. Most (91% or 10 of 11) also cited application software as limiting and almost two thirds (64% or 7 of 11) cited computers. Almost all respondents (92% or 12 of 13) considered that upgrading their NMHS operational forecasting and warning services would enhance disaster risk reduction in their countries. More specifically, most (92% or 11 of 12) advocated the upgrading or technical training of professional staff, also drawing attention to needs for access to tools and latest forecasting technologies.

8.5.5 Forecast and Warning Products

Table 7 in Annex 4 summarizes information on hazard warnings and products issued by NMHSs in the South-West Pacific who responded to the survey. The survey responses indicated that the hydrometeorological hazards affecting the greatest number of South-West Pacific countries were, in declining order, strong winds, tropical cyclones, flash floods, thunderstorms and lightning, droughts, coastal flooding, storm surges, river flooding, tsunami, and landslides or mudslides closely followed by earthquakes, forest or wild land fires, marine hazards and volcanic events[24].

[23] There is an apparent anomaly in responses in that 11 NMHS in the South-West Pacific reported that they operate a dedicated 24-hourly/year-round forecast service but 13 NMHS state that they have a 24-hourly/year-round warning program.

[24] The survey responses do not provide information on the magnitudes of the impacts associated with individual hazards, simply that they occur in the reported number of countries.

Examination of the data in Table 7 reveals that most affected NMHSs issued warnings for the majority of the above hazards that affected them. The most notable exceptions were landslides and mudslides where warnings were issued by only half of the affected NMHSs and flash floods and forest or wild land fires where warnings were issued in roughly three quarters of the affected countries. This suggests that South-West Pacific NMHSs should re-examine the extent of their hazard warning programmes and, where necessary, expand them to include additional phenomena that have the potential to cause major disasters.

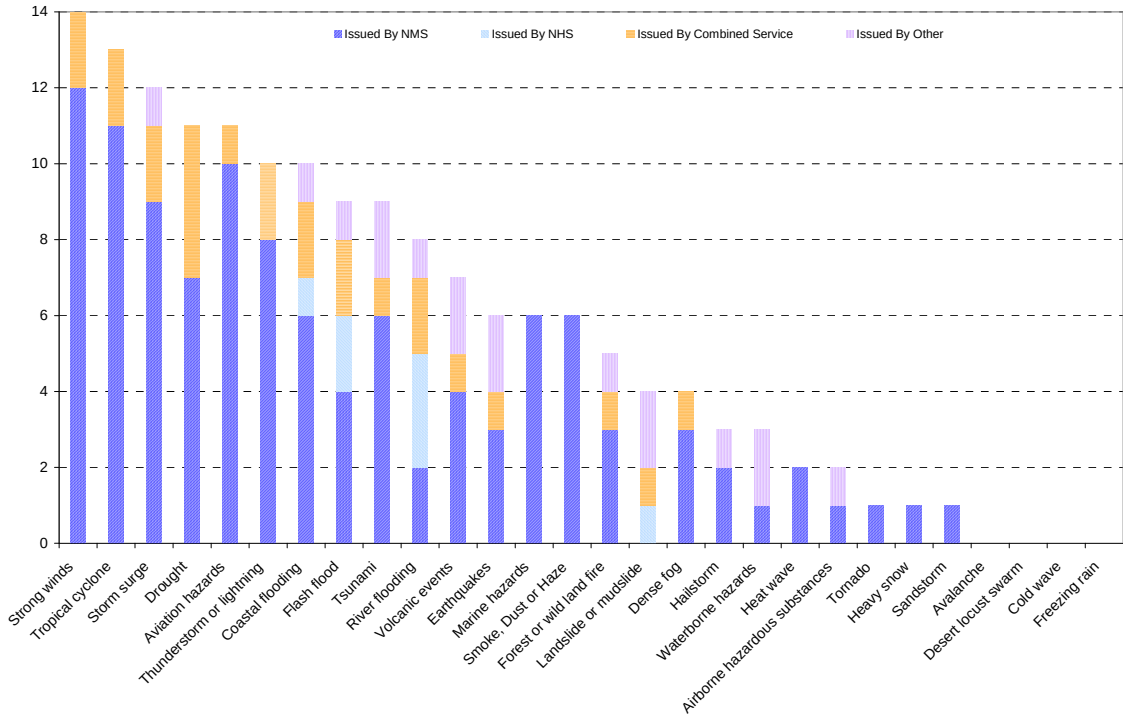


Figure 109. Agencies mandated for issuance of warnings in the South-West Pacific.

The survey contributions from the South-West Pacific clearly indicate that NMSs and, to a much lesser extent, combined NMHSs are the issuers of almost all warnings for the major hydrometeorological hazards in the region. The only exceptions are the few cases where NHSs issue warnings for river flooding, flash floods, coastal flooding, and landslides or mudslides. The data also indicate that NMHSs (or, as the case may be, NMSs or NHSs) were not the sole issuers of warnings in all cases but that a competing warning service exists in some countries. Survey respondents in the South-West Pacific reported that, in a majority of instances, official warnings for the major hydrometeorological hazards included information regarding their potential impacts. Finally, as in other regions, almost all contributing NMHSs in the South-West Pacific considered that further improvements to their warnings were necessary. Again, this represents an opportunity to expand individual warning programmes to include additional important hazards such as those cited earlier as being areas of deficiency in some countries.

8.5.6 Coordination of Warnings

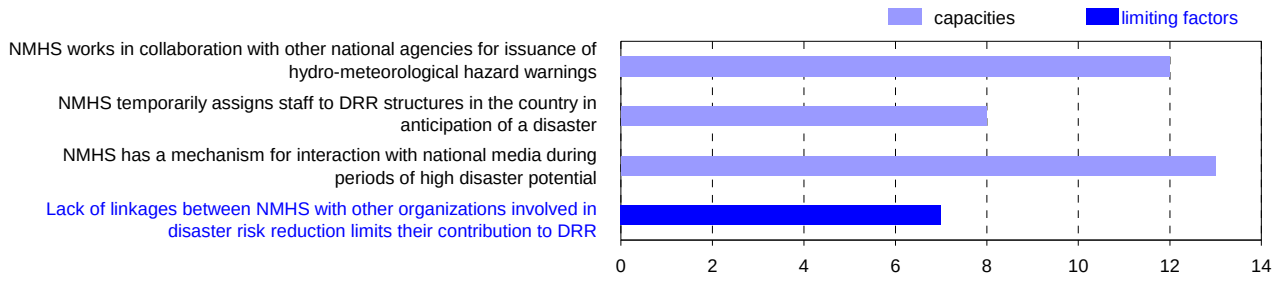


Figure 110. External coordination for issuance of warnings in the South-West Pacific.

Early warnings of hydrometeorological hazards represent a vital contribution to disaster risk reduction. In the South-West Pacific, most NMHSs (86% or 12 of 14) who contributed to the survey reported that they worked in collaboration with other agencies (e.g. agriculture, aviation, etc) with respect to hazard warnings. Most of these (79% or 9 of 12) discussed the hazard's characteristics and potential impacts with these agencies prior to issuing a warning. In addition, most respondents (93% or 13 of 14) stated that they had a mechanism for interaction with their country's media during periods of high disaster potential. Moreover, over half of them (57% or 8 of 14) indicated that they temporarily assigned staff to disaster risk management structures in anticipation of a disaster. A few NMHSs (28% or 3 of 14) in the region pointed out that there were other public or commercial entities that provided competing warning services in their countries. All respondents to the survey (100% or 11 of 11) considered that their NMHS required better coordination of watches and warnings with neighbouring NMHSs and most of these (100% or 9 of 9) also advocated improved coordination with WMO Regional Specialized Meteorological Centres.

8.5.7 Products and Services for Selected Socio-Economic Sectors

As a further refinement, Figure 111 illustrates the provision by NMHSs of specialized alerts, warnings and other products to significant socio-economic sectors in South-West Pacific that can be seriously affected by hazardous events. In the context of disaster risk reduction, it is noteworthy from Figure 111 that less than a third (29%) of responding NMHSs indicated that they provided support to development and housing, just over a third (36%) provided support for the land-use planning and under a half (43%) provided services to the fresh water sector.

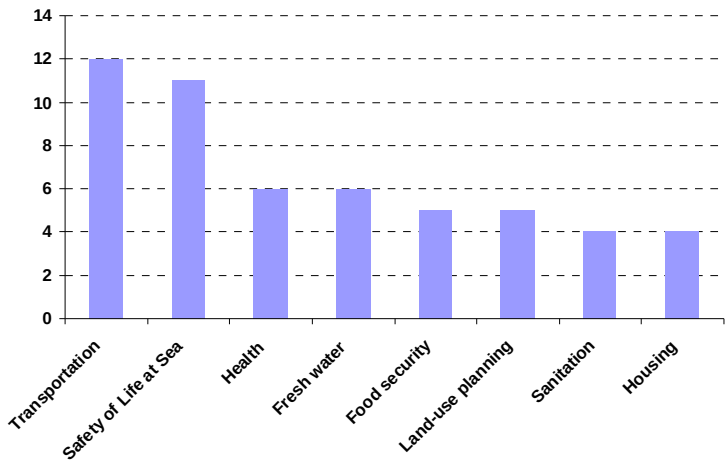


Figure 111. NMHS provision of services to selected economic sectors in the South-West Pacific.

8.5.8 Dissemination Systems and Target Audiences

The following Figures 112 and 113 summarize the survey responses relating to the dissemination of hazard products by NMHSs in the South West Pacific. They provide information on the types of products that are disseminated, to whom they are provided, and on the methods of dissemination that are used to convey the products to the recipients. The same information is also presented in numerical form in Table 6 of Annex 5 where the figures represent the number of responding NMHSs who reported that they provided the specified product to the indicated target audience or, as appropriate, utilized a particular means of dissemination.

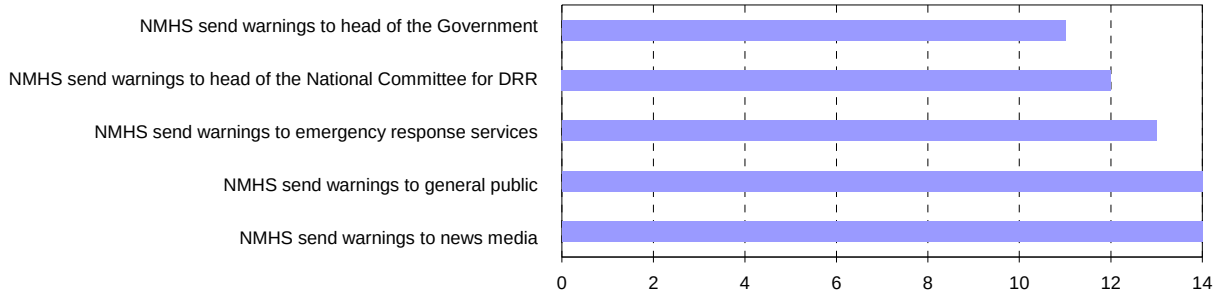


Figure 112. Warning target audience in the South-West Pacific.

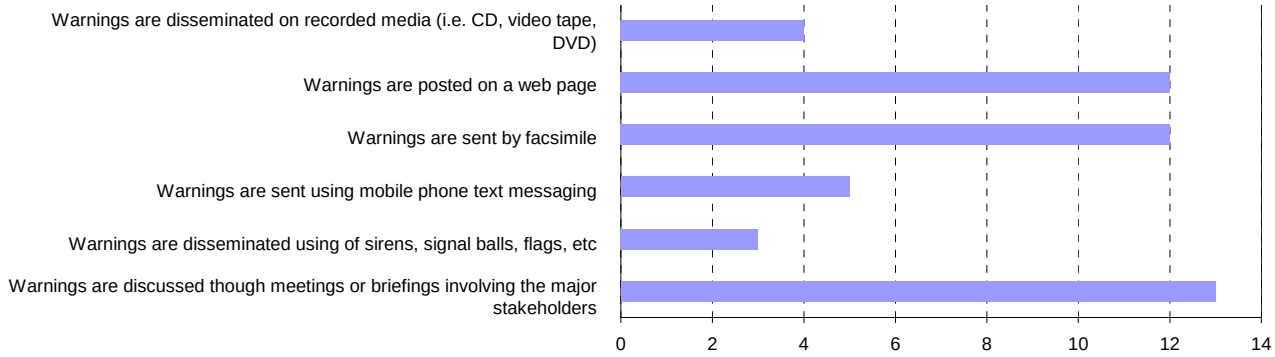


Figure 113. Warning dissemination methods in the South-West Pacific.

As might be expected, virtually all contributors to the WMO survey from the South-West Pacific indicated that they disseminated hazard warnings to the public and the media and to emergency response agencies and other relevant government authorities. A significant percentage of responding NMHSs also disseminated warnings and other products to external partners in disaster risk reduction such as national Red Cross and Red Crescent Societies and others. The major dissemination methods in the South-West Pacific were via briefings, facsimile, web page and Internet and hard copy mailings, with sirens and other signal devices also being used fairly widely.

8.5.9 Product Utility and Product Improvement

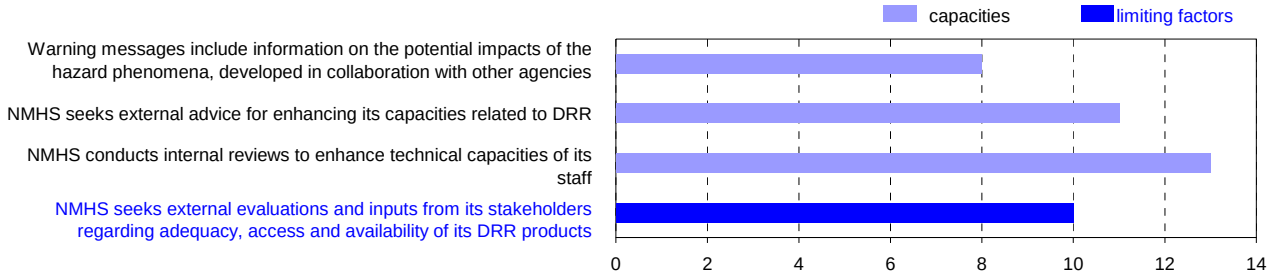


Figure 114. Ongoing feedback and improvement of products in the South-West Pacific.

Just over half (57% or 8 of 14) of responding NMHSs in the South-West Pacific indicated that they work with other agencies with respect to hazard warnings. Three quarters of them (75% or 9 of 12) also stated that they had regular interaction with disaster risk authorities to enhance their warning capabilities and content. Just over half (57% or 8 of 14) of those who included information on potential risks (impacts) in warning statements indicated that they collaborated with other agencies to develop risk information. Almost all survey contributors (92% or 11 of 12), however, stated that they sought external advice to enhance their capacities to support disaster risk reduction, specifically to enhance monitoring and forecasting, watches and warnings (93% or 13 of 14), or overall products and services (86% or 12 of 14). Moreover, almost two thirds of respondents (64% or 9 of 14) indicated that their NMHSs had a quality control mechanism to enhance their warning capabilities and content. Three quarters of these (75% or 9 of 12) stated that the mechanism provided for regular interaction with stakeholders (disaster risk authorities) and included feedback from stakeholders and the public after an event had occurred. Just over half of them (58% or 7 of 12) also stated that it provided for training for stakeholders to understand hazards, warnings and their implications. In addition, many NMHSs (71% or 10 of 14) reported that they sought external evaluations and inputs from stakeholders regarding the adequacy, relevance, method of access and availability of their disaster risk reduction products.

Despite the preceding activities, most South-West Pacific contributors to the survey (86% or 12 of 14) believed that the lack of public understanding of hazards, watches and warnings limited the public response to them. More than half (57% or 8 of 14) also considered that the lack of joint training between NMHS staff and disaster risk and emergency authorities and managers limited their disaster risk reduction efforts. Furthermore, most NMHSs (86% or 12 of 14) in the region felt that educational modules for media, public and disaster risk authorities would enhance their effectiveness in disaster risk reduction.

8.5.10 Internal NMHS Training and Capacity Enhancement

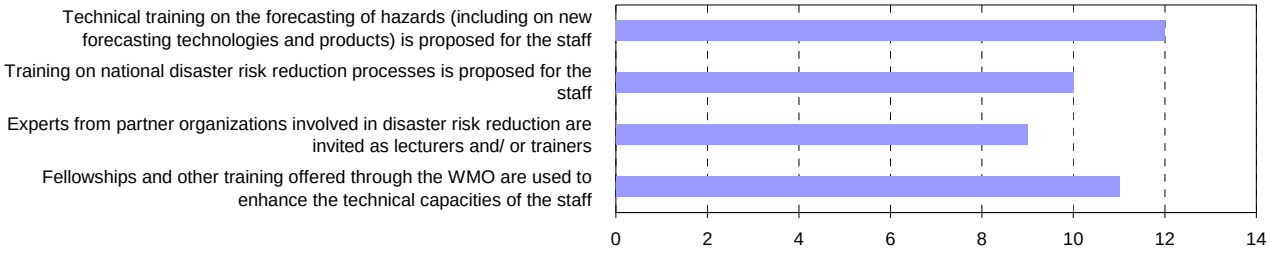


Figure 115. Training and capacity building of NMHS' staff in the South-West Pacific.

Most contributing NMHSs (86% or 12 of 14) in the South-West Pacific indicated that they provided ongoing technical training to staff on forecasting of hazards, including up to date training on new forecasting technologies and products. Most (93% or 13 of 14) also reported that they conducted internal reviews and sought staff inputs to enhance their capacity building and technical training activities. In addition, most of them (79% or 11 of 14) stated that they utilized Fellowships and other training offered through WMO to enhance the technical capacities of their staff. Many (71% or 10 of 14) provided training to staff on their country's disaster risk reduction processes and related topics and most of these (64% or 9 of 14) invited experts from partner organizations involved in disaster risk reduction as lecturers and/or trainers. The majority (79% or 11 of 14) of South-West Pacific contributors to the survey also conducted evaluations of the suitability of communications, workstations, and software and all of them implemented upgrades to these systems to support disaster risk reduction. However, only half of responding NMHSs (50% or 7 of 14) reported that they held or participated in joint training activities for NMHS staff and emergency response agencies.

Balancing the preceding, over half of the survey respondents (57% or 8 of 14) indicated that lack of forecaster training at their NMHS reduced the effectiveness of their warning service. A similar number (69% or 9 of 13) reported that (lack of) professional staff with appropriate training limited their ability for real time monitoring of hazards. About the same number (57% or 8 of 14) stated that a lack of joint training with emergency and disaster risk authorities and managers and with media limited their contributions to disaster risk reduction. Equally, many contributors to the survey (62% or 8 of 13) also identified that their ability to provide hazard data products was limited by the lack of professional staff with appropriate training. Not surprisingly, most responding NMHSs (92% or 12 of 13) considered that upgrading and improving their operational forecasting and warning activities would enhance their disaster risk capacities. Most of these (100% or 11 of 11) advocated the conduct of cross-border training activities with neighbouring NMHSs, targeted at common hydrometeorological hazards.

8.5.11 Outreach Activities

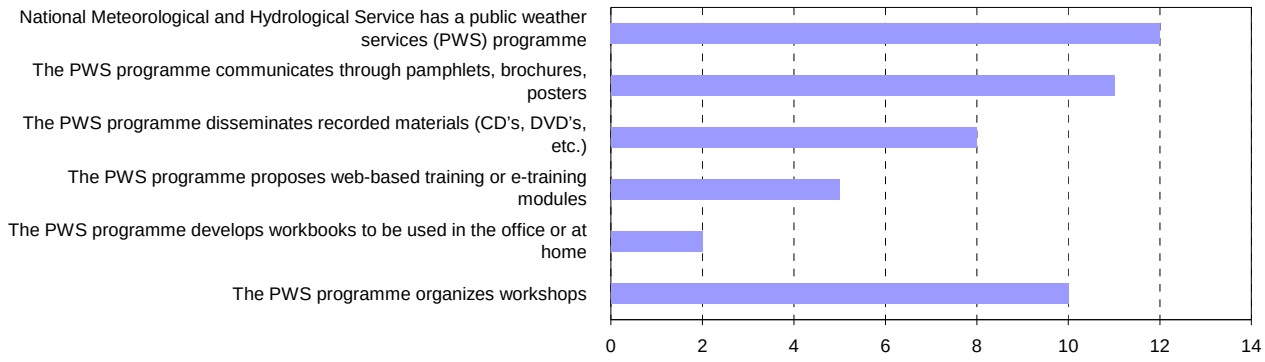


Figure 116. Outreach activities in the South-West Pacific.

Outreach activities aimed at the general public and other stakeholders are an important component of any effective disaster risk reduction programme. Within NMHSs, outreach activities are often part of a public weather services programme. In the South-West Pacific, most (86% or 12 of 14) contributors to the survey identified that their NMHSs had such a public weather services programme. Over half (58% or 7 of 12) of them stated that their NMHSs quality control programme included training for the stakeholders to understand the hazards, warnings and their implications and a similar number (57% or 8 of 14) provided training to the media. More than half (62% or 8 of 13) also provided education and training on hazards, watches, warnings, etc to disaster risk reduction managers and authorities and operational emergency response managers. However, less than half (43% or 6 of 14) the survey contributors identified that they provided training targeted

at the trainers (i.e. of disaster risk authorities, emergency response staff, media, etc). A majority (71% or 10 of 14) provided educational modules and training programmes targeted at the general public. Half of respondents (50% or 7 of 14) pursued joint training activities with emergency response agencies. The following materials and methods were identified as being used in NMHSs public outreach programmes in the South-West Pacific: - pamphlets, brochures, posters (85% or 11 of 13), workshops (71%), recorded materials (CDs, DVDs, etc) (57%), Web-based training (36%), and workbooks for office or home use (14%).

Most (86% or 12 of 14) South-West Pacific contributors to the WMO survey judged that the lack of public understanding of the effects of hazards limited public response to warning services. In addition, more than half (57% or 8 of 14) also felt that the lack of joint training with the media, disaster risk managers and emergency authorities and managers limited their disaster risk reduction efforts. As a consequence, most NMHSs (86% or 12 of 14) in the region considered that educational modules that they could target at media, public and disaster authorities would enhance their effectiveness in disaster risk reduction.

8.6 NMHS Contingency Planning

Most responding NMHSs in the South-West Pacific (79% or 11 of 14) reported that they had a contingency plan to maintain the continuity of products and services in the event of organizational emergencies such as power failure or communications disruption. Almost half of them (46% or 6 of 13) also stated that their contingency plans involved an agreement or protocol with neighbouring NMHSs to support them in the event of catastrophic failure. In addition, most (79% or 11 of 14) stated that they conducted or participated in drills and exercises to ensure disaster preparedness. However, all South-West Pacific contributors to the survey (100% or 11 of 11) identified needs for improved coordination with neighbouring NMHSs, specifically citing the need for support from them in the event of disruption of services.

8.7 Overarching Factors

NMHSs participating in the country-level survey were asked to respond to a series of questions directed at obtaining expressions of opinion from them regarding overarching factors or realities that either limited or could enhance their ability to make optimal contributions to disaster risk reduction. To varying degrees, the responses to these questions also served to validate statements, expressions of opinion and/or recommendations contained in responses to earlier sections of the survey. The following summarizes the inputs that fall under the above broad category:

8.7.1.1 NMHS Visibility

A majority of contributing NMHSs in the South-West Pacific region (71% or 10 of 14) considered that they needed higher visibility and recognition within government as a major contributing agency to disaster risk reduction. Almost two thirds (64% or 9 of 14) also felt that their contributions to disaster risk reduction were limited by the lack of understanding by government authorities of the value provided by the NMHSs. Most respondents (86% or 12 of 14) considered that improved ministerial level understanding of the socio-economic benefits of hydrometeorological products and services would increase the visibility of their NMHSs at the national level.

8.7.1.2 Organization and Governance

Almost half of NMHSs in the region (46% or 6 of 13) considered that their national organizational structure for disaster risk reduction limited their potential contributions in this area. A similar number (43% or 6 of 14) believed that the effectiveness of their contributions to disaster risk reduction was limited by the lack of clear legislation or policies regarding the role of their NMHS (e.g. as the sole issuer of warnings). In addition, a majority of contributors (60% or 6 of 10) from countries with separate NMSs and NHSs considered that there was a need for legislation or partnership agreements to better define the role each agency played in disaster risk reduction.

8.7.1.3 Coordination and Partnership

Half (50% or 7 of 14) of the NMHSs in the South-West Pacific considered that their contributions to disaster risk reduction were limited by a lack of linkages between the NMHSs and other involved organizations. In addition, most of them (79% or 11 of 14) considered that better coordination with neighbouring or adjacent countries would improve their contribution to their own nation's disaster risk reduction activities. Many (64% or 9 of 14) also felt that better coordination with WMO Regional Specialized Meteorological Centres would improve their contribution.

8.7.1.4 Resources and Capacity

Most NMHSs in the South-West Pacific (92% or 12 of 13) who contributed inputs to the WMO country-level survey indicated that resources and infrastructure limited their ability to deliver critical products and services for disaster risk reduction, specifically identifying financial resources (82% or 9 of 11) and professional staff (75% or 9 of 12) and as key limiting factors. In consequence, almost all (92% or 12 of 13) respondents considered that upgrading and improving NMHS operational forecasting and warning services would enhance the disaster risk reduction capacity within their country.

8.8 WMO Support

The following list summarizes the needs for support from WMO expressed by the NMHSs in the South-West Pacific who contributed to the survey.

1. Provision of technical advice and specifications (e.g. to enhance observing networks, operational infrastructures, relevant products and services for disaster risk reduction applications).
2. Technology transfer, capacity building, technical guidelines and technical trainings (e.g. forecasting tools and methodologies, hazard mapping, and other inputs to risk assessment tools, etc.).
3. Strengthening strategic partnerships with stakeholders (e.g. disaster risk managers, media, etc.).
4. Education, training and public outreach programmes in disaster risk reduction (e.g. targeted at National Meteorological and Hydrological Service and their stakeholders).
5. Cost-benefit analysis of hydro-meteorological services in disaster risk reduction.
6. Strengthening strategic partnerships with other technical organizations and agencies (e.g. meteorology, hydrology, ocean services, etc.).
7. Resource mobilization.
8. Assist members in the development of the national disaster risk reduction plans.
9. Advocacy for enhanced visibility of National Meteorological and Hydrological Service' in the area of disaster risk reduction.
10. Establishment of regional emergency protocols for the National Meteorological and Hydrological Services in support of each other in case of disruption of services due to the impact of a disaster.

8.9 Sub-Regional Considerations

Significant differences exist in economic development and in climatic and hazard regimes across the vast extent of the South-West Pacific. The following sections summarize the responses to the WMO Disaster Risk Reduction survey from two sub-groups of countries in that region – Small Island Developing States (SIDS) and non-SIDS South-West Pacific countries. Annex 2 lists the countries falling into each of these categories.

8.9.1 Small Island Developing States in the South-West Pacific

The following paragraphs briefly compare the survey responses contributed by seven NMHSs in Small Island Developing States in the South-West Pacific against the preceding analysis of all survey responses from the South-West Pacific region.

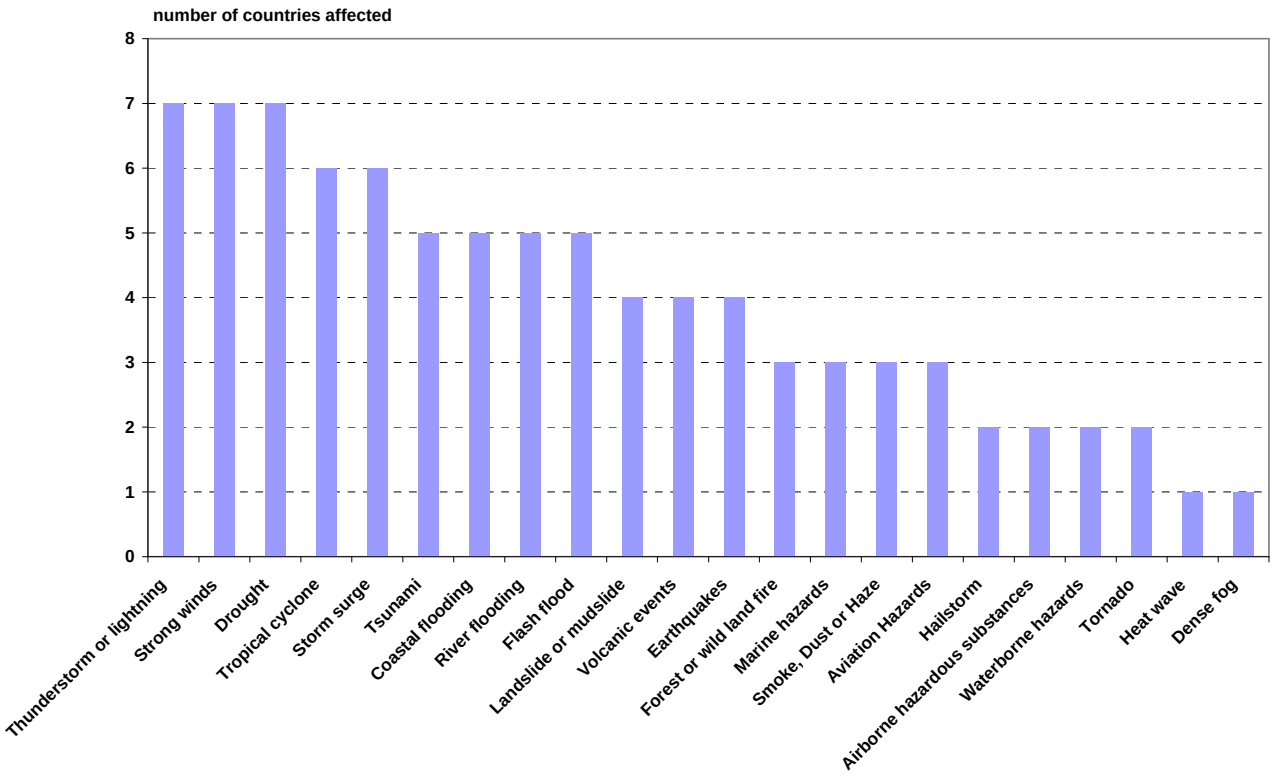


Figure 117. Number of responding Small Island Developing States in the South-West Pacific who identified themselves as being affected by specified hazards.

Figure 117 shows the number of responding members of South-West Pacific SIDS who stated that they were affected by the specified hazards. As Figure 117 illustrates, the hazards that affect most South-West Pacific SIDS countries are strong winds, thunderstorms or lightning, droughts, tropical cyclones, storms surges, flash floods, coastal flooding, river flooding, tsunami, landslides or mudslides, earthquakes and volcanic events. Other hazards – maritime hazards, aviation hazards, forest and wild land fires, smoke, dust or haze, tornadoes, hailstorms, airborne hazardous substances, waterborne hazards, dense fog and heat waves are experienced by less than half of the countries in question.

The responses to the survey indicated that the situation with respect to hazard impact databases and access to impacts information in the South West Pacific SIDS countries was, in many respects, similar to the overall regional picture. However, a noticeably lower percentage of SIDS NMHSs reported that they maintained official databases on the impacts of hazards and used hazard and impacts data to provide value-added services in support of hydrometeorological risk assessment. Legislative, governance and disaster risk coordination structures in the SIDS were similar to those across the region. A higher percentage of SIDS NMHSs stated that they were participants in their national committees or structures for disaster risk reduction. However, a lower percentage of them provided support for the reconstruction phase following disasters. It is noteworthy that proportionately more NMHSs in SIDS considered that their national disaster risk reduction committee structures limited their contributions to that priority area. Correspondingly, the SIDS NMHSs, without exception, advocated the implementation of “readiness level” systems as contrasted to this simply being a majority viewpoint across the region. Survey responses from SIDS in the South West Pacific suggested that partnerships were less widely developed than in the region as a whole. Similarly, a significantly higher percentage of SIDS respondents identified lack of linkages with national disaster risk reduction partners as limiting their contributions to disaster risk reduction. Only one SIDS respondent reported that they had a combined NMHS and related SIDS responses reflected stronger support for improved coordination between NMSs and NHSs.

Where infrastructure and operational capacity were concerned, a significantly higher percentage of SIDS NMHSs identified a lack of resources for the maintenance of observational networks as a substantial limiting factor. In this context, all of them cited professional staff with appropriate training as a particular constraint. The picture with respect to telecommunications and informatics, however, closely paralleled that for the whole region. A higher proportion of SIDS respondents indicated that professional staff with appropriate training limited their data management and data exchange capacities. In contrast to the overall regional picture, no SIDS NMHSs reported that competing warning services existed in their country. All South West Pacific respondents, however, stated that their ability to deliver critical products and services for disaster risk reduction was limited by professional staff and by applications software. Efforts to improve the quality and utility of products generally mirrored those across the region except that a noticeably lower percentage of SIDS respondents reported that they collaborated with other agencies to develop risk information for inclusion in warning statements. Where staff training was concerned, however, SIDS NMHSs in the South West Pacific, without exception, considered that upgrading their operational forecasting and warning services would enhance their disaster risk reduction capacities. A higher percentage of them also drew attention to deficiencies in forecaster training, joint training with disaster risk and emergency authorities and training with the media.

All South West Pacific SIDS respondents considered that a lack of public understanding of hazards, watches, warnings and other products limited the response to them. Similarly, higher percentages of SIDS NMHSs than in the region as a whole identified the lack of joint training with emergency authorities, disaster risk managers and the media as limiting factors. However, only one SIDS NMHS indicated that it sought external reviews and inputs regarding the adequacy of its education and public outreach activities. Finally, the survey responses from South West Pacific SIDS reflected generally higher levels of concern regarding limited NMHS visibility and inadequate understanding of the value of NMHSs contributions, lack of clarity regarding their role and the need for improved linkages with other disaster partners. In summary, the capacities of NMHSs in Small Island Developing States to support disaster risk reduction are, not surprisingly, weaker than the norm across the South-West Pacific region as a whole.

8.9.2 Non-SIDS Countries in the South-West Pacific

The following paragraphs briefly assess the responses from the seven non-SIDS countries in the South-West Pacific who contributed to the WMO survey in comparison to all survey responses from the region. Figure 118 below shows the number of responding NMHSs in non-SIDS countries in the South-West Pacific who stated that they were affected by the specified hazards.

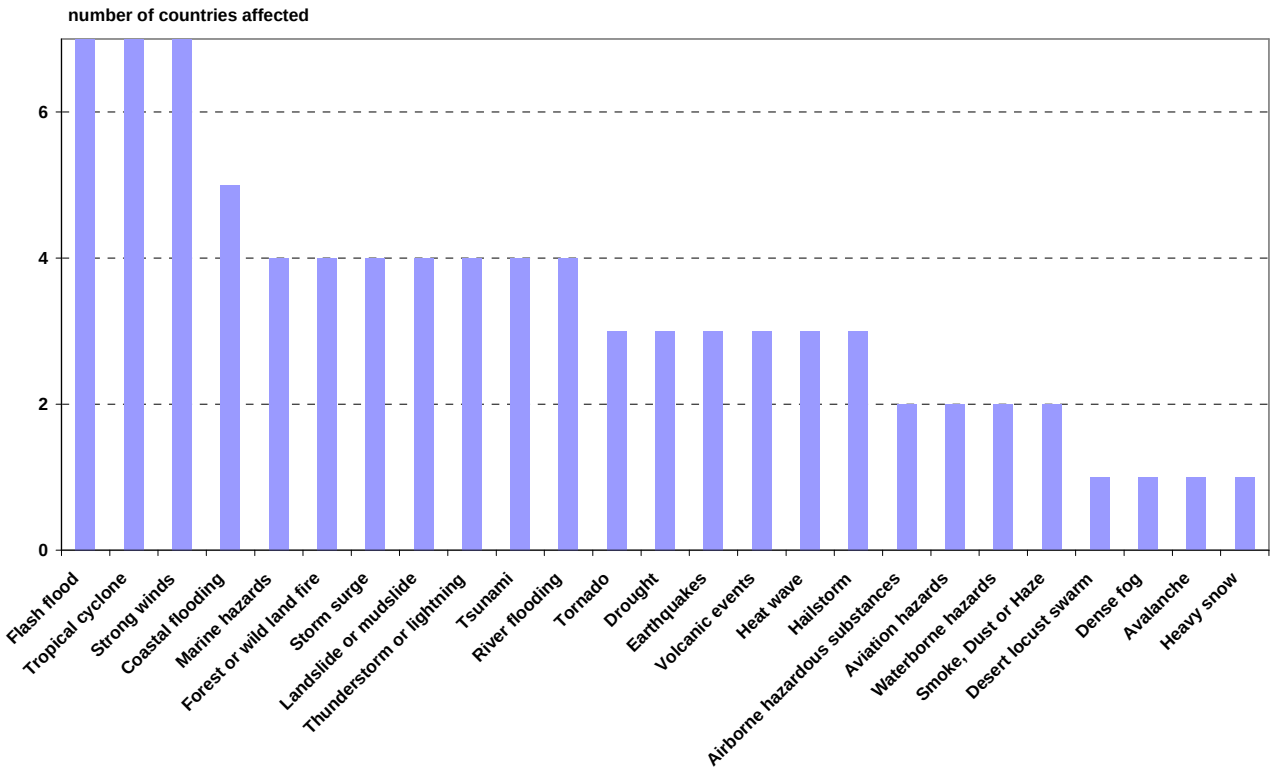


Figure 118. Number of responding non-SIDS countries in the South-West Pacific who identified themselves as being affected by specified hazards.

As Figure 118 illustrates, survey responses indicated that all responding non-SIDS countries in the South-West Pacific are affected by flash floods, strong winds and tropical cyclones. Coastal flooding, thunderstorms or lightning, storms surges, river flooding, marine hazards, landslides or mudslides, forest and wild land fires and tsunamis were reported to affect over half of these countries while tornadoes, hailstorms, heat waves, droughts, earthquakes and volcanic events were of concern in just under one half of them. Other hazards – airborne hazardous substances, waterborne hazards, aviation hazards, smoke, dust or haze, heavy snow, dense fog, desert locust swarms and avalanches - affected only one or two countries.

The responses to the survey indicated that the proportion of non-SIDS countries in the region who had access to official, reliable, information on the impacts of disasters or who maintained and regularly updated their own databases of such information was higher than the regional norm. Correspondingly, higher percentages of non-SIDS NMHSs used hazards and impacts data archives to provide value-added services in support of hydrometeorological risk assessments of other agencies. Survey responses illustrated that legislative, governance and disaster risk coordination structures in the non-SIDS countries were roughly similar to those across the South-West Pacific region as a whole. In contrast to the regional picture, however, only one non-SIDS respondent considered that a lack of clear national legislation or policies regarding the role of the NMHS limited their contribution to disaster risk reduction. A noticeably lower percentage of non-SIDS NMHSs also considered that their national organizational structures for disaster risk reduction limited their contributions to that priority area. Furthermore, relative to the overall regional view, proportionately fewer non-SIDS NMHSs advocated the implementation of “readiness level” systems. In addition, survey responses suggested that NMHS partnerships and collaboration were somewhat better developed in non-SIDS countries than was the case for the South West Pacific as a whole. Moreover, a lower percentage of contributors identified a lack of linkages with national disaster risk reduction partners as limiting their support to disaster risk reduction. Survey inputs from non-SIDS countries in the region also indicated somewhat less need to improve coordination and partnership between NMSs and NHSs.

Non-SIDS responses reflected the regional norm with respect to the lack of appropriate observing networks to support disaster risk reduction. However, relatively fewer non-SIDS NMHSs identified resource, maintenance and human resources deficiencies related to the maintenance of these observing networks. The non-SIDS picture with respect to telecommunications and informatics was similar to that for the whole region. Comparatively, however, fewer non-SIDS respondents cited deficiencies in staff expertise as limiting their data management and data exchange capacities. Competing warning services were reported to exist in proportionately more non-SIDS countries. About half of South West Pacific respondents from non-SIDS countries stated that their ability to deliver critical products and services for disaster risk reduction was limited by professional staff and over three quarters by applications software, again somewhat lower than the corresponding regional figures. Efforts to improve the quality and utility of products roughly mirrored those across the region. As an exception, however, noticeably higher percentages of non-SIDS respondents reported that they collaborated with other agencies to develop risk information for inclusion in warning statements and sought external evaluations and inputs regarding the adequacy, relevance, method of access and availability of their disaster risk reduction products. In addition, a somewhat lower percentage of NMHSs in the non-SIDS countries in the South West Pacific considered that upgrading their operational forecasting and warning services would enhance their disaster risk reduction capacities. Equally, lower percentages of them drew attention to deficiencies in forecaster training, joint training with disaster risk and emergency authorities and training with the media. However, as was general across the region, they unanimously advocated the value of cross border training activities targeted at common hydrometeorological hazards.

A smaller majority of non-SIDS respondents than the overall regional figure considered that a lack of public understanding of hazards, watches, warnings and other products limited the response to them. Similarly, fewer non-SIDS NMHSs identified the lack of joint training with emergency authorities, disaster risk managers and the media as limiting factors. However, non-SIDS respondents were equally supportive of the value of educational modules that NMHSs could target at media, the public and disaster risk reduction authorities. Finally, the survey contributions from non-SIDS countries in the South West Pacific reflected generally lower levels of concern regarding the negative impacts of limited NMHS visibility, lack of governmental understanding of the value of NMHS contributions, lack of clarity regarding their role or the need for improved linkages with other organizations involved in disaster risk reduction. As a group, however, they shared the regional view that their ability to deliver critical products and services for disaster risk reduction was limited by resources and infrastructure. In summary, NMHSs in non-SIDS countries in the South-West Pacific have, in general, somewhat higher capacities in terms of infrastructure and scientific and technical expertise than the regional norm.

8.10 Concluding Assessments and Recommendations for the South West Pacific

The following sections include assessments and conclusions related to the analysis of the survey responses from South-West Pacific NMHSs that has been presented in this chapter. In order to facilitate identification of subject areas, the titles associated with the individual assessments and conclusions presented below match those used during the analyses of South-West Pacific survey responses outlined in the preceding pages.

8.10.1 Access to Data on Hazards and their Impacts

NMHSs need to have easy access to official information on hazards and on the impacts of disasters in order to provide support for planning activities and to facilitate monitoring the effectiveness of their own services in support of disaster risk reduction. As Annex 3 illustrates, roughly a third of NMHSs in the South-West Pacific do not maintain records of even the most common hazards such as strong winds and very few maintain records of less frequent hazards. As the agencies responsible for monitoring and prediction of hydrometeorological hazards within their countries, NMHSs (or NMSs and NHSs) may, reasonably, be expected to maintain records of occurrences of those hazards. Equally, it is important that NMHSs have ready access to official

information on the impacts of disasters. The survey responses indicate that this is not the case in about a third of the countries in the region.

8.10.2 Value Added Services based on Historical Hazard Data

Responses indicate that only about two thirds of NMHSs in the South-West Pacific provide technical advice and statistical analysis related to hazard data. The identified limitations suggest that this situation can be explained by a lack of expertise and a need for training and capacity building in data quality assurance, analysis, data rescue, archiving and data display techniques. Without exception, the respondents recommended that enhanced delivery of value added services would strengthen their contributions to disaster risk reduction and identified related needs for capacity building. The respondents' recommendation is strongly supported by the survey responses.

8.10.3 Legislation and Governance

The responses suggest that, in those countries where a lack of clarity undercuts their potential contributions to disaster risk reduction, NMHSs should press for clear policy direction from their governments regarding their roles and responsibilities.

8.10.4 National Structures/Mechanisms for Disaster Risk Reduction

The degree to which NMHSs are integrated into national disaster risk reduction structures and their operational relationships with civil protection agencies, planning authorities and important non-governmental partners such as the Red Cross/ Red Crescent Society, exercise a significant influence on their ability to contribute effectively to disaster risk reduction. For optimum effectiveness, state of the art NMHS scientific, technical and operational capacities must be mainstreamed into national planning, decision-making and disaster response structures and systems and, in addition, be well connected to important non-governmental partners. Responses to the survey indicate that not all NMHSs in the South-West Pacific are part of their national disaster risk reduction system. Those NMHS that are not part of their national coordinating committees should endeavour to acquire membership on these committees and seek to contribute effectively to their national disaster risk reduction activities.

8.10.5 NMHS Contributions to National Disaster Risk Reduction Systems

The survey responses suggest that NMHSs in the South-West Pacific should devote continuing attention to building effective working relationships with national disaster authorities by providing timely, accurate and relevant products and services for disaster risk reduction. The responses also suggest that, in about half of the countries in the region, efforts are needed to expand and reinforce partnerships with other agencies and organizations involved in disaster related activities. Experience elsewhere indicates that the respondents' recommendation for the establishment of a "readiness system" could, if implemented, enhance NMHS contribution to disaster risk reduction and increase their visibility as contributing organizations. However, this should be pursued at the national level.

8.10.6 NMHS Collaboration with other Partners

The survey responses indicate that most NMHSs do not actively pursue coordination and collaboration with significant national, regional and international partners in the disaster community. Expanded collaboration and partnership can benefit NMHSs through broader utilization of their products and services and enhanced visibility and can result in more effective contributions to disaster risk reduction

8.10.7 The Organization and Priorities of NMHSs

The respondents' majority recommendation for enhanced coordination appears entirely valid in light of the earlier responses. Close coordination between meteorological and hydrological

authorities is an essential foundation for the provision of timely, accurate and consistent hydrometeorological hazard warnings and other services.

8.10.8 Operational Coordination between NMSs and NHSs

The survey responses summarized above clearly indicate that needs exist for enhanced operational coordination between NMSs and NHSs in a number of countries in the South- West Pacific. The survey respondents' recommendation should, therefore, be pursued at the country level through immediate action to achieve more effective operational coordination between the meteorological and hydrological communities, particularly with respect to hazard warnings and other critical products for disaster risk reduction.

8.10.9 Observation and Monitoring Networks and Systems

Responses indicate that a majority of respondents consider that their observing networks are not optimal to support disaster risk reduction. In particular, three NMHSs in the region do not have a dedicated 24-hour/year-round observation programme. Maintenance of observation networks was also identified as presenting challenges to most NMHSs, particularly in relation to availability of resources and trained staff. Moreover, hazard-related damage to observation stations was a compounding problem in over half of the countries in the South-West Pacific. Reliable, round the clock, observations, available in real time, are the essential raw material for the production of early warnings of hydrometeorological hazards, forecasts and other products to support disaster risk reduction. Consequently, every effort should be made to ensure that adequate observational networks and systems are put in place and maintained in operation on a 24hourly/year round basis.

8.10.10 Telecommunications and Informatics

Survey responses indicate that 24-hourly/year-round telecommunications systems are in place in all but one or two countries. However, deficiencies have been widely identified in relation to telecommunications networks, computer hardware and software in most countries in the South-West Pacific and Internet access poses a problem in a significant number of them. The responses validate the respondents' recommendation that upgrading of telecommunications and informatics infrastructure should be undertaken in most NMHSs in the South-West Pacific.

8.10.11 Data Exchange

The respondents' recommendations for improved coordination with neighbouring NMHSs and RSMCs on data exchange make good sense since collaboration and coordination are fundamental to effective and efficient exchange of data and products. The survey responses also indicate, however, that improved data exchange will require enhancements to telecommunications systems and to data management, including quality assurance and archiving systems, in a significant number of NMHSs in the region. These responses also draw attention to related needs for capacity building in relation to data processing and customization of data and products.

8.10.12 Forecast and Warning Capability

The respondents' recommendations are validated by the responses earlier in this section. Clearly, there are quite general needs for upgrading of professional staff, computing capacity and supporting applications software and for access to latest forecasting techniques and tools. However, the facts that one NMHS does not have an operational forecasting and warning capacity and two do not operate their forecasting service services on a round the clock basis represent major deficiencies in relating to disaster risk reduction.

8.10.13 Forecast and Warning Products

The respondents' recommendation regarding the need to improve their warning products and services is solidly based.

8.10.14 Coordination of Warnings

The respondents' strong recommendation for improved coordination with neighbouring NMHSs and RSMCs in relation to watches and warnings makes good sense. Such coordination reduces the risk of ambiguous or, in the worst case, conflicting warning messages from different sources reaching the same audience. A compounding issue here is the increased potential for confusion that arises when commercial or other entities also issue hazard warnings, as is the case in at least three South-West Pacific countries. As a general principle, therefore, it is desirable to work towards a situation where official warnings for hydrometeorological hazards emanate from a single recognized issuing authority within each country**.** Ideally, prepared by NMHSs with the scientific and technical capacity to make such predictions, hydrometeorological warnings may, in some circumstances, benefit from assessment and interpretation by civil defence authorities as to their likely impacts before being disseminated to the public, perhaps accompanied by advice from the authorities on actions that people should take to minimize loss of life and property.

8.10.15 Products and Services for Selected Socio-Economic Sectors

Experience around the globe demonstrates that the socio-economic sectors discussed earlier can benefit significantly from the incorporation of hydrometeorological information and products into their planning and decision-making processes. Sensible land-use planning to minimize risk of flooding and other hazards, engineering design of housing and other structures to withstand expected wind loads or heavy rains and other similar measures contribute to hardening societies and communities against disastrous impacts of hydrological and meteorological events. Equally, early warnings of hazards enable people to take avoidance or mitigating actions. The survey responses indicate that the target sectors do not receive special hydrometeorological services in more than half of the South-West Pacific countries. Consequently, NMHSs in the region could contribute substantively to disaster risk reduction by enhancing the provision of relevant products and services to land-use planning, development, water resources and other key socio- economic sectors.

8.10.16 Dissemination Systems and Target Audiences

Reliable and timely dissemination of accurate early warnings of hazards to stakeholders and the public at large is among the most useful services that NMHSs can provide in support of disaster risk reduction. Consequently, every effort should be made to ensure that warnings and other relevant products reach all important target audiences. In the context of disaster risk reduction, national Red Cross/Red Crescent Societies and external stakeholders should be targeted for receipt of hazard warnings on virtually the same level as government disaster authorities. It is encouraging to note that efforts are being made to implement this approach in the South-West Pacific and these are to be encouraged.

8.10.17 Product Utility and Product Improvement

The responses indicate that many NMHSs in the South-West Pacific have adopted and are using best practices in relation to assessing and attempting to improve the utility of their products. They also suggest, however, that much remains to be done to bring public and other stakeholders' knowledge and understanding of hazards, warnings and other NMHS products up to an adequate level. A main message is that greater emphasis is needed on increasing the awareness of stakeholders and the public at large with respect to hazards, hazard warnings and how to react to the latter as well as on building mutual understanding and support between NMHSs staff and disaster management agencies.

8.10.18 Internal NMHS Training and Capacity Enhancement

The respondents' recommendations for upgrading of operational forecasting and warning capabilities and for cross-border operational training of forecasters are strongly validated by the survey responses. These indicate that a few NMHSs do not provide ongoing training to forecaster staff and that most others advocate increased emphasis on this aspect. More broadly, however,

the responses also indicate that most NMHSs would benefit from much closer collaboration with disaster risk authorities and emergency managers in relation to both internal training programmes for NMHS staff and joint training programmes with disaster agencies. The overall responses provide clear evidence of needs for increased emphasis on orientation of NMHS staff towards provision of products and services for disaster risk reduction, drawing upon the training capacities of disaster management authorities and experts.

8.10.19 Outreach Activities

The respondents' recommendation that educational modules for stakeholders, the public and the media would be helpful is valid and strongly supported by the survey responses. Based on survey responses, the major weaknesses in outreach activities in the region relate to the need to increase emphasis on public awareness and understanding and on joint training activities for NMHS staff and those from disaster risk/emergency response agencies. The respondents' recommendation, in consequence, makes good sense though it is somewhat narrowly focussed on a single outreach tool or mechanism. From an overall perspective, the responses suggest that a much higher priority should be assigned to outreach activities by most NMHSs. As a useful first step, those NMHSs that do not have a public weather service programme should give serious consideration to establishing such a programme to provide a foundation for enhanced outreach activities.

8.10.20 NMHS Contingency Planning

Establishment of back-up capability to maintain critical hazard warning services in the event of emergencies is a prudent step for all NMHSs. In many, perhaps most, instances, a partnership agreement with neighbouring NMHSs can be an effective and low-cost approach to ensuring back-up capability.

8.10.21 WMO Support

South West Pacific NMHSs who responded to the survey identified their highest priority needs for support from WMO as being in relation to infrastructure development and technology transfer and capacity building, followed by strengthening of strategic partnerships and education, training and public outreach programmes related to disaster risk reduction. Areas such as partnerships with other technical organizations, resource mobilization, national disaster risk reduction plans and enhancement of NMHS visibility were somewhat lower priorities in relation to WMO assistance. The identification of high priority needs for assistance with education, training and public outreach specifically related to disaster risk reduction further reinforces the similar requirements identified earlier. Moreover, the assignment of a high priority to the provision of assistance for strengthening strategic partnerships with key disaster risk reduction stakeholders also poses a special challenge for WMO.

8.11 Region-wide Capacities and Resources in the South-West Pacific

On an operational level, NMHSs in the South-West Pacific have access to operational products and expertise from WMO Regional Specialized Meteorological Centres at Darwin and Melbourne, Australia and Wellington, New Zealand, the Tropical Cyclone Centre at Nadi, Fiji and from the Pacific Tsunami Warning Centre to reinforce their national contributions to disaster risk reduction. Drawing on resources from the UK Met Office Pacific Fund, US NOAA GCOS Technical Support Programme and the Meteorological Service of New Zealand, enhancements to regional upper air (GUAN) and surface (GSN) observing stations are underway. These initiatives will improve the quality and reliability of atmospheric data available for disaster risk reduction applications. Hydrological infrastructures and expertise are poorly developed in the South West Pacific. In the face of their vulnerability to climatic extremes, including droughts, associated with ENSO events and flooding due to the passage of cyclones, Pacific Island Countries need improved capacities in water resources management. With funding support from the European Union Water Facility, a Pacific-HYCOS has, in consequence, been initiated as a component of WMO's World Hydrological Cycle Observing System. Pacific-HYCOS addresses flood and drought forecasting, water

resources assessment, water resources databases, groundwater and water quality monitoring and assessment. As it proceeds, the project will significantly enhance hydrological infrastructures and capacities across the region, generating expertise and information to support disaster risk reduction and other regional priorities. In addition, NMHSs can access programmes at a number of training institutions across the region their efforts to strengthen their capacities. These include the New Zealand NMS Regional Training Centre in Wellington, the Australian Bureau of Meteorology (BOM) Training Centre in Melbourne and the Meteorological Services Training Centre in Nadi, Fiji.

On a broader level, coordination and more general support for disaster risk reduction activities are available from a number of regional bodies. Examples include the WMO Regional Association V Tropical Cyclone Committee, Council of Pacific Regional Organisations and Programmes (CROP), the South Pacific Applied Geoscience Commission (SOPAC) Disaster Management Programme, the Secretariat of the Pacific Regional Environment Programme (SPREP) Pacific Climate Change Framework, US NOAA Pacific Disaster Programme and the Pacific Islands GCOS Advisory Group. Disaster risk reduction falls under the Sustainable Development component of the Pacific Plan aimed at enhancing economic growth, sustainable development, good governance and security for Pacific countries. The Strategic Action Plan for the Development of Meteorology in the Pacific (SDMP) represents a blueprint for the development of National Meteorological Services to fulfill their roles and responsibilities in disaster risk reduction. The SDMP, the Pacific Islands Global Climate Observing System (PI-GCOS) Action Plan and projects formulated under the Pacific Meteorological Services Needs Analysis Project (PMSNAP) provide foundations for further strengthening of the capacities of regional NMHSs. Resource mobilization efforts in support of capacity and infrastructure development can, moreover, target a broad range of potential partners with interests in the South-West Pacific including the World Bank and Asian Development Bank, the UNDP and national programmes such as AusAID, NZAID and donor agencies in the USA, France, China, Japan, the European Union and the United Kingdom.

CHAPTER 9

EUROPE

WMO REGIONAL ASSOCIATION VI

9 EUROPE (WMO Regional Association VI)

9.1 Abstract

Survey responses from 44 European NMHSs indicated that virtually all operate observation and telecommunications networks and forecast/warning centres on a round-the-clock basis and most of them have emergency contingency plans in place. However, about half consider that their observing and telecommunications networks are inadequate and most also believe that upgrading their forecasting and warning services would enhance disaster risk reduction. Almost all of them advocate better coordination with nearby NMHSs, Regional Specialized Meteorological Centres (RSMCs) and other stakeholders. Across Europe, NMHS hazard warning programmes are generally in place though not all significant hazards are always addressed. Moreover, competing private sector hazard warning services are present in about a third of the countries. Over half the countries have separate National Meteorological Services (NMSs) and National Hydrological Services (NHSs) and advocate improved coordination between them. Fewer than half of the NMHSs provide value-added services to critical sectors such as land-use planning, development and housing and fresh water supply and, though endorsing the value of such services; many point to their lack of related expertise. Most of them also consider that educational outreach programmes for the media, public and disaster authorities should receive greater emphasis. In addition, many cite needs for additional forecast training and joint training with stakeholders. Most also feel constrained by limited resources, identifying operating budgets and professional staff as particular issues. While most of the 44 NMHSs participate in their national disaster risk coordination committees, at least some feel constrained by inadequate recognition and by a lack of clarity regarding their roles. At sub-regional levels, NMHSs in North-West Europe have, on average, better infrastructures and capacities and are more closely integrated into disaster risk mechanisms. In Eastern Europe, infrastructures and capacities match the regional picture but national coordinating committees are less widely established and NMHSs more often feel constrained by them. Southern European NMHSs, in contrast, have generally weaker than average infrastructures and capacities while coordination with other disaster stakeholders is less well established. The preceding survey results provide a substantive rationale for the following conclusions and recommendations aimed at enhancing European NMHSs' capacities to contribute to disaster risk reduction:

- All European NMHSs should be integrated into their national disaster risk reduction systems. Those who are not already members, particularly some in Eastern and Southern Europe, should seek membership in their national disaster risk coordinating committees. Where necessary, NMHSs should press for clear direction regarding their roles and responsibilities.
- Though most European NMHSs maintain records of the most common hydrometeorological hazards, progressively fewer do so for less frequently occurring ones. Consequently, needs exist to improve data management and archiving systems for hazard data in a considerable number of countries along with associated needs for related training and capacity development.
- A significant number of European NMHSs require capacity development and training in disaster risk applications such as hazard and impact analysis, hazard mapping, risk zone analysis and product customization in order to provide enhanced services for disaster risk reduction.
- Roughly half the European NMHSs consider that their observation networks inadequate; with a few NMHSs not maintaining 24-hourly observational coverage. Similarly, many NMHSs point out deficiencies in their telecommunications systems with one reporting that it does not have 24-hourly telecommunications capability. Therefore, needs exist to upgrade some observation and telecommunications systems in Europe, with particular emphasis on their 24-hourly operation.
- Needs also exist to strengthen many European NMHSs' hazard warning infrastructures and associated capacities. In a few instances the NMHSs do not provide 24-hourly warnings services

and one NMHS does not have forecasting and warning capabilities. These latter NMHSs should be particular targets for upgrading and capacity building initiatives.

- Official warnings of hydrometeorological hazards should emanate from a single competent issuing authority in each country, ideally the NMHS. In some circumstances, they may, nevertheless, benefit from interpretation by civil defence authorities before being widely disseminated.
- Verification programmes for hydrometeorological hazard warnings should be implemented by all European NMHSs to monitor warning accuracy and timeliness, assess improvements in skill, and demonstrate NMHSs' warning capabilities to stakeholders.
- European NMHSs who have not already done so should establish back-up arrangements to maintain services in emergency situations, possibly through partnership agreements with neighbouring NMHS.
- NMHSs should encourage the establishment of national readiness systems within their countries.
- Operational coordination should be improved between NMSs and NHSs in Europe and with neighbouring NMHSs and RSMCs, particularly in relation to issue of hazard warnings.
- European NMHSs should increase emphasis on the provision of enhanced products and services to sensitive economic sectors such as land-use planning, housing and development and water resources. These sectors do not receive special services in about half the countries.
- Most European NMHSs should increase emphasis on education and outreach directed at key stakeholders and the public at large since fewer than half of them currently giving high priority to such activities.
- European NMHSs identify wide ranging needs for support from WMO particularly in relation to technology transfer and capacity building, education, training and public outreach and infrastructure and strategic partnership development.

The present chapter centres on the assessment of the survey responses from NMHSs in Europe (WMO RA VI). Its internal structure follows the sequence outlined earlier in section 2.6.1.

9.2 The Response to the Survey

The 44 countries in Europe who contributed responses to the WMO country-level survey are listed in Annex 2. It is important to note here that, under the WMO Regional Association system, the survey responses from Kazakhstan are not included in the analysis for Europe while those from Russia are included.

9.3 The Hazards affecting Countries in Europe

Figure 119 below lists the number of responding countries in Europe (WMO RA VI) who identified themselves as being affected by the specified hazards.

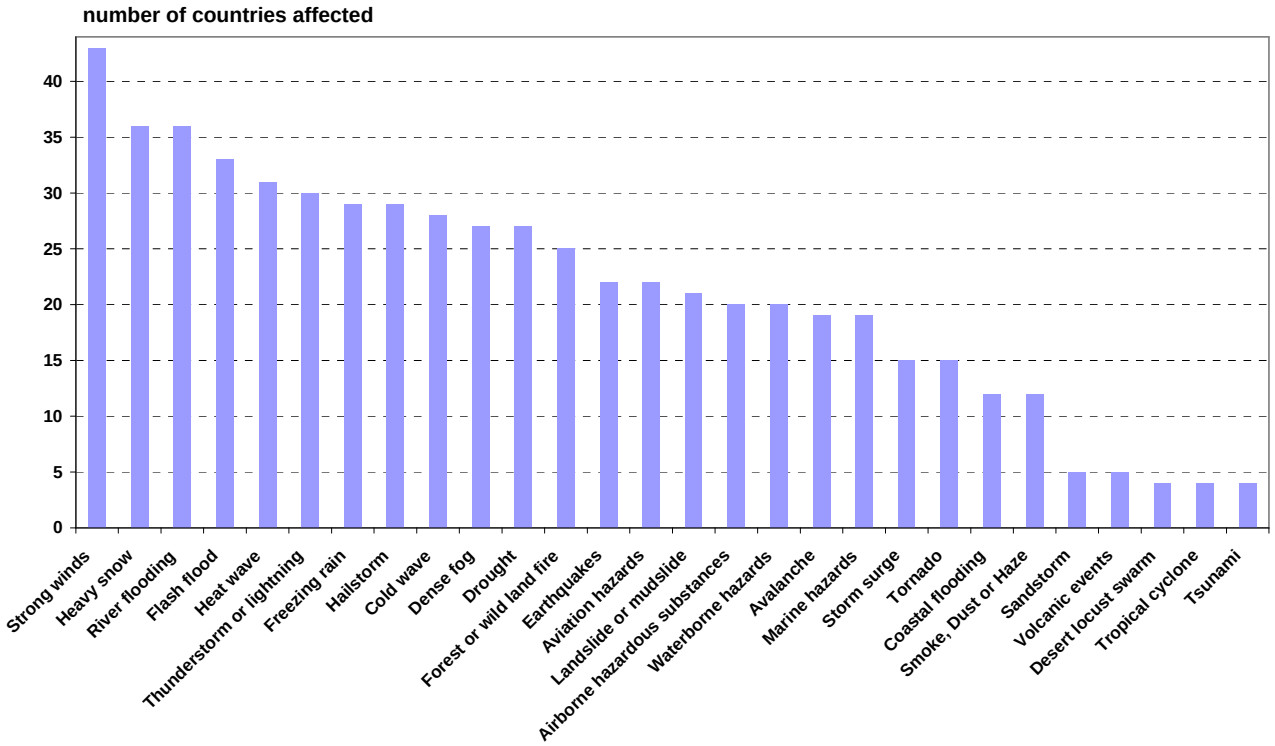


Figure 119. Number of responding countries in Europe who identified themselves as being affected by specified hazards.

9.3.1 Access to Data on Hazards and their Impacts

Annex 3 presents an overview of the hazard databases maintained by survey respondents in Europe (RA VI) and includes some supplementary information on related metadata and impacts information. Over half of the NMHSs in the region (56% or 24 of 43) who contributed to the WMO country-level survey stated that another agency was responsible for providing official information on the impacts of disasters in their country and that they had access to such official, reliable, information. In addition, however, roughly one third (34% or 15 of 44) of respondents reported that

they maintained their own internal database of official information on the impacts of hazards that affected their countries and most of them (76% or 13 of 17) regularly updated this database[25].

9.3.2 Value Added Services based on Historical Hazard Data

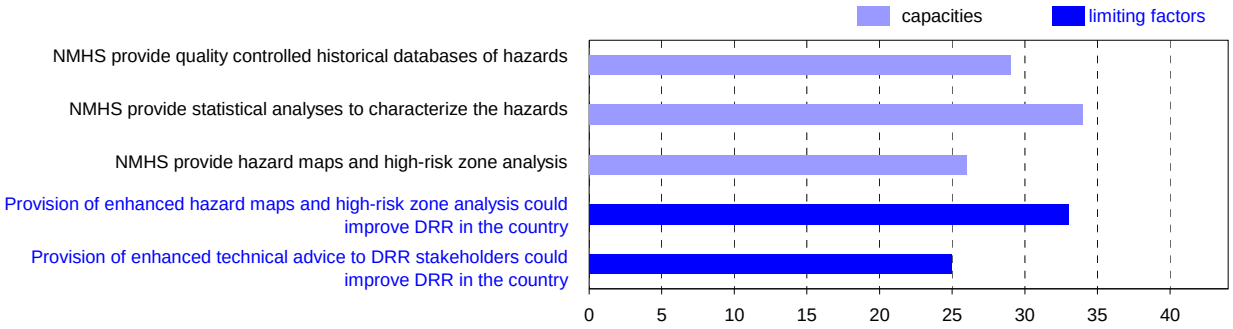


Figure 120. Provision of hazard information by NMHSs in Europe.

The following draws attention to the extent of value added services provided by NMHSs in Europe who maintain historical archives of hydrometeorological hazards. Most NMHSs who contributed to the country-level survey (80% or 33 of 41) stated that that they provided technical advice on hazards and about the same number (83% or 34 of 41) provided statistical analyses to characterize them. Over two thirds of respondents (71% or 29 of 41) reported that they maintained quality controlled historical databases of hazards and most of these (63% or 26 of 41) indicated that they undertook hazard mapping and high-risk zone analysis. About a quarter of respondents (28% or 11 of 40) stated that they provided analyses of the potential impacts of hazards.

More than a third of contributing NMHSs identified factors that limited their ability to provide hazard data products. Identified as limiting factors were quality assurance (42% or 16 of 38), ability to archive and update (41% or 16 of 39), professional staff with appropriate training and customization of data for stakeholders (39% or 15 of 38), and data rescue (36% or 14 of 39). Most NMHSs (85% or 34 of 40) considered that the provision of enhanced value added services in support of hydrometeorological risk assessment would strengthen their contributions to disaster risk reduction activities. The following specialized services were identified as valuable enhancements - hazard mapping and high-risk zone analysis (92% or 33 of 36) analyses of the potential impacts of hazards (89% or 32 of 36) and provision of technical advice (81% or 25 of 31).

9.4 The National Context for Disaster Risk Reduction

National legislative, governance and organizational structures for disaster risk reduction establish the context within which NMHSs make their contributions to safety of life and property. The following sections summarize survey responses regarding European countries' national systems for disaster risk reduction and the impact of these systems on their NMHSs.

[25] It is important to note, that, to date, no systematized, universally accepted, methodology or protocol has been established on a global basis for the creation and maintenance of hazard and hazard impacts databases.

9.4.1 Legislation and Governance

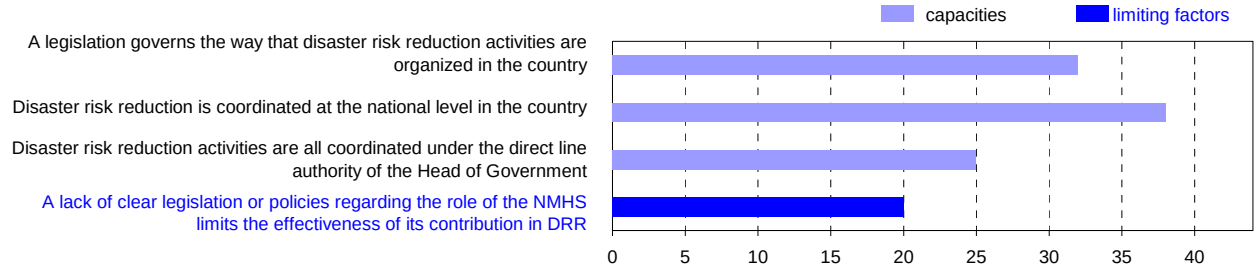


Figure 121. Legislation and coordination in support of disaster risk reduction at the national level in Europe.

Most European (RA VI) NMHSs who contributed to the survey (93% or 38 of 41) reported that disaster reduction activities were coordinated at the national level, in a majority of cases (63% or 25 of 40) under the direct line authority of the head of government. The organization of these activities was governed by legislation in about three quarters of the countries (78% or 32 of 41). In just under half (46% or 19 of 41) coordination was centred under one ministry. At the same time, almost half the survey respondents (49% or 20 of 41) considered that a lack of clear legislation or policies regarding the role of their NMHSs (e.g. as the sole issuer of hydrometeorological hazard warnings) limited their contributions to disaster risk reduction.

9.4.2 National Structures/Mechanisms for Disaster Risk Reduction

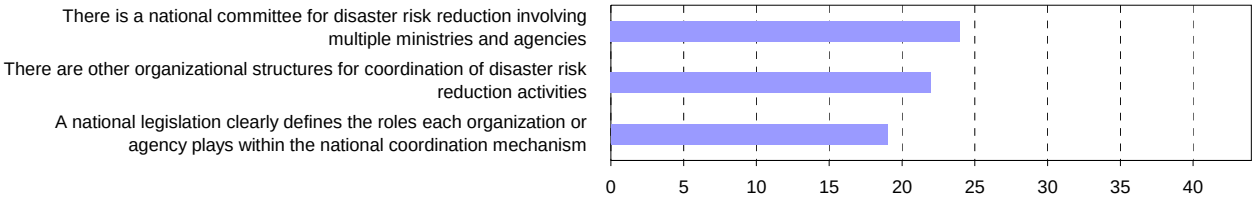


Figure 122. National structures for coordination of disaster risk reduction in Europe.

Almost two thirds of European contributors (62% or 24 of 39) indicated that their countries had a national committee for disaster risk reduction that involved multiple ministries and agencies. However, almost three quarters of them (74% or 29 of 39) stated that they were members of their national coordinating committee. Half of the survey respondents (50% or 19 of 38) reported that the roles of each participating agency in the national coordination mechanism were defined by legislation. Just over half (55% or 22 of 40) pointed out that other organizational structures for coordination also existed in their countries. A significant number of European NMHSs (41% or 17 of 41) felt that their contributions to disaster risk reduction were limited by their national disaster management structures and a lesser number (33% or 14 of 42) by a lack of linkages with other involved organizations.

9.4.3 NMHS Contributions to National Disaster Risk Reduction Systems

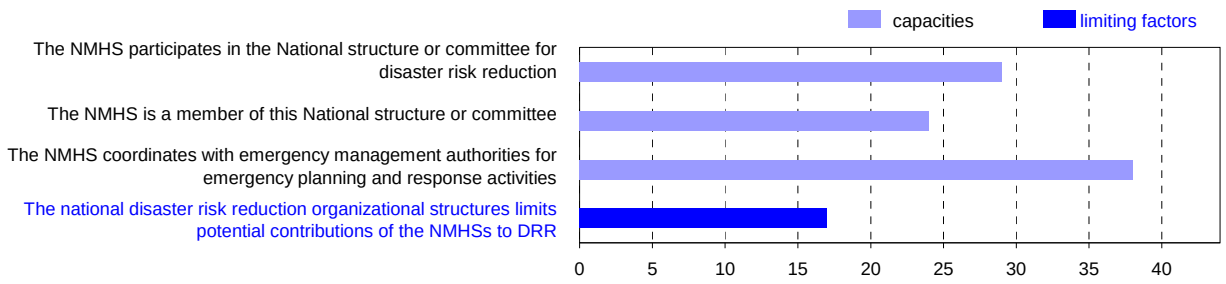


Figure 123. NMHS participation in national structures for disaster risk reduction in Europe.

All contributing European NMHSs (100% or 42 of 42) indicated that they provided support to agencies responsible for disaster risk reduction at the national level and the same number stated that they provided support to emergency response operations and emergency planning and preparedness. Most (95% or 41 of 43) also supported disaster prevention (e.g. hazard mapping, advice, historical hazard data) and a smaller number (76 or 31 of 41) supported post-disaster reconstruction (e.g. hazard data as input to reconstruction decisions). Virtually all survey respondents (98% or 40 of 41) reported that they extended their support to provincial or state government disaster-related activities and about three quarters (77% or 30 of 39) also provided support to municipal or local levels. About a third (33% or 14 of 42) of NMHSs who contributed to the survey, however, pointed to inadequate linkages with other involved organizations (e.g. emergency planners, emergency response agencies) as limiting their contributions to disaster risk reduction. Finally, three quarters of responding NMHSs (76% or 29 of 38) considered that their contributions would be enhanced by a “readiness system” that required appropriate responses by authorities to information issued by the NMHSs.

9.4.4 NMHS Collaboration with other Partners

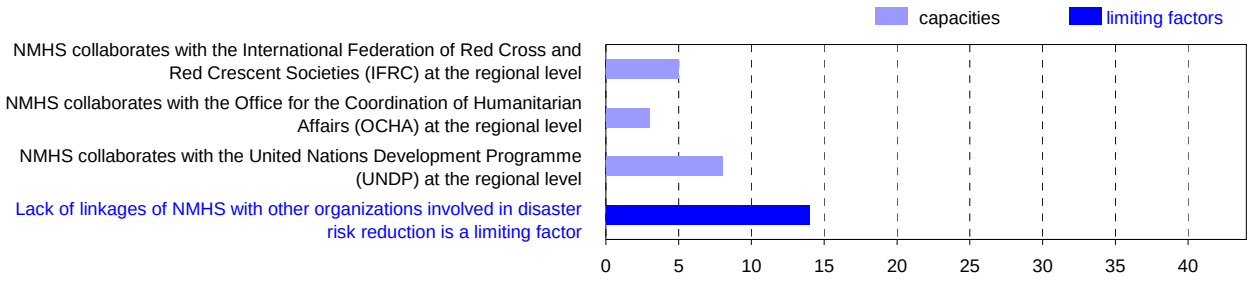


Figure 124. NMHS collaboration with partner agencies at the regional level in Europe.

Almost all survey contributors (95% or 38 of 40) in Europe reported that they coordinated with emergency management authorities for emergency planning and response and a similar number (98% or 40 of 41) stated that coordination was at the national level. A significant number (44% or 19 of 43) participated in activities on the level of a WMO Region or a regional economic grouping. Considerably smaller numbers (75% or 12 of 16) of them, however, participated in activities of international organizations, collaborated with their National Red Cross and Red Crescent Societies (26% or 11 of 43), interacted with the office of their national United Nations Coordinator (24% or 10 of 42) or participated in disaster reduction activities of the UNDP (47% or 8 of 17), the Office for the Coordination of Humanitarian Affairs (23% or 3 of 13) or the IFRC (36% or 5 of 14).

9.4.5 The Organization and Priorities of NMHSs

The priorities of individual NMHSs are, inevitably, influenced by the missions and priorities of their parent government ministries or departments. In consequence, the orientation of NMHSs may be more broadly focussed in some countries than in others. A parent department with a civil aviation mandate might, for example, emphasize provision of NMHS services to aviation while one with a natural resources or environment mandate might encourage its NMHS to provide warnings and other services to a broader range of sectors. Where National Meteorological Services, or combined National Meteorological and Hydrological Services[26], in Europe are concerned parent ministries include: Science; Equipment, Environment and Urbanism; Environment; Environment and Spatial Planning; Protection of Nature; Agriculture, Forestry and Water Economy; Natural Resources and Environmental Protection; Science, Education and Sport; Sustainable Development; Transport; Environmental Protection and Natural Resources; Transport and Energy; Transport and Communications; Defence; Traffic, Railroads and Development; Environment, Heritage and Local Government; Science Policy; Agriculture, Viticulture and Rural Development; Environment and Water Management; Equipment; Home Affairs; Science, Technology and Higher Education; and Research and Education. Correspondingly, parent departments of National Hydrological Services include: Environment, Food and Rural Affairs; Energy and Natural Resources; Environment; Interior; Agriculture, Forestry, Environment and Water Management; Agriculture and Forestry; Development; Petroleum and Energy; Water; National Infrastructures; Public Works; Industry; Water Law; Transport; Environment, Transport, Energy and Communications; and Environment and Management of Water Resources.

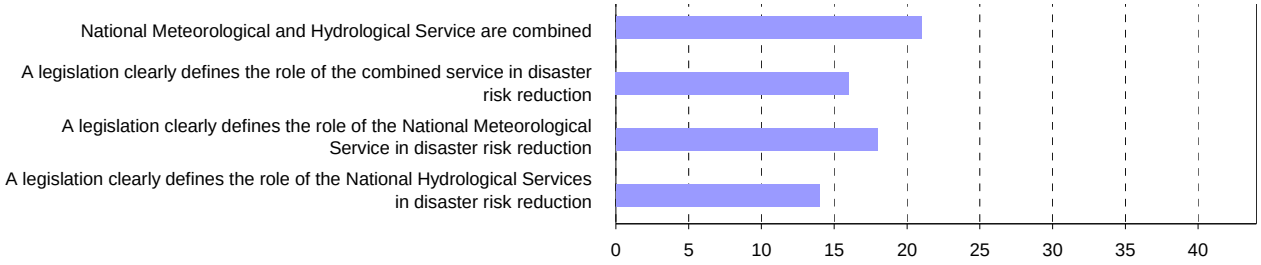


Figure 125. Organizational structure of meteorological and hydrological services in Europe.

The internal organization of National Meteorological and Hydrological Services within individual countries can also influence their ability to deliver well-coordinated hydrometeorological warnings and other services in support of disaster risk reduction. In Europe, almost half (48% or 21 of 44) of the contributors to the WMO country-level survey stated that they had a combined National Meteorological and Hydrological Service. Many of these (52% or 16 of 31) indicated that their country had national legislation that clearly defined the NMHSs role in disaster risk reduction[27]. Almost three quarters of those (72% or 18 of 25) with a separate NMSs and NHSs stated that they had legislation that clearly defined the role of the NMSs in disaster risk reduction. A somewhat smaller number (58% or 14 of 24) reported legislation that applied to the role of the NHSs. At the same time, a majority (63% or 15 of 23) of European contributors thought that legislation or partnership agreements were needed to better define the respective roles of their NMSs and NHSs in disaster risk reduction. In addition, most European NMHSs (91% or 20 of 22) considered that better technical coordination between their NMSs and NHSs would result in enhanced joint products and services with a slightly smaller majority (82% or 18 of 22) advocating that better coordination would result in enhanced issuance of warnings.

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[26] Parent departments of NMS and NMHS have been grouped together due to ambiguities in responses regarding the existence or otherwise of combined NMHS.

[27] A possible anomaly exists in relation to the reported NMHS organization in several countries.

9.4.6 Operational Coordination between NMSs and NHSs

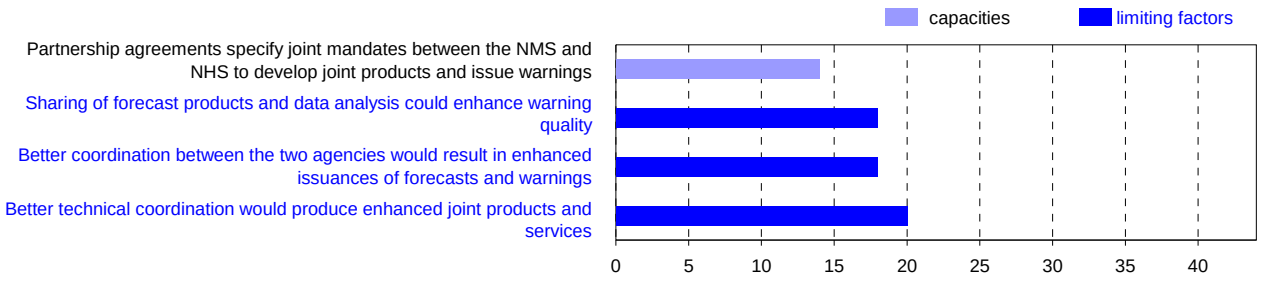

Figure 126. Coordination between NMS and NHS in Europe.

More than half (61% or 14 of 23) the survey contributors from European countries with separate NMSs and NHSs identified that partnership agreements were in place specifying mandates between their NMS and NHS to develop joint products and issue warnings. A larger number (72% or 18 of 25) indicated that the two agencies shared forecast products and data analyses that could enhance warning quality. Many of these (50% or 12 of 24) stated that coordination took place before warnings were issued for hazards of mutual concern a smaller number (29% or 7 of 24) indicated that coordination also took place for any hazard warning was issued. Some contributing NMHSs (57% or 8 of 14), however, reported that there was no coordination on warnings. Most respondents (82% or 18 of 22) to the survey felt that better overall coordination between the two agencies would enhance issuance of forecasts and warnings and slightly more (91% or 20 of 22) considered that improved technical coordination would result in enhanced joint products and services.

9.5 NMHS Infrastructure, Products and Services

The following sections summarize the information contained in survey response related to observational networks, telecommunications systems, warning and forecast production systems and their products, dissemination systems and related aspects of the overall operational capacities of the NMHSs in Europe (WMO RA VI).

9.5.1 Observation and Monitoring Networks and Systems

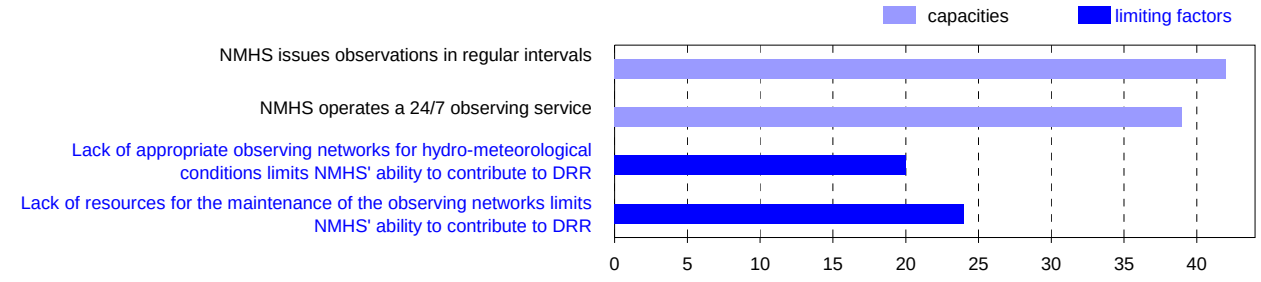

Figure 127. Observation and monitoring networks and systems in Europe.

Most European NMHSs who contributed to the survey (98% or 42 of 43) stated that they had an operational observing capacity that issued observations at regular intervals and most of these (91% or 39 of 43) reported that the observing service operated 24-hourly/year-round. Over half (62% or 21 of 34) of them indicated that their observation network included sea level monitoring stations. However, almost half the respondents (49% or 20 of 21) also considered that a lack of

appropriate hydrometeorological observing networks limited their ability to contribute to disaster risk reduction. Moreover, some (23% or 9 of 39) identified the availability of a dedicated 24-hour/year-round observing service as an additional limiting factor. Major challenges in maintaining observation networks were also stressed, with a majority of respondents (78% or 32 of 41) highlighting limited resources (e.g. financial, replacement parts, personnel, etc), half (50% or 20 of 40) citing limited professional staff with appropriate training, and a few (18% or 7 of 39) mentioning hazard-related damage.

9.5.2 Telecommunications and Informatics

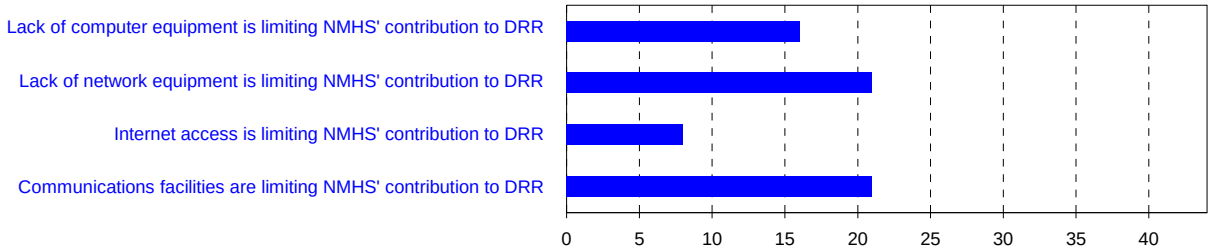

Figure 128. Telecommunication and informatics in Europe.

Almost all European NMHSs who contributed to the survey (98% or 42 of 43) reported that their telecommunications systems were available 24-hourly/year-round. Confirmation was provided by responses indicating that almost all forecasting staff (98% or 42 of 43) in the region had access to real time hydrometeorological data. However, over half of respondents (55% or 21 of 38) went on to identify that their ability to deliver critical products for disaster risk reduction was limited by communications facilities. Other limitations were cited in major areas of informatics, with three quarters of respondents (74% or 28 of 38) highlighting the unavailability of application software, over half (57% or 21 of 37) identifying network equipment (57% or 21 of 37), computers (44% or 16 of 36) and inadequate Internet access (22% or 8 of 37). Finally, most contributing NMHSs (88% or 30 of 34) considered that upgrading the operational infrastructure for forecasting and warning services would enhance disaster risk reduction capacities in their countries.

9.5.3 Data Exchange

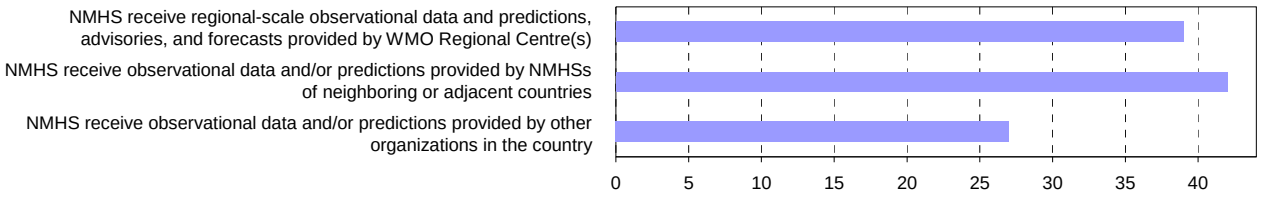

Figure 129. Data exchange in Europe.

Survey responses from NMHSs in Europe (RA VI) identified that almost all (98% or 42 of 43) forecasting staff had real time access to hydrometeorological data. Most contributors to the survey (91% or 39 of 43) also used regional scale observational data and forecasts provided by WMO Regional Specialized Meteorological Centres, data from neighbouring countries (95% or 42 of 44) and from other organizations in their countries (63% or 27 of 43). In addition, more than half of them (69% or 22 of 32) received real time marine observations from the GTS and some (54% or 13 of 24) relayed sea level observations on that global network. Conversely, however, over half of the respondents to the WMO survey (55% or 21 of 38) indicated that their NMHSs were limited in their ability to deliver critical products and services for disaster risk reduction by communications

facilities. Equally, significant numbers stated that their NMHSs were limited by customization of data for stakeholders (39% or 15 of 38), quality assurance (42% or 16 of 38) or ability to archive and update (41% or 16 of 39). A substantial majority of contributing NMHSs in Europe considered that they required better coordination with neighbouring NMHS (91% or 30 of 33) on hydrometeorological data exchange and with RSMCs (96% or 25 of 26).

9.5.4 Forecast and Warning Capability

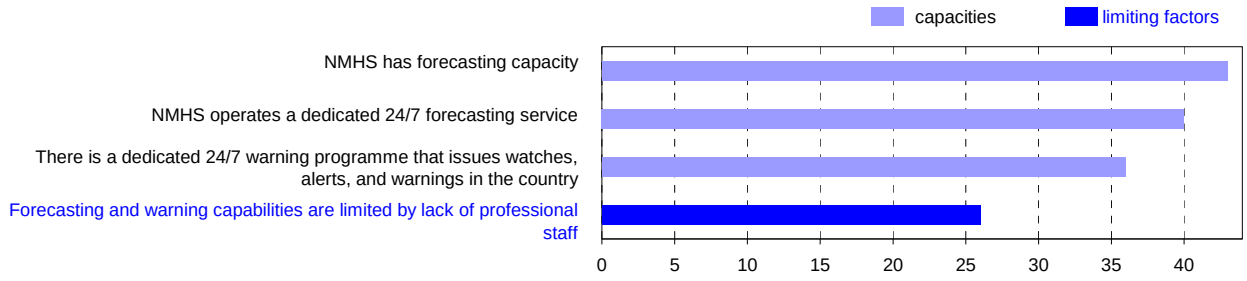

Figure 130. Forecast and warning capabilities in Europe.

Almost all NMHSs (98% or 43 of 44) in Europe who contributed to the country-level survey indicated that they had an operational forecasting capability and most (93% or 40 of 43) of these stated that this was a dedicated 24-hourly/year-round forecast service. All respondents (100% or 39 of 39) stated that a meteorologist was required to be on-site to operate this service. Most contributors (84% or 36 of 43) also reported that they had a dedicated hazard warning programme that issued watches, alerts and warnings on a 24-hourly/year-round basis. All who responded to the question (100% or 35 of 35) indicated that a meteorologist was on site during the operational hours of the warning programme. In addition, most NMHSs (89% or 31 of 35) stated that they provided a marine forecast and warning service to mariners and coastal zone users and about half of these (50% or 16 of 32) also prepared marine forecasts for the Global Maritime Distress and Safety System (GMDSS). On the negative side, three quarters of survey contributors (74% or 28 of 38) indicated that their NMHS was limited in its ability to deliver critical products and services for disaster risk reduction by application software. Roughly two thirds (68% or 26 of 38) cited professional staff as limiting and almost one half (44% or 16 of 36) cited computers. Most European respondents (85% or 35 of 41) considered that upgrading their NMHSs operational forecasting and warning services would enhance disaster risk reduction in their countries. More specifically, most (94% or 32 of 34) of them advocated the upgrading or technical training of professional staff.

9.5.5 Forecast and Warning Products

Table 8 in Annex 4 summarizes information on hazard warnings and products issued by NMHSs in Europe who responded to the survey. The survey responses indicated that the hydrometeorological hazards affecting the greatest number of European countries were, in declining order, strong winds, heavy snow, river flooding, flash floods, heat waves, thunderstorms and lightning, hailstorms, freezing rain, cold waves, droughts, dense fog, and forest or wild land fires[28]. Additional hazards identified as of concern to roughly half of European countries included earthquakes, aviation hazards, landslides or mudslides, waterborne hazards and airborne hazardous substances.

[28] The survey responses do not provide information on the magnitudes of the impacts associated with individual hazards, simply that they occur in the reported number of countries.

Examination of the data in Table 8 reveals that most affected NMHSs issued warnings for the most common of the above hazards, with warnings service being provided less widely for the less common hazards. The most notable deficiency areas were in relation to landslides or mudslides, where only about half of affected NMHSs reported that they had a warning programme, and tornadoes, where only about two thirds of affected NMHSs had a warning programme. Desert locust swarms, a much less widely experienced hazard, represented another anomaly where four countries reported that they were affected but only one NMHS issued warnings. It will clearly be necessary to implement warnings for these latter hazards in all affected countries if effective support for disaster risk reduction is to be ensured.

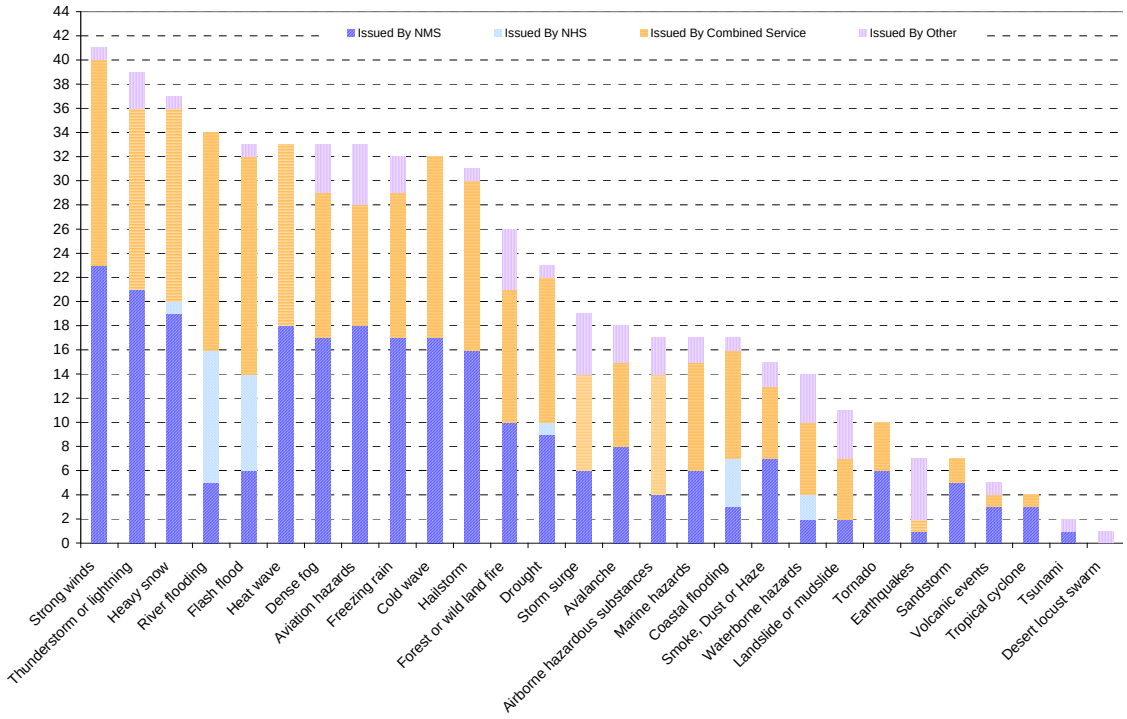

Figure 131. Agencies mandated for issuance of warnings in Europe.

Survey contributions from European NMHSs indicate that, broadly speaking, NMSs and combined NMHSs are responsible for roughly equal numbers of warnings for most major hazards, probably reflecting organizational structures across Europe. A striking exception, however, is the situation with respect to river flooding, flash floods and coastal flooding where combined NMHSs are responsible for roughly three times as many warnings as NMSs and warnings issued by NHSs also exceed those issued by NMSs. Furthermore, a possible survey anomaly is a reported situation where one NHS is responsible for issue of warnings of heavy snow. The survey data also indicate that the NMHSs (or, as the case may be, NMSs or NHSs) are the sole issuers of warnings in a majority of European countries but that competing warning services are also present in up to about a third of the countries in the region. Survey responses suggest that official warnings for the major hazards include information regarding their potential impacts in about a third to one half of European countries. The inclusion rate for impacts information, however, also varies somewhat between different hazards for which warnings are issued. Finally, the fact that a large majority of contributing NMHSs considered that further improvements were needed to their warnings opens the door to inclusion of impacts information and additional hazards in European NMHSs warning programmes.

9.5.6 Coordination of Warnings

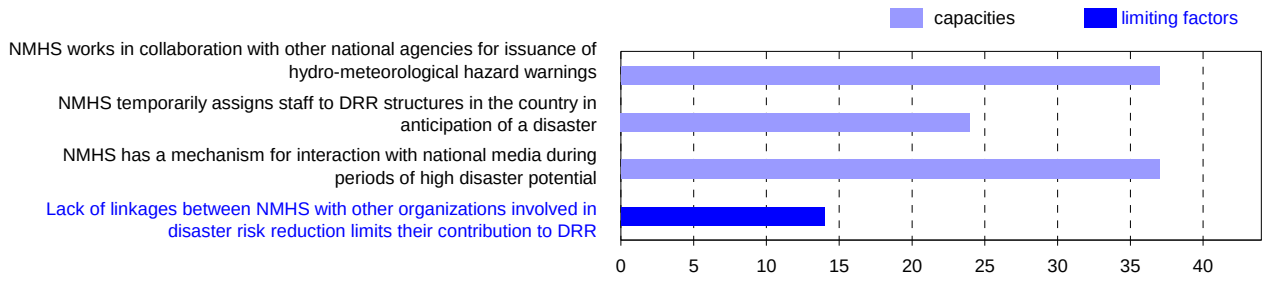

Figure 132. External coordination for issuance of warnings in Europe.

Early warnings of hydrometeorological hazards represent a vital contribution to disaster risk reduction. In Europe, most NMHSs (90% or 37 of 41) who contributed to the WMO country-level survey reported that they worked in collaboration with other agencies (e.g. agriculture, aviation, etc) with respect to hazard warnings. Most of them (82% or 31 of 38) discussed the hazard's characteristics and potential impacts with these agencies prior to issuing a warning. In addition, most survey respondents (88% or 37 of 42) stated that they had a mechanism for interaction with their country's media during periods of high disaster potential. Over half of them (59% or 24 of 41) indicated that they temporarily assigned staff to disaster risk management structures in anticipation of a disaster. Roughly a third of NMHSs (34% or 15 of 44) pointed out that there were other public or commercial entities that provided competing warning services in their countries. Almost all survey contributors in Europe (91% or 30 of 33) considered that their NMHSs required better coordination of watches and warnings with neighbouring NMHSs and most of these (88% or 23 of 26) also advocated improved coordination with WMO Regional Specialized Meteorological Centres.

9.5.7 Products and Services for Selected Socio-Economic Sectors

As a further refinement, Figure 113 illustrates the provision by NMHSs of specialized alerts, warnings and other products to significant socio-economic sectors in Europe that can be seriously affected by hazardous events. In the context of disaster risk reduction, it is noteworthy from Figure 113 that less than half (45%) of responding NMHSs indicated that they provided support to development and housing or land-use planning and, equally, less than half (47%) provided services to the fresh water sector.

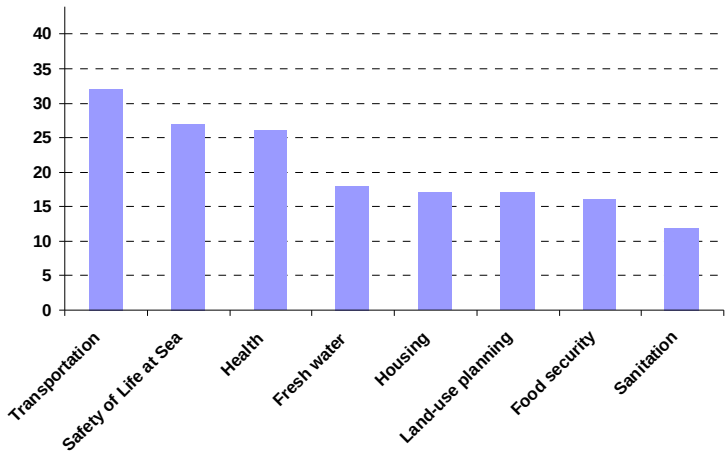

Figure 133. NMHS provision of services to selected economic sectors in Europe.

9.5.8 Dissemination Systems and Target Audiences

The following Figures 134 and 135 summarize the survey responses relating to the dissemination of hazard products by NMHSs in Europe. They provide information on the types of products that are disseminated, to whom they are provided and on the methods of dissemination that are used to convey the products to the recipients. The same information is also presented in numerical form in Table 7 of Annex 5 where the figures represent the number of responding NMHSs who reported that they provided the specified product to the indicated target audience or, as appropriate, utilized a particular means of dissemination.

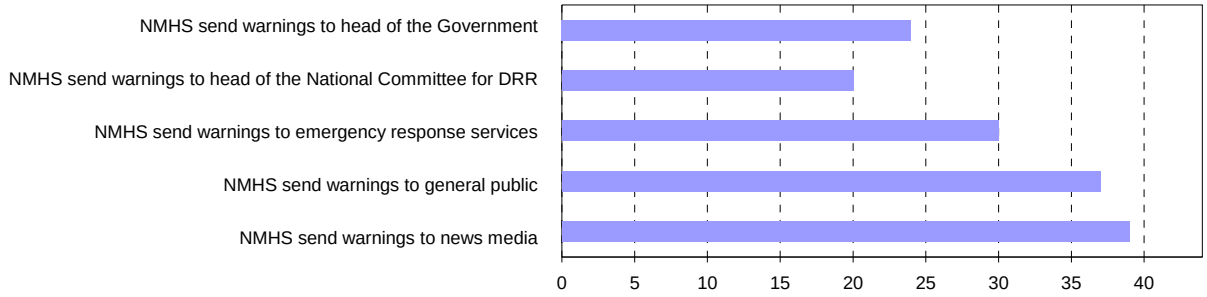

Figure 134. Warning target audience in Europe.

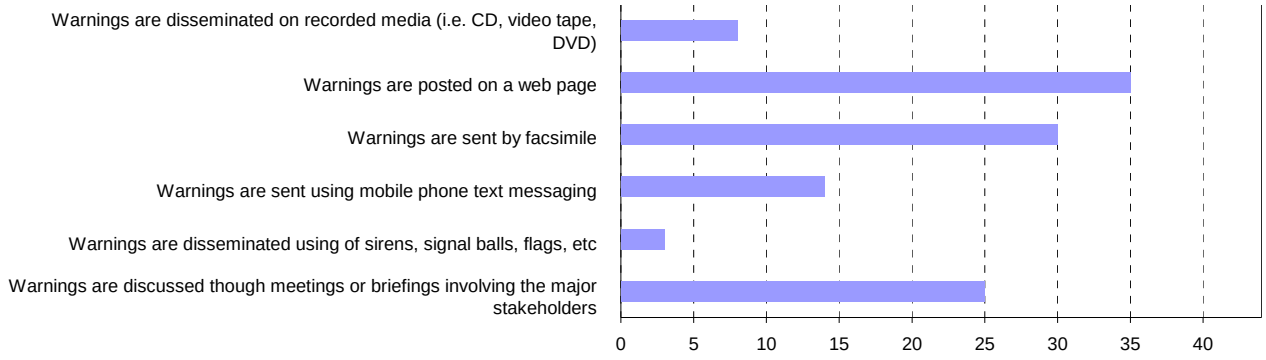

Figure 135. Warning dissemination methods in Europe.

As might be expected a very high percentage of survey respondents from Europe indicated that they disseminated hazard warnings to the public and the media and to relevant government authorities. In contrast, however, a relatively low percentage of contributing European NMHSs disseminated warnings and other products to external partners in disaster risk reduction such as national Red Cross and Red Crescent Societies and others. The major dissemination methods in Europe were via web page, facsimile, briefings and Internet downloads. Substantial numbers of European NMHSs also used hard copy mailings and a few used sirens and other signal devices.

9.5.9 Product Utility and Product Improvement

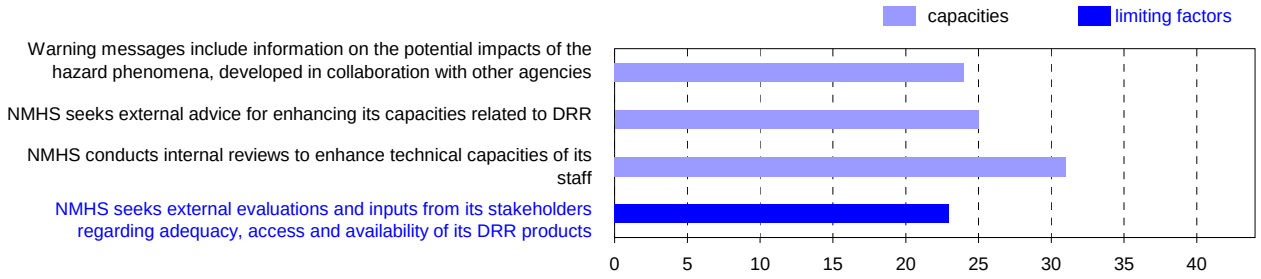

Figure 136. Ongoing feedback and improvement of products in Europe.

Most (90% or 37 of 41) NMHSs in Europe who contributed to the survey indicated that they worked with other agencies with respect to hazard warnings. Most (90% or 26 of 29) also stated that they had regular interaction with disaster risk authorities to enhance their warning capabilities and content. Almost two thirds (63% or 24 of 38) of those who included information on potential risks (impacts) in warning statements indicated that they collaborated with other agencies to develop risk information. A majority (63% or 25 of 40) of European respondents also stated that they sought external advice for enhancing their capacities to support disaster risk reduction, specifically to enhance monitoring and forecasting, watches and warnings (83% or 24 of 29), or overall products and services (79% or 22 of 28). Moreover, almost two thirds of them (63% or 27 of 43) indicated that their NMHSs had a quality control mechanism to enhance their warning capabilities and content. Most of these (90% or 26 of 29) indicated that the mechanism provided for regular interaction with stakeholders (disaster risk authorities) and included feedback from stakeholders and the public after an event had occurred (88% or 23 of 26). Less than half (44% or 12 of 27), however, stated that it provided for training for stakeholders to understand hazards, warnings and their implications. About half of responding European NMHSs (56% or 23 of 41) reported that they sought external evaluations and inputs from stakeholders regarding the adequacy, relevance, method of access and availability of their disaster risk reduction products. Most survey contributors (78% or 32 of 41), however, believed that the lack of public understanding of hazards, watches and warnings limited the public response to them. Roughly half (56% or 23 of 41) also considered that the lack of joint training between NMHS staff and disaster risk managers limited their disaster risk reduction efforts and a similar number (50% or 21 of 42) advocated the need for joint training with emergency authorities and managers. Furthermore, most European NMHSs (80% or 33 of 41) who contributed to the survey felt that educational modules for media, public and disaster risk authorities would enhance their effectiveness in disaster risk reduction.

9.5.10 Internal NMHS Training and Capacity Enhancement

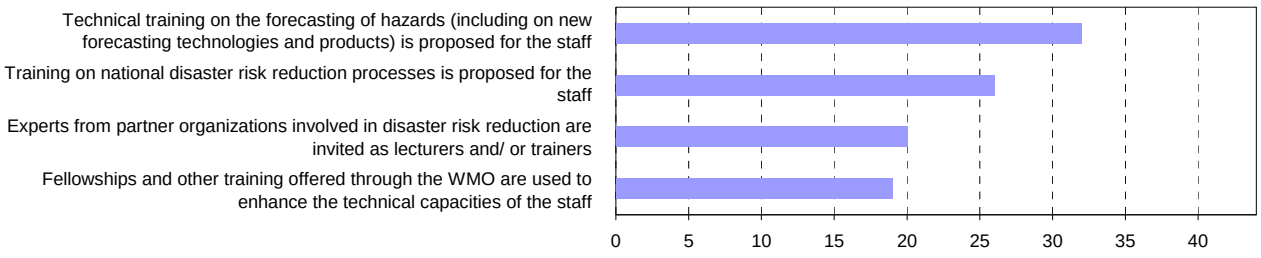

Figure 137. Training and capacity building of NMHS' staff in Europe.

Three quarters of responding NMHSs (74% or 32 of 43) in Europe indicated that they provided ongoing technical training to staff on forecasting of hazards, including up to date training on new forecasting technologies and products. A similar number (74% or 31 of 42) also reported that they conducted internal reviews and sought staff inputs to enhance their capacity building and technical training activities. In addition, some (44% or 19 of 43) stated that they utilized Fellowships and other training offered through WMO to enhance the technical capacities of their staff. Over half (60% or 26 of 43) provided training to staff on their country's disaster risk reduction processes and related topics and many of them (47% or 20 of 43) invited experts from partner organizations involved in disaster risk reduction as lecturers and/or trainers. The majority of European survey contributors (71% or 30 of 42) also conducted evaluations of the suitability of communications, workstations, and software and many (79% or 31 of 39) implemented upgrades to these systems to support disaster risk reduction. However, less than half of responding NMHSs (48% or 20 of 42) in Europe reported that they held or participated in joint training activities for NMHS staff and emergency response agencies.

Balancing the preceding, over one third of European contributors (37% or 15 of 41) indicated that lack of forecaster training at their NMHS reduced the effectiveness of their warning service. A similar number (39% or 15 of 38) reported that (lack of) professional staff with appropriate training limited their ability for real time monitoring of hazards. Over half (56% or 23 of 42) stated that a lack of joint training with disaster risk managers and with media limited their contributions to disaster risk reduction. Half the European respondents (50% or 21 of 42) to the WMO country-level survey stated that the lack of joint training between NMHS staff and emergency authorities and managers limited their disaster risk reduction efforts. Equally, half (50% or 20 of 40) identified that their ability to provide hazard data products was limited by the lack of professional staff with appropriate training. Not surprisingly, most responding NMHSs (85% or 35 of 41) in Europe considered that upgrading and improving their operational forecasting and warning activities would enhance their disaster risk capacities. Most of them (92% or 32 of 34) considered that upgrading and improving the technical training of the professional forecasting staff would enhance these capacities. Most (85% or 28 of 33) also advocated the conduct of cross-border training activities with neighbouring NMHSs, targeted at common hydrometeorological hazards.

9.5.11 Outreach Activities

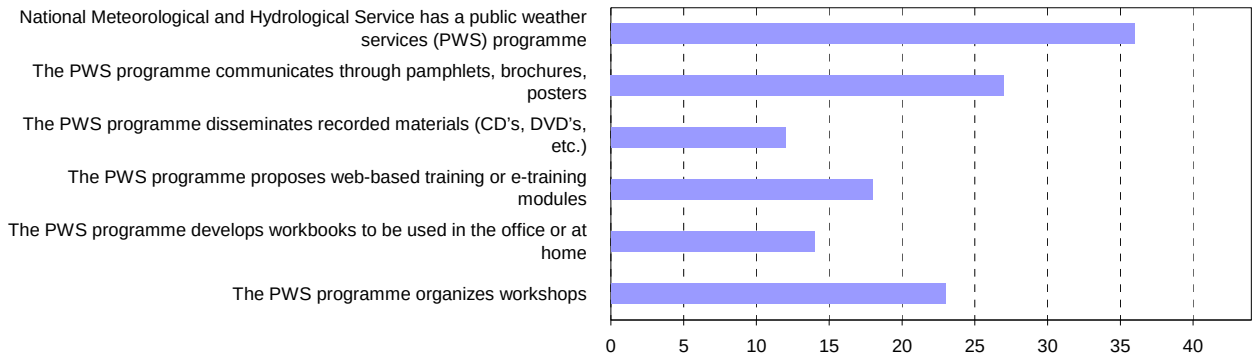

Figure 138. Outreach activities in Europe.

Outreach activities aimed at the general public and other stakeholders represent an important component of any effective disaster risk reduction programme. Within NMHSs, outreach activities are often part of a public weather services programme. In Europe (RA VI), most NMHSs (82% or 36 of 44) who contributed to the WMO survey identified that they had such a public weather services programme. Less than half (44% or 12 of 27) the respondents, however, stated that their NMHS quality control programme included training for the stakeholders to understand the hazards, warnings and their implications. About a quarter of the responding NMHSs (26% or 11 of 42)

provided education and training on hazards, watches, warnings, etc to disaster risk reduction managers and authorities and operational emergency response managers. Relatively few (17% or 7 of 42) respondents identified that they provided training targeted at the trainers (i.e. of disaster risk authorities, emergency response staff, media, etc). Similarly, relatively few (14% or 6 of 42) provided educational modules and training programmes targeted at the general public and few (15% or 6 of 41) provided training to the media. Almost half (48% or 20 of 42) the European NMHSs, however, reported that they pursued joint training activities with emergency response agencies. The following materials and methods were identified as being used in NMHS public outreach programmes in Europe: - pamphlets, brochures, posters (69% or 27 of 39), workshops (59%), Web-based training (45%), workbooks for office or home use (36%), recorded materials (CDs, DVDs, etc) (32%) and E-training modules (21%).

Most (78% or 32 of 41) European contributors to the country-level survey judged that the lack of understanding of the effects of hazards limited the public's response to warning services. In addition, more than half (56% or 23 of 41/42) also felt that the lack of joint training with the media and disaster risk managers and with emergency authorities and managers (50% or 21 of 42) limited their disaster risk reduction efforts. As a consequence, most NMHSs (80% or 33 of 41) in Europe considered that educational modules that they could target at media, public and disaster authorities would enhance their effectiveness in disaster risk reduction.

9.6 NMHS Contingency Planning

Most contributing NMHSs in Europe (76% or 32 of 34) reported that their NMHS had a contingency plan to maintain the continuity of products and services in the event of organizational emergencies such as power failure or communications disruption. Almost half of them (47% or 15 of 32) stated that their contingency plans involved an agreement or protocol with neighbouring NMHSs to support them in the event of catastrophic failure. In addition, most (71% or 30 of 42) also reported that they conducted or participated in drills and exercises to ensure disaster preparedness. However, most European contributors to the survey (81% or 26 of 32) identified needs for improved coordination with neighbouring NMHSs, specifically citing the need for support from them in the event of disruption of services.

9.7 Overarching Factors

NMHSs participating in the country-level survey were asked to respond to a series of questions directed at obtaining expressions of opinion from them regarding overarching factors or realities that either limited or could enhance their ability to make optimal contributions to disaster risk reduction. To varying degrees, the responses to these questions also served to validate statements, expressions of opinion and/or recommendations contained in responses to earlier sections of the survey. The following summarizes the inputs that fall under the above broad category:

9.7.1.1 NMHS Visibility

Most NMHSs in Europe (83% or 35 of 42) who responded to the survey considered that they needed higher visibility and recognition within government as a major contributing agency to disaster risk reduction. Over half (61% or 25 of 41) also felt that their contributions to disaster risk reduction were limited by the lack of understanding by government authorities of the value provided by the NMHSs. Most respondents (93% or 37 of 40) considered that improved ministerial level understanding of the socio-economic benefits of hydrometeorological products and services would increase the visibility of the NMHSs at the national level.

9.7.1.2 Organization and Governance

Close to half of responding NMHSs in Europe (41% or 17 of 41) considered that their national organizational structure for disaster risk reduction limited their potential contributions in this area. A larger number (49% or 20 of 41) considered that the effectiveness of their contributions to disaster

risk reduction was limited by the lack of clear legislation or policies regarding the role of the NMHSs (e.g. as the sole issuer of warnings). In addition, a majority of the contributors (65% or 15 of 23) from European countries with separate NMSs and NHSs considered that there was a need for legislation or partnership agreements to better define the role each agency played in disaster risk reduction.

9.7.1.3 Coordination and Partnership

A third (33% or 14 of 42) of NMHSs in Europe who responded to the survey considered that their contributions to disaster risk reduction were limited by a lack of linkages between the NMHSs and other involved organizations. In addition, most responding NMHSs (83% or 34 of 41) considered that better coordination with neighbouring or adjacent countries would improve their contributions to their own nation's disaster risk reduction activities. Many (65% or 26 of 40) also considered that better coordination with WMO Regional Specialized Meteorological Centres would improve their contributions.

9.7.1.4 Resources and Capacity

Most contributing NMHSs in Europe (88% or 29 of 33) indicated that resources and infrastructure limited their ability to deliver critical products and services for disaster risk reduction, specifically identifying financial resources (92% or 35 of 38) and professional staff (68% or 26 of 38) as key limiting factors. In consequence, most (85% or 35 of 41) considered that upgrading and improving NMHS operational forecasting and warning services would enhance the disaster risk reduction capacity within their country.

9.8 WMO Support

The following list summarizes the needs for support from WMO expressed by the NMHSs in Europe who responded to the survey. They needs are listed in the descending order of priority assigned to them by European NMHS who contributed to the country-level survey.

1. Technology transfer, capacity building, technical guidelines and technical training (e.g. forecasting tools and methodologies, hazard mapping, and other inputs to risk assessment tools, etc.).
2. Education, training and public outreach programmes in disaster risk reduction (e.g. targeted at National Meteorological and Hydrological Service and their stakeholders).
3. Provision of technical advice and specifications (e.g. to enhance observing networks, operational infrastructures, relevant products and services for disaster risk reduction applications).
4. Strengthening strategic partnerships with stakeholders (e.g. disaster risk managers, media, etc.).
5. Advocacy for enhanced visibility of National Meteorological and Hydrological Service' in the area of disaster risk reduction.
6. Cost-benefit analysis of hydro-meteorological services in disaster risk reduction.
7. Strengthening strategic partnerships with other technical organizations and agencies (e.g. meteorology, hydrology, ocean services, etc.).
8. Establishment of regional emergency protocols for the National Meteorological and Hydrological Services in support of each other in case of disruption of services due to the impact of a disaster.
9. Resource mobilization.
10. Assist members in the development of the national disaster risk reduction plans.

9.9 Sub-Regional Considerations

Climate, exposure to individual hydrometeorological hazards and even the organization and orientation of National Meteorological and Hydrological Services vary considerably across Europe. The following sections examine the survey responses from three major European sub-regions – North-West Europe, Eastern Europe and Southern Europe. Annex 2 lists the countries included in each of these sub-regions.

9.9.1 North-West Europe

As listed in Annex 2, the countries included in the North-West Europe sub-region are as follows: Austria, Belgium, Denmark, Finland, France, Germany, Iceland, Ireland, Luxembourg, Netherlands, Norway, Sweden, Switzerland, and the United Kingdom. The following paragraphs briefly assess the responses from this selected group of NMHSs against the backdrop of the preceding analysis of the survey responses from Europe as a whole. Figure 139 below illustrates the number of responding countries in the sub-region who stated that they were affected by the specified hazards.

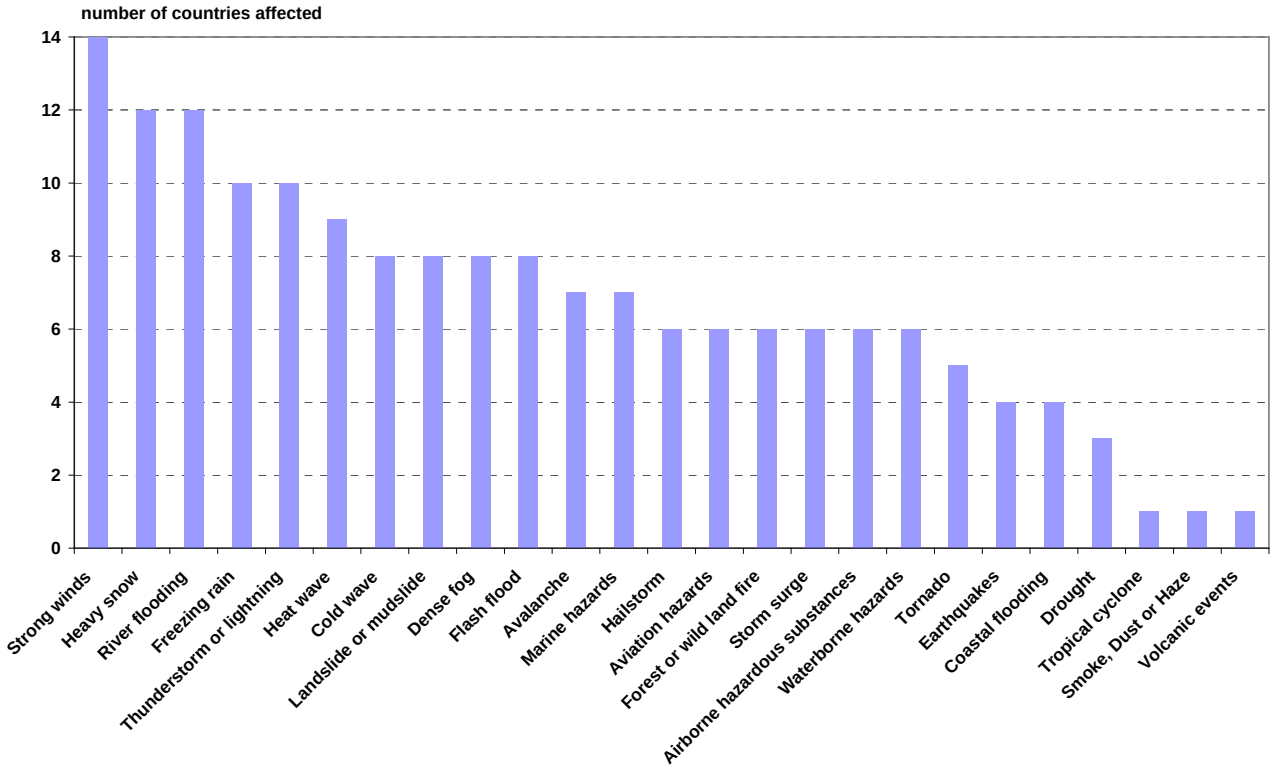

Figure 139. Number of responding NMHSs in North West Europe who identified themselves as being affected by specified hazards.

The hazards that affect most North-West European countries are strong winds, heavy snow, river floods, freezing rain, thunderstorms or lightning, heat waves, flash floods, dense fog, cold waves, landslides or mudslides, marine hazards and avalanches followed by hailstorms, storm surge, airborne hazards, waterborne hazards, forest and wild land fires and coastal flooding. Other hazards such as earthquakes, droughts, tropical cyclones, smoke, dust and haze and volcanic hazards are at the bottom of the list in numbers of responding countries affected by them.

The following overview examines the sub-regional picture for North West Europe drawing attention to differences from the general European situation. The sub-regional situation with respect to hazard databases, access to impacts information and provision of value added services based on data archives was broadly similar to that for Europe as a whole. However, a noticeably lower percentage of NMHSs in North-West Europe identified data rescue, quality assurance, archiving and updating and customization of data as factors that limiting their ability to provide hazard data products. Where legislative, governance and disaster risk structures were concerned, the sub-regional pattern generally mirrored that for all of Europe. However, a noticeably lower percentage of North-West European respondents felt constrained by their national coordination systems for disaster risk reduction than was the case for the region as a whole. Moreover, only one country in the sub-region identified that it had a combined National Meteorological and Hydrological Service.

Where operational infrastructure and capacities are concerned, visibly lower percentages of North-West European respondents identified their disaster risk reduction contributions as being limited by inadequate observational networks, telecommunications, informatics and data management/data exchange capacities, applications software, Internet access and availability of trained professional than was the norm across the European region. In addition, significantly smaller percentages of contributing NMHSs in North-West Europe expressed needs for improved coordination and collaboration with neighbouring NMHSs and with RSMCs. This pattern also prevailed in relation to internal training of NMHS staff, joint training with disaster agencies and activities related to product improvement where North-West European respondents presented a somewhat more positive than average picture. The survey responses revealed a more uneven pattern where public outreach was concerned. However, sub-regional responses generally either matched or were more positive than those for the total region. Moreover, almost all NMHSs in North-West Europe had a contingency plan in place to maintain operations in emergency situation and, in many instances, this involved partnership agreements with neighbouring NMHSs. Finally, North-West European respondents expressed significantly lower levels of concern regarding the lack of understanding by government authorities of the value of their contributions to disaster risk reduction. Taken overall, the sub-region, therefore, presented a somewhat more positive picture than Europe as a whole with respect to its capacity and involvement in disaster risk reduction.

9.9.2 Eastern Europe

As illustrated in Annex 2, the countries included in the Eastern Europe sub-region are as follows: Belarus, Czech Republic, Estonia, Georgia, Latvia, Lithuania, Poland, Russian Federation, Slovakia and Ukraine. The following paragraphs briefly assess the responses from this selected group of NMHSs against the backdrop of the preceding analysis of the survey responses from Europe as a whole. Figure 140 below illustrates the number of responding countries in the sub-region who stated that they were affected by the specified hazards.

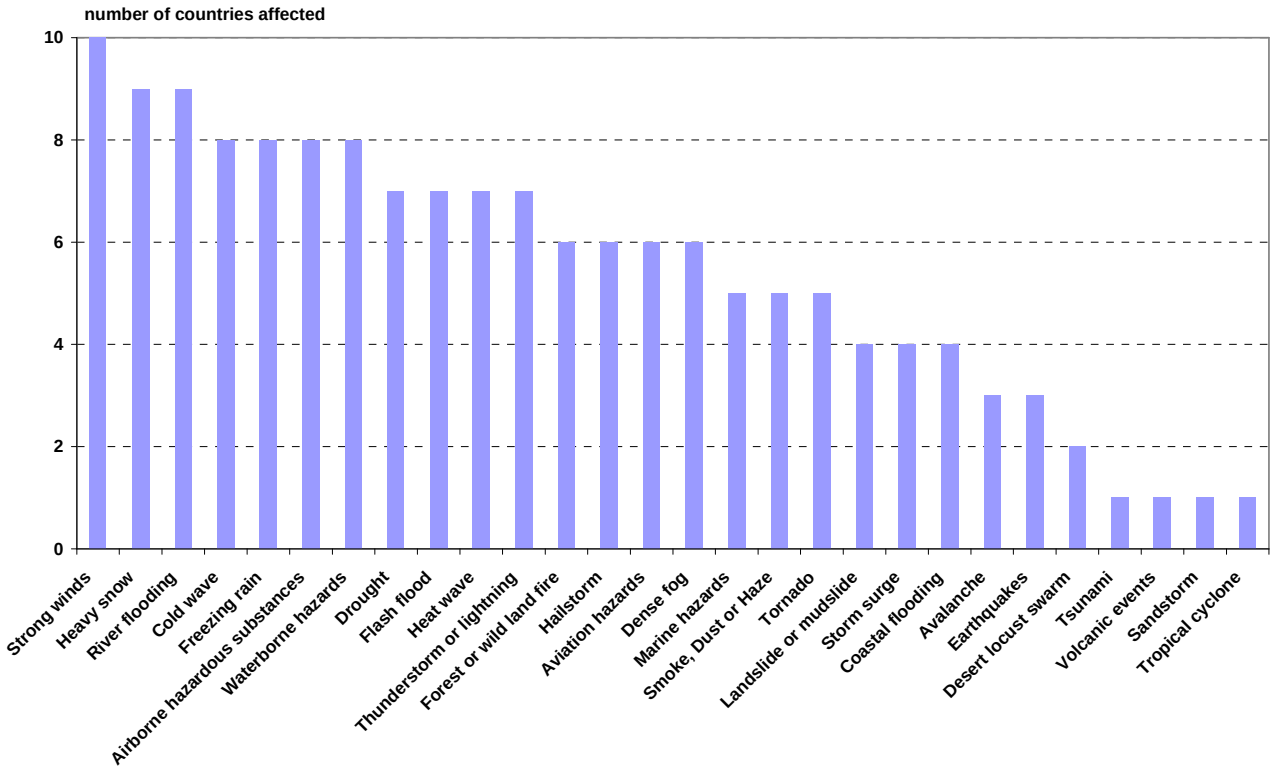

Figure 140. Number of responding NMHSs in Eastern Europe who identified themselves as being affected by specified hazards.

In descending order of breadth of occurrence, the major hazards identified by Eastern European NMHSs were strong winds, heavy snow, river flooding, freezing rain, cold waves, airborne hazardous substances, waterborne hazards, flash floods, thunderstorms and lightning, heat waves, droughts, dense fog, hailstorms, aviation hazards, forest and wild land fires, tornado, marine hazards, smoke, dust and haze with remaining hazards affecting relatively fewer countries in the sub-region.

The following comments on aspects of the country-level survey responses in Eastern Europe that differed noticeably from the overall European picture, presented earlier in this chapter. The responses indicated that proportionately more Eastern European NMHSs maintained historical hazard databases and provided mapping and risk zone analysis based on these data. However, more of them (almost two thirds) also maintained internal databases of information on the impacts of hazards. While the legislative and governance pattern in the sub-region generally matched that for Europe as a whole, relatively fewer Eastern European countries had a national coordinating committee for disaster risk reduction and proportionately more NMHSs stated that this structure limited their ability to contribute to that priority. All Eastern European NMHSs supported the implementation of a readiness system. All respondents also indicated that they had a combined NMHS.

In operational areas, the picture was much like that in Europe as a whole, with all or almost all contributing NMHSs indicating that they had observation networks and telecommunications and a forecast system that operated on a 24-hourly/year-round basis. A somewhat lower percentage of Eastern Europe respondents, however, identified themselves as being limited by data management challenges such as quality assurance, data customization and archiving and updating. The overall European pattern prevailed in relation to warnings coordination, product improvement, internal training and capacity enhancement and to outreach activities though possibly with a few more positive aspects in Eastern Europe. Almost the same proportion of responding NMHSs from the Eastern European sub-region had contingency plans in place to maintain their services in emergencies and slightly more of them indicated that they had involved neighbouring NMHSs in those plans. Survey responses relating to overarching areas generally matched the overall European pattern though, as noted earlier, a higher percentage of Eastern European respondents identified their national disaster risk management structures as limiting the NMHSs ability to contribute to that priority area.

9.9.3 Southern Europe

As outlined in Annex 2, the countries included in the Southern Europe sub-region are as follows: Albania, Armenia, Bosnia and Herzegovina, Croatia, Cyprus, Greece, Hungary, Israel, Italy, Jordan, Malta, Monaco, Portugal, Republic of Moldova, Romania, Serbia and Montenegro, Slovenia, Spain, the former Yugoslav Republic of Macedonia and Turkey. The following paragraphs briefly assess the responses from this selected group of NMHSs, against the backdrop of the preceding analysis of the survey responses from Europe as a whole. Figure 141 below illustrates the number of responding countries in the sub-region who stated that they were affected by the specified hazards.

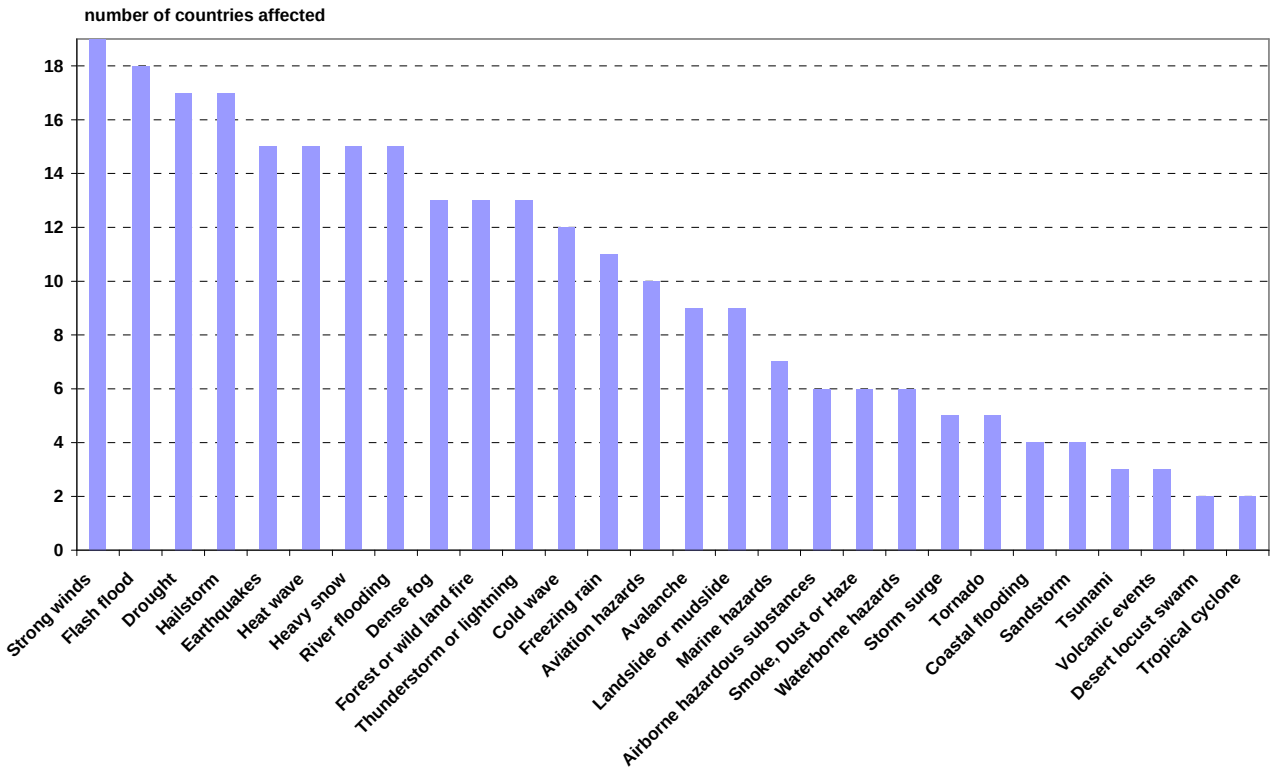

Figure 141. Number of responding NMHSs in Southern Europe who identified themselves as being affected by specified hazards.

The hazards affecting most countries in Southern Europe, not surprisingly, differ somewhat in relative distribution from those affecting Europe as a whole. In descending order of breadth of occurrence, the major hazards identified by Southern European NMHSs were as follows: strong winds, flash floods, hailstorms, droughts, heavy snow, river flooding, earthquakes, heat waves, thunderstorms and lightning, dense fog, forest and wild land fires, cold waves, freezing rain, aviation hazards, avalanches, landslides or mudslides and marine hazards, with remaining hazards affecting relatively few countries in the sub-region.

The following comments on aspects of the country-level survey responses in Southern Europe that differ noticeably from the overall European picture presented earlier in this chapter. A somewhat lower percentage of NMHSs maintained historical hazard databases and provided mapping and risk zone analysis based on these data. Legislative, governance, organizational and partnership aspects in the sub-region generally matched those for Europe as a whole. The survey responses, however, indicated that a lower level of operational coordination between NMSs and NHSs prevailed in Southern Europe and a significantly higher proportion of respondents stated that no coordination took place between these agencies on warnings issue. Similarly, a lower percentage of NMHSs in Southern Europe stated that they maintained a 24-hourly/year-round observation programme. Conversely, higher percentages indicated that lack of appropriate observation networks limited their ability for real time monitoring of hazards and to contribute to disaster risk reduction. Higher percentages of Southern European respondents also identified themselves as being limited by the telecommunications and informatics. In the latter sector, applications software, network equipment and computers were cited as weak areas relative to the overall European picture. The preceding weaknesses were stated to have a negative impact on data exchange in relation to which all Southern European respondents indicated needs for better coordination with neighbouring NMHSs. A somewhat lower than average percentage of Southern European respondents maintained a dedicated, round-the-clock, hazard warning service. In this context, Southern European contributors to the WMO country-level survey cited with greater frequency limitations imposed by lack of applications software, professional staff and computers. Furthermore,

this general pattern prevailed in relation to warnings coordination, product improvement, internal training and capacity enhancement and to outreach activities. In all of these areas, Southern European responses generally reflected weaker capacities or relative performance. In addition, a somewhat lower proportion of contributing NMHSs from the sub-region had contingency plans in place to maintain their services in emergencies. Furthermore, significantly fewer of them indicated that they had involved neighbouring NMHSs in those plans. In overarching areas, the main departures from the overall European picture were in coordination and partnership, where a lack of linkages with disaster risk reduction partners was identified by a higher proportion of Southern European respondents who more strongly advocated needs for better coordination with neighbouring NMHSs and RSMCs. In summary, the overall picture for Southern Europe was somewhat less positive than that for Europe as a whole.

9.10 Concluding Assessments and Recommendations for Europe

The following summarizes assessments and conclusions related to the analysis of the survey responses from European NMHSs that has been presented in this chapter. In order to facilitate identification of subject areas, the titles associated with individual assessments and conclusions presented below match those used during the analyses of European survey responses outlined in the preceding pages.

9.10.1 Access to Data on Hazards and their Impacts

NMHSs need to have easy access to official information on hazards and on the impacts of disasters in order to provide support for planning activities and to facilitate monitoring the effectiveness of their own services in support of disaster risk reduction. As Annex 3 illustrates, while most European NMHSs maintain records of the most common hazards such as strong winds, the number declines rapidly for less frequently occurring hazards. As the agencies responsible for monitoring and prediction of hydrometeorological hazards within their countries, NMHSs (or NMSs and NHSs) may, reasonably, be expected to maintain records of occurrences of significant hazards. Equally, it is important that NMHSs have ready access to official information on the impacts of disasters. The survey responses indicate that this is not the case in almost half the countries in the region.

9.10.2 Value Added Services based on Historical Hazard Data

The respondents' recommendations regarding enhanced valued added services are supported by earlier responses. Against the backdrop of the limiting factors identified above, however, the implications of these recommendations are that substantial training and capacity development will need to be undertaken in a significant number of the NMHSs in Europe to acquire the capability to deliver the added value services under discussion

9.10.3 Legislation and Governance

The responses suggest that, in those countries where a lack of clarity undercuts their potential contributions to disaster risk reduction, NMHSs should press for clear policy direction from their governments regarding their roles and responsibilities.

9.10.4 National Structures/Mechanisms for Disaster Risk Reduction

The degree to which NMHSs are integrated into national disaster risk reduction structures and their operational relationships with civil protection agencies, planning authorities and important non-governmental partners exercise a significant influence on their ability to contribute effectively to disaster risk reduction. For optimum effectiveness, state of the art NMHS scientific, technical and operational capacities must be mainstreamed into national planning, decision-making and disaster response structures and systems and, in addition, be well connected to important non-governmental partners. Responses to the survey indicate that many NMHS in Europe are not part of their national disaster risk reduction system. Those NMHS that are not members of their

national coordinating committees or structures should endeavour to acquire membership in these bodies and seek to contribute effectively to national disaster risk reduction activities.

9.10.5 NMHS Contributions to National Disaster Risk Reduction Systems

Experience elsewhere indicates that the respondents' recommendation for the establishment of a "readiness system" could, if implemented, enhance NMHSs contributions to disaster risk reduction and this should be pursued at the national level. Continuing efforts should be made to promote the contributions that NMHSs can make to disaster risk reduction and to encourage disaster authorities to build on NMHSs capacities. In parallel, however, the capacities of NMHSs must, where necessary, be enhanced to ensure that they can in fact deliver state of the art products and services in support of disaster risk reduction.

9.10.6 NMHS Collaboration with other Partners

Survey responses indicate that relatively few NMHSs in Europe pursue coordination and collaboration with significant national, regional and international partners in the disaster community. Expanded collaboration and partnerships can benefit NMHS through broader utilization of their products and services, increase their visibility, and result in more effective contributions to disaster risk activities. NMHS should be proactive in expanding their partnerships with the broader disaster community both within and outside government circles.

9.10.7 The Organization and Priorities of NMHSs

The respondents' majority recommendation appears entirely valid in light of the earlier responses. Close coordination between meteorological and hydrological authorities is an essential foundation for the provision of timely, accurate and consistent hydrometeorological hazard warnings and other services.

9.10.8 Operational Coordination between NMSs and NHSs

The survey responses summarized earlier clearly indicate that needs exist for enhanced operational coordination between NMSs and NHSs in many countries in Europe. The survey respondents' recommendation should, therefore, be pursued at the country level through actions to achieve more effective operational coordination between the meteorological and hydrological communities, particularly with respect to hazard warnings and other critical products.

9.10.9 Observation and Monitoring Networks and Systems

The survey responses indicate that about half of responding NMHSs in Europe consider that their observing networks are not optimal for disaster risk reduction and that a few do not maintain a dedicated 24-hour/year-round observation programme. Maintenance of their observation networks was also identified as presenting challenges to many NMHS, particularly in relation to the availability of resources and trained staff, with hazard-related damage being a compounding problem for some. Reliable, round the clock, observations, made available in real time, are the essential raw material needed for the production of early warnings, forecasts and other products to support disaster risk reduction. Consequently, every effort should be made to ensure that adequate observational networks and systems are put in place and maintained in operation on a 24-hourly/year-round basis.

9.10.10 Telecommunications and Informatics

Survey responses indicate that 24-ourly/year-round telecommunications systems are in place in all but one responding countries. However, significant deficiencies have been identified in relation to application software, network equipment, telecommunications facilities and computer hardware in many countries in Europe and Internet access poses a problem in a few of them. The responses validate the respondents' recommendation that upgrading of these systems is required in many NMHS.

9.10.11 Data Exchange

The respondents' recommendations for improved coordination with neighbouring NMHSs and RSMCs on data exchange make good sense since collaboration and coordination are fundamental to effective and efficient exchange of data and products. The survey responses, however, indicate that improved data exchange will also require enhancements to telecommunications systems and to data management, including quality assurance and archiving systems, in a significant number of NMHSs in the region. These responses also draw attention to related needs for capacity building in relation to data processing and customization of data and products.

9.10.12 Forecast and Warning Capability

The respondents' recommendations for upgrading of forecast and warning capabilities are validated by the responses summarized earlier in this section. Clearly, there are quite general needs for upgrading of professional staff, computing capacity and supporting applications software. However, the fact that one NMHS does not have operational forecast and warning services and a few more do not operate these services on a round-the-clock basis is a particularly serious deficiency in relation to issue of early warnings of hazards and other services for disaster risk reduction.

9.10.13 Forecast and Warning Products

The respondents' recommendation regarding the need to improve their warning products and services is soundly based.

9.10.14 Coordination of Warnings

The respondents' strong recommendation for improved coordination with neighbouring NMHSs and RSMCs in relation to watches and warnings makes good sense. Such coordination reduces the risk of ambiguous or, in the worst case, conflicting warning messages from different sources reaching the same audience. A compounding issue here is the increased potential for confusion that arises when commercial or other entities also issue hazard warnings, as is the case in some European countries. As a general principle, therefore, it is desirable to work towards a situation where official warnings for hydrometeorological hazards emanate from a single recognized issuing authority within each country**.** Ideally being prepared by NMHSs with the scientific and technical capacity to make such predictions, hydrometeorological warnings may, in some circumstances, benefit from assessment and interpretation by civil defense authorities as to their likely impacts before being relayed to local communities, perhaps accompanied by advice on actions that people should take to minimize loss of life and property.

9.10.15 Products and Services for Selected Socio-Economic Sectors

Experience around the globe demonstrates that the socio-economic sectors discussed earlier could benefit significantly from the incorporation of hydrometeorological information and products into their planning and decision-making processes. Sensible land-use planning to minimize risk of flooding and other hazards, engineering design of housing and other developments to withstand expected wind loads, design of drainage system to accomodate heavy rainfalls or rapid snowmelt and other similar measures contribute to hardening societies and communities against disastrous impacts of hydrometeorological events. Equally, early warnings of hazards enable people to take avoidance or mitigating actions to prevent disasters. The survey responses indicate that vulnerable target sectors do not receive special hydrometeorological services in roughly half of European countries. Consequently, NMHSs in the region have the opportunity to contribute substantively to disaster risk reduction by enhancing the provision of relevant products and services to planning, development, water resources and other key socio-economic sectors.

9.10.16 Dissemination Systems and Target Audiences

Reliable and timely dissemination of early warnings of hazards to stakeholders and the public at large is among the most useful services that NMHSs can provide in support of disaster risk reduction. Consequently, every effort should be made to ensure that warnings and other relevant products reach all important target audiences. In the context of disaster risk reduction, national Red Cross/Red Crescent Societies and similar non-government bodies should be targeted for receipt of hazard warnings on virtually the same level as government disaster authorities. Efforts to enable such important external partners to access and utilize early warnings of hazards and other relevant NMHS products should be strongly encouraged in Europe, given the relatively low percentage of NMHSs who currently disseminate to these stakeholders.

9.10.17 Product Utility and Product Improvement

The responses indicate that many, perhaps most, of the NMHSs in the region have adopted best practices approaches to assessing and attempting to improve the utility of their products. The majority of responses also indicate, however, that continuing emphasis is needed on increasing the awareness and understanding of stakeholders, including the public at large, disaster risk authorities, and the staff of emergency agencies, regarding hazards, their impacts and the content of warnings and other disaster products. As a specific initiative, roughly half of NMHS advocated implementation of joint training for staff of NMHS and those of disaster management and emergency response agencies. The respondents recommendation is well supported by survey other responses.

9.10.18 Internal NMHS Training and Capacity Enhancement

The respondents' recommendations, while valid, only partially address the deficiencies and limitations identified in the above responses. Taken overall, the survey responses support the need for continued emphasis by NMHSs on training and capacity building in forecast and warning preparation and also encourage an increased emphasis on the development of the capability to provide specialized support products and services for disaster risk reduction.

9.10.19 Outreach Activities

Survey responses indicate that fewer than half of the NMHSs in Europe have given high priority to outreach activities directed at the general public or disaster risk authorities and emergency managers and staff. The respondents' recommendation is, therefore, supported by other survey responses, though it is narrowly focussed on a single outreach tool or mechanism. Taken overall, the survey responses indicate the need for greater emphasis on outreach activities by most NMHS in the region. Even the best hazard warnings and disaster risk products will have little value if the recipients do not understand and know how to apply these products. As a useful first step, those NMHS that do not have a public weather service programme should give serious consideration to establishing such a programme to provide a foundation for enhanced outreach activities.

9.10.20 NMHS Contingency Planning

Establishment of back-up capability to maintain critical hazard warning services in the event of emergencies is a prudent step for all NMHS. In many, perhaps most, instances, a partnership agreement with neighbouring NMHS can be an effective and low-cost approach to ensuring back-up capability.

9.10.21 WMO Support

European NMHS who responded to the WMO survey identified their highest priority needs for support from WMO as being in relation to technology transfer and capacity building, followed by education, training and public outreach programmes related to disaster risk, infrastructure development and strengthening of strategic partnerships with stakeholders. Areas such as enhancement of NMHS visibility, cost-benefit analysis, partnerships with other technical

organizations, resource mobilization, emergency protocols and national disaster risk reduction plans were somewhat lower priorities in Europe. The identification by European NMHS, the majority of whom are well developed, of high priority needs for assistance with stakeholder education, training and public outreach specifically related to disaster risk reduction provides additional validation for requirements in these less traditional areas of focus of WMO training and development programmes.

9.11 Region-wide Capacities and Resources in Europe

National Meteorological and Hydrological Services in Europe can draw upon operational products, data, training and other assistance from an extensive regional network of data sources and centres of excellence to bolster their domestic capacities to support disaster risk reduction. EUMETNET, a network grouping 21 European National Meteorological Services, provides a framework to organize co-operative programmes between NMHSs across all aspects of their activities. As in other regions, WMO Regional Specialized Meteorological Centres (RSMCs) at Bracknell, Moscow, Offenbach, Rome and Toulouse supply a range of operational products. The European Centre for Medium-Range Weather Forecasting (ECMWF) disseminates medium range forecast products for the region and beyond. Domestic capacities in the acquisition, processing and application of satellite remote sensing data are reinforced by the EUMETSAT system. Since 1998, floods have caused some 700 deaths, about €25 billion in insured economic losses, and displaced about half a million people in Europe. In response, the European Commission is pursuing an action programme to increase awareness of flood risks, improve information exchange and promote best practices. Under the umbrella of GMES, a European Flood Alert System (EFAS) is being developed to assist Water Authorities and the European Commission to prepare and respond to flood events. In addition, a European Exchange Circle on Flood Forecasting (EXCIFF) is being implemented to facilitate the exchange of flood forecasting knowledge and experience. A WMO Regional Association working group on Flood forecasting has also been established to improve the capability of NMHSs in flood forecasting and warning. Furthermore, under the umbrella or WHYCOS, a MED-HYCOS has been implemented that involves eighteen countries from the Mediterranean rim that has improved the hydrological observation network in the sub-region and also established a Mediterranean Hydrological Information System (MHIS). In addition, a follow-up HYCOS project has been initiated to re-establish and upgrade the hydrological observing network, data exchange and forecasting capacities in the countries in the Sava River Basin. On a broader level, European NMHSs can access several disaster-related data sources such as the EM-DAT database, maintained by the WHO Collaborating Centre for Research on the Epidemiology of Disasters (CRED), NATHAN (Natural Hazards Assessment Network), maintained by Munich Re Group, the Swiss Re CatNet^{TM} , a web-based natural hazard information and mapping tool, and the European Severe Weather Database. A further regional resource is represented by Global Monitoring of Environment and Security (GMES), a European Union initiative to establish an integrated observational strategy (surface, remote and space based) that feeds into an integrated modeling and forecasting system to deliver services to the user community. Under the GMES umbrella, the EU is currently underwriting projects to provide regularly updated, Internet-accessible, forecasts of wind storms and to develop improved Forest Fire Danger Indices. The NMHS in Europe can also access the training expertise of WMO Regional Meteorological Training Centres located in Israel, Italy, the Russian Federation and Turkey in addition to the highly developed university and technological institute programs in meteorology and hydrology that exist in many countries in the region.

CHAPTER 10

DEVELOPING COUNTRIES

10 DEVELOPING COUNTRIES (DC)

10.1 Abstract

Survey responses from 60 Developing Countries (DCs) that are not classified as Least Developed indicate that almost all of them operate observation and telecommunications networks and forecast/warning programmes. Roughly three quarters also have emergency contingency plans in place. Most, however, also highlight significant deficiencies in infrastructure, expertise and round-the-clock operations and all stress needs for upgrading. Without exception, they consider that improving their hazard warning programmes would strengthen their countries' disaster risk reduction capacities. Though NMHSs or National Meteorological Services (NMSs) or National Hydrological Services (NHSs), as the case may be, are the sole providers of meteorological and hydrological hazard warnings in most Developing Countries, competing warning services are present in a few. A large majority believes that coordination should be improved with other NMHSs, WMO Regional Specialized Meteorological Centers (RSMCs) and other disaster stakeholders. Most draw attention to their lack of expertise in providing value added services and only about half target services to critical sectors such as land-use planning, development and fresh water. A substantial majority advocates expansion of outreach and joint training activities to enhance their effectiveness. Financial and human resources are cited by virtually all of them as major constraints on their operatons. Finally, while most participate in national disaster risk coordination committees, almost a third of them feel restricted by these structures and even more by a lack of clarity regarding their roles. These survey results underpin the following conclusions and recommendations aimed at enhancing the disaster risk reduction capacities of Developing Countries NMHSs:

- All Developing Countries NMHSs should be integrated into their national disaster risk reduction systems. The significant number of NMHSs who are not already members should seek membership in their national coordinating committees for disaster risk management. Where necessary, they should also press for clear direction regarding their roles and responsibilities.
- Most Developing Countries NMHSs need to improve their archiving systems for hazard and their access to impact data. This generates associated requirements for capacity development related to data rescue, quality assurance and data management and archiving.
- Most Developing Countries NMHSs require capacity development and training in disaster risk applications such as hazard and impact analysis, hazard mapping, risk zone analysis and product customization.
- Every effort should be made to establish, operate, and maintain adequate hydrometeorological observation and telecommunications systems in Developing Countries where most observing and telecommunications networks are not adequate (in several instances they do not operate on a 24-hourly basis) and, in general, there are insufficient resources and trained staff to maintain them.
- Developing Countries NMHSs' hazard warning capacities should be strengthened given the widespread deficiencies in infrastructures and professional staff capacities, with six or seven NMHSs not providing 24-hourly warning services and one that does not have any forecasting capability. Major enhancements will be required to forecasting infrastructures along with provision of further training for professional staff. Warning programmes should be expanded to address all significant hydrometeorological hazards and warnings should be routed to all important governmental and external stakeholders.
- Official warnings of hydrometeorological hazards should emanate from a single competent issuing authority, ideally the NMHS. In some circumstances, they may benefit from assessment and interpretation by civil defence authorities before being widely disseminated.
- Verification programmes for hydrometeorological hazard warnings should be implemented by all NMHSs in Developing Countries to monitor warning accuracy and timeliness, assess improvements in skill, and demonstrate their warning capabilities to stakeholders.

- The roughly one quarter of Developing Countries NMHSs who have not already done so should establish back-up arrangements to maintain hazard warnings and other services in emergency situations, perhaps through partnership agreements with neighbouring NMHS.
- Developing Countries' NMHSs should encourage the establishment of national readiness systems within their countries.
- Operational coordination should be improved between NMSs and NHSs and with neighbouring NMHSs and RSMCs. In some Developing Countries, this may require policy direction or partnership agreements to clarify the respective roles of NMSs and NHSs, particularly in relation to issue of early warnings.
- Developing Country NMHSs can make major contributions to disaster risk reduction by enhancing the provision of value-added products and services to sensitive economic sectors such as land-use planning, development and water resources. Significant training and capacity development will, however, be required to develop the capacities to deliver such services
- Most Developing Countries NMHSs should increase emphasis on education and outreach directed at the public, the media and other key stakeholders, particularly since less than one half currently undertake outreach activities. The conduct of joint training with disaster risk authorities represents a related priority.
- Most Developing Countries NMHSs need extensive support from WMO in capacity building, infrastructure development and resource mobilization. Capacity development and training is particularly needed in forecasting techniques, hazard mapping, inputs to risk assessment tools, data management and the development of national disaster risk reduction plans**.**

The present chapter centres on the assessment of survey responses from NMHSs in Developing Countries who are WMO Members. Its internal structure follows the sequence outlined earlier in section 2.6.1.

10.2 The Response to the Survey

As noted earlier, a total of 85 Developing Countries responded to the WMO country- level survey. It must be pointed out, however, that this Developing Country response figure also includes the Least Developed Countries. The analyses that follows only considers Developing Countries that are not also classified as Least Developed Countries, or a total of 60 countries, and these are listed in Annex 2. The Least Developed Countries are the subject of a separate chapter of this report (Chapter 11).

10.3 The Hazards affecting Developing Countries

Figure 142 below lists the number of responding Developing Countries who identified themselves as being affected by the specified hazards.

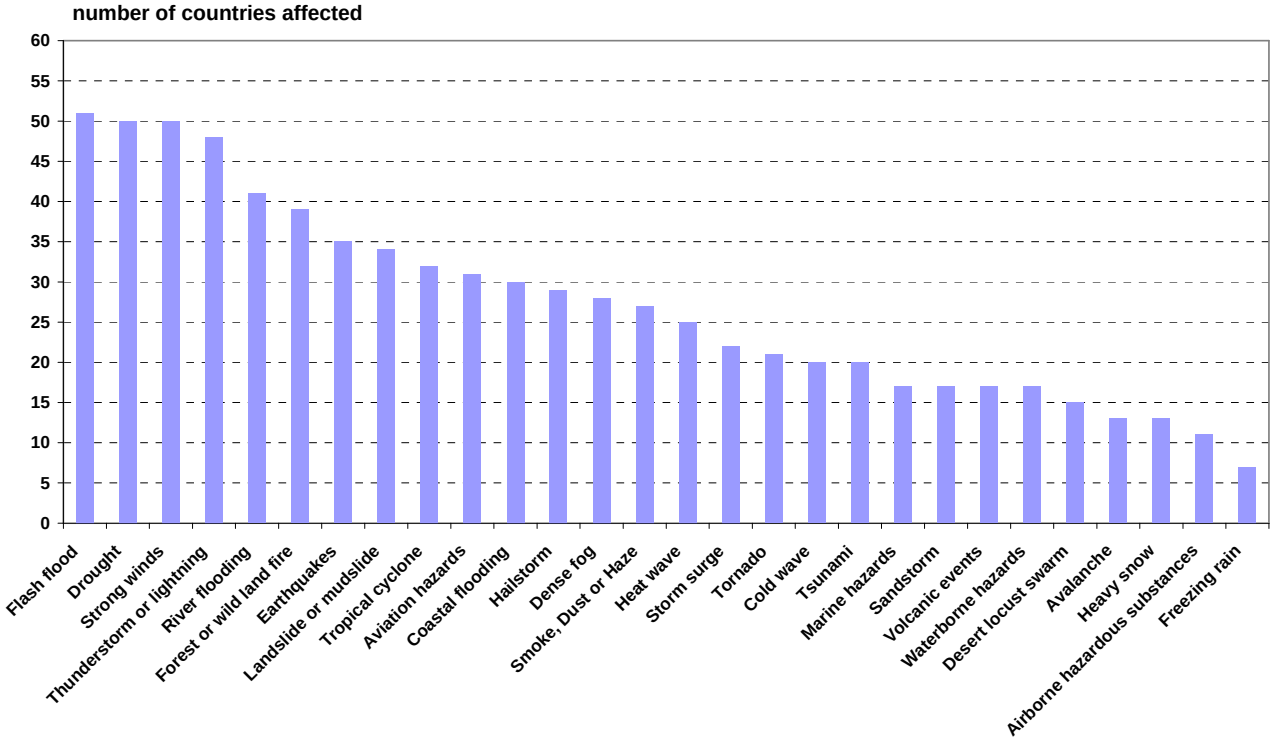

Figure 142. Number of responding Developing Countries who identified themselves as being affected by specified hazards.

10.3.1 Access to Data on Hazards and their Impacts

Annex 3 presents an overview of the hazard databases maintained by survey respondents in Developing Countries and includes some supplementary information on related metadata and impacts information. Most NMHSs in Developing Countries (85% or 50 of 59) who contributed to the WMO country-level survey stated that another agency was responsible for providing official information on the impacts of disasters in their country. Most of them (73% or 44 of 60) also said that they had access to such official, reliable, information. In addition, however, roughly one third (35% or 21 of 60) of contributing NMHSs reported that they maintained their own internal database

of official information on the impacts of hazards that affected their countries and a majority of them (73% or 19 of 26) regularly updated this database[29].

10.3.2 Value Added Services based on Historical Hazard Data

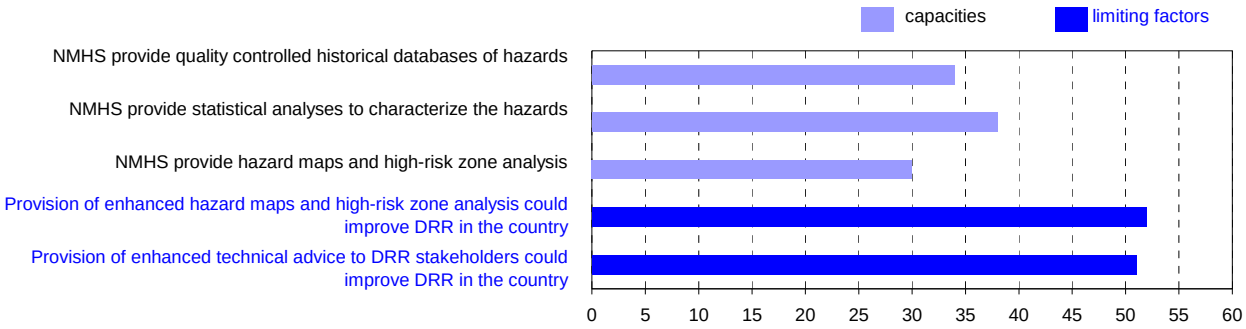

Figure 143. Provision of hazard information by NMHSs in Developing Countries.

The following draws attention to the extent of value added services provided by NMHSs in Developing Countries who maintain historical archives of hydrometeorological hazards. Most Developing Country NMHSs who contributed to the country-level survey (77% or 46 of 60) stated that that they provided technical advice on hazards and many (63% or 38 of 60) also provided statistical analyses to characterize them. Over half of the survey respondents (57% or 34 of 60) reported that they maintained quality controlled historical databases of hazards and most of these (50% or 30 of 60) indicated that they undertook hazard mapping and high-risk zone analysis. Only about a third of respondents (32% or 19 of 60), however, stated that they provided analyses of the potential impacts of hazards.

Two thirds of Developing Country NMHSs identified factors that limited their ability to provide hazard data products. Limiting factors were professional staff with appropriate training (66% or 39 of 59), data rescue (66% or 38 of 58), quality assurance (63% or 37 of 58), customization of data for stakeholders (64% or 37 of 58) and ability to archive and update (57% or 33 of 58). The vast majority of survey respondents (93% or 54 of 58) considered that the provision of enhanced value added NMHS services in support of hydrometeorological risk assessment would strengthen their contributions to disaster risk reduction activities. The following specialized services were identified as valuable enhancements - analyses of the potential impacts of hazards (95% or 54 of 57), provision of technical advice (93% or 51 of 55) and hazard mapping and high-risk zone analysis (93% or 52 of 56).

10.4 The National Context for Disaster Risk Reduction

National legislative, governance and organizational structures for disaster risk reduction establish the context within which NMHSs make their contributions to safety of life and property. The following sections summarize the survey responses from Developing Countries regarding their national systems for disaster risk reduction and the impact of these systems on the NMHSs.

[29] It is important to note, that, to date, no systematized, universally accepted, methodology or protocol has been established on a global basis for the creation and maintenance of hazard and hazard impacts databases.

10.4.1 Legislation and Governance

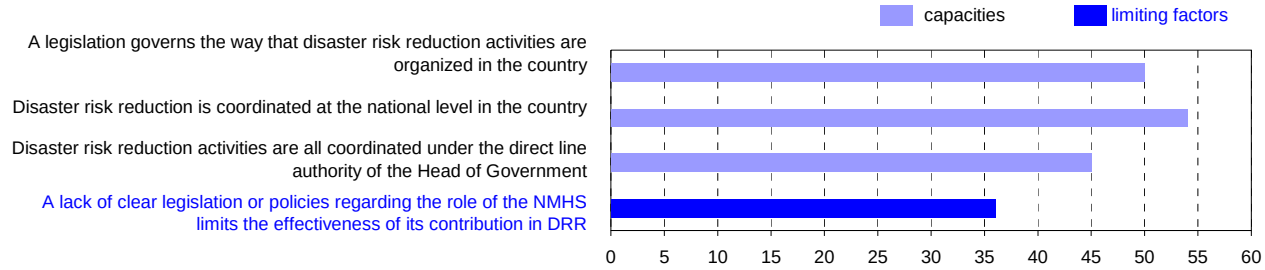

Figure 144. Legislation and coordination in support of disaster risk reduction at the national level in Developing Countries.

Most Developing Country NMHSs who contributed to the survey (92% or 54 of 59) reported that disaster reduction activities were coordinated at the national level, in most cases (82% or 45 of 55) under the direct line authority of the head of government. The organization of these activities was governed by legislation in over three quarters of them (83% or 50 of 60) and in about half (51% or 29 of 57) coordination was centred under one ministry. At the same time, almost two thirds of Developing Country respondents (62% or 36 of 58) considered that a lack of clear legislation or policies regarding the role of the NMHSs (e.g. as the sole issuer of hydrometeorological hazard warnings) limited their contributions to disaster risk reduction.

10.4.2 National Structures/Mechanisms for Disaster Risk Reduction

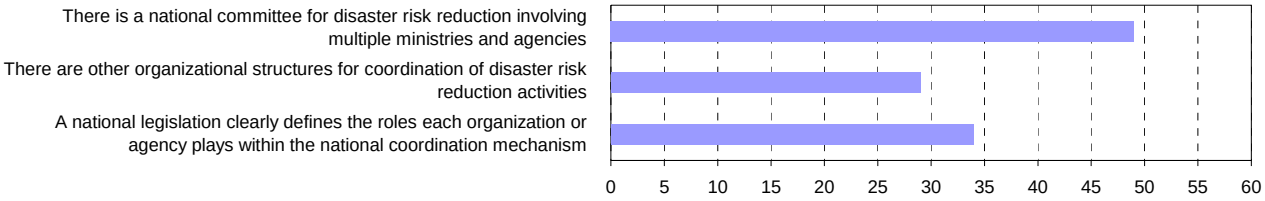

Figure 145. National structures for coordination of disaster risk reduction in Developing Countries.

Most Developing Country contributors to the WMO survey (83% or 49 of 59) indicated that their countries had a national committee for disaster risk reduction that involved multiple ministries and agencies. Most of them (91% or 50 of 55) also stated that they were members of their national coordinating committee. Over half (60% or 34 of 57) reported that the roles of each participating agency in the national coordination mechanism were defined by legislation. About half of them (51% or 29 of 57) also pointed out that other organizational structures for coordination existed in their countries. Finally, almost a third of responding NMHSs (29% or 17 of 58) considered that their contributions to disaster risk reduction were limited by their national disaster management structure.

10.4.3 NMHS Contribution to the National Disaster Risk Reduction Effort

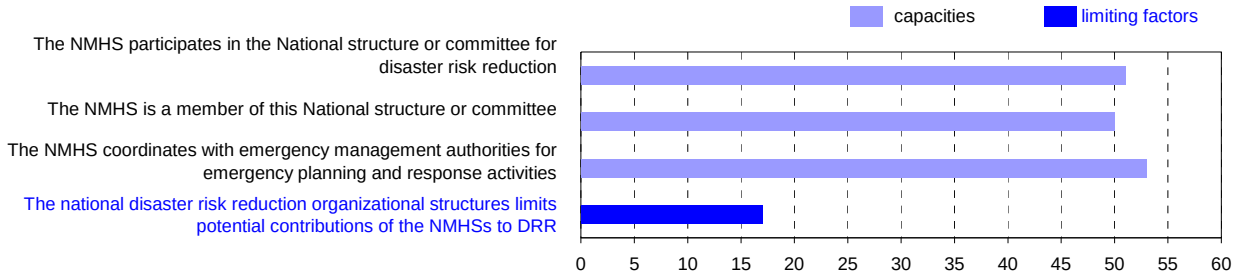

Figure 146. NMHS participation in national structures for disaster risk reduction in Developing Countries.

Almost all Developing Countries NMHSs (98% or 59 of 60) who contributed to the survey indicated that they provided support to agencies responsible for disaster risk reduction at the national level. Almost as many (97% or 58 of 60) provided support to emergency planning and preparedness and emergency response operations while smaller numbers (90% or 54 of 60) undertook activities related to disaster prevention (e.g. hazard mapping, data for risk assessments, etc) and post disaster reconstruction (76% or 45 of 59). Most survey respondents (95% or 56 of 59) extended their support to provincial or state government disaster-related activities and over three quarters of them (81% or 47 of 58) also provided support to municipal or local levels. Almost two thirds of NMHSs (60% or 35 of 58), however, pointed to inadequate linkages with other involved organizations (e.g. emergency planners, emergency response agencies) as limiting their contributions to disaster risk reduction. Finally, most Developing Country NMHSs who contributed to the survey (91% or 53 of 58) considered that their contributions would be enhanced by a "readiness system" that required appropriate responses by authorities to information issued by the NMHSs.

10.4.4 NMHS Collaboration with other Partners

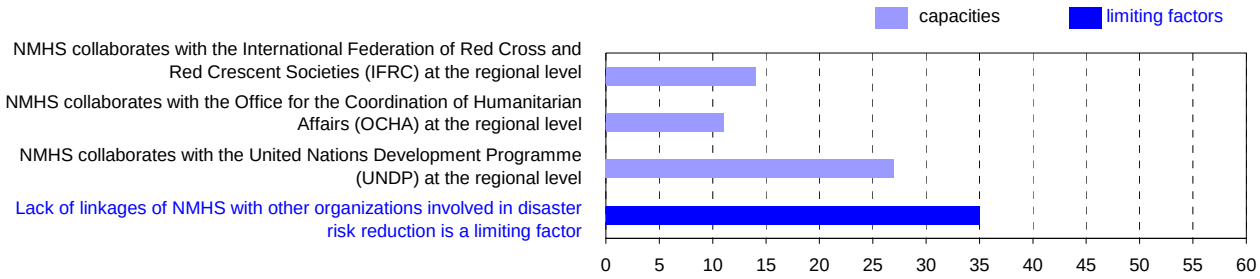

Figure 147. NMHS collaboration with partner agencies at the regional level in Developing Countries.

Almost all survey contributors (97% or 58 of 60) from Developing Countries reported that they coordinated with emergency management authorities for emergency planning and response at the national level. Over half of them (56% or 33 of 59) participated in disaster-related activities on the level of a WMO Region or a regional economic grouping. Substantial numbers of survey respondents interacted with the office of their national United Nations Coordinator (57% or 33 of 58), participated in disaster reduction activities of the UNDP (66% or 27 of 41) or international organizations (62% or 21 of 34), collaborated with their National Red Cross and Red Crescent Societies (51% or 30 of 59) and the IFRC (36% or 14 of 39), or participated in activities of the Office for the Coordination of Humanitarian Affairs (29% or 11 of 38).

10.4.5 The Organization and Priorities of NMHSs

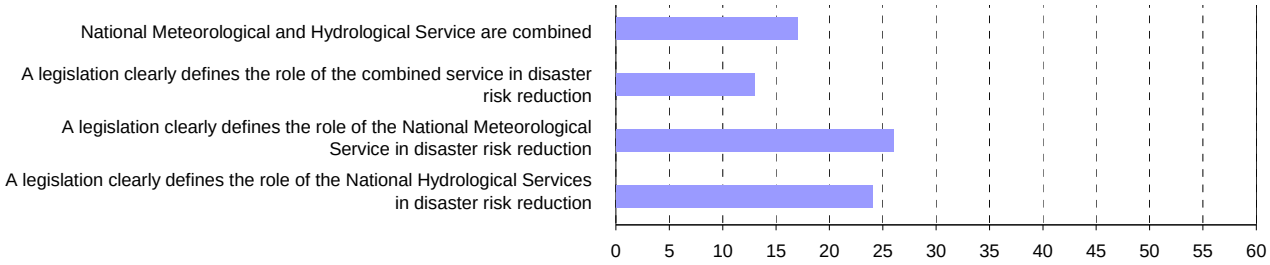

Figure 148. Organizational structure of meteorological and hydrological services in Developing Countries.

The priorities of individual NMHSs are, inevitably, influenced by the missions and priorities of their parent government ministries or departments. In consequence, the orientation of NMHSs may be more broadly focussed in some countries than in others. A parent department with a civil aviation mandate might, for example, emphasize provision of NMHS services to aviation while one with a natural resources or environment mandate might encourage its NMHS to provide warnings and other services to a broader range of sectors. As illustrated in earlier chapters of this report, NMHSs, NMSs and NHSs report to a wide variety of parent ministries or departments. The internal organization of National Meteorological and Hydrological Services can also influence their ability to deliver well-coordinated hydrometeorological warnings and other services in support of disaster risk reduction. Over one quarter of survey contributors (29% or 17 of 58) from Developing Countries stated that they had a combined National Meteorological and Hydrological Service. A third (34% or 13 of 38) indicated that their country had national legislation that clearly defined the NMHS role in disaster risk reduction. Just over half the contributors with a separate NMSs (53% or 26 of 49) and NHSs stated that they had legislation that clearly defined the role of the NMSs in disaster risk reduction. A similar number of them (52% or 24 of 47) reported legislation that applied to the role of the NHSs. At the same time, two thirds (67% or 32 of 48) of the Developing Country contributors to the WMO country-level survey thought that legislation or partnership agreements were needed to better define the respective roles of their NMSs and NHSs in disaster risk reduction. In addition, most of these (96% or 43 of 45) considered that better technical coordination between their NMSs and NHSs would result in enhanced joint products and services while a slightly smaller majority (89% or 41 of 46) advocated that better coordination would result in enhanced issuance of forecasts and warnings.

10.4.6 Operational Coordination between NMSs and NHSs

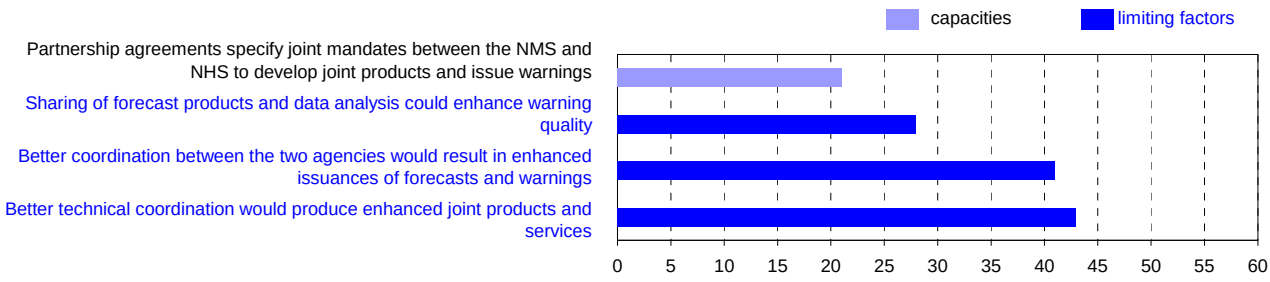

Figure 149. Coordination between NMS and NHS in Developing Countries.

Less than half (43% or 21 of 49) of survey contributors from Developing Countries that had separate NMSs and NHSs identified that a partnership agreement was in place specifying

mandates between their NMSs and NHSs to develop joint products and issue warnings. A larger number (55% or 28 of 51) indicated that the two agencies shared forecast products and data analyses that could enhance warning quality and the same number (55% or 28 of 51) stated that coordination took place before warnings were issued for hazards of mutual concern. A smaller number (47% or 24 of 51) indicated that coordination took place for any hazard warning was issued by either organization. Over a third of Developing Country NMHSs (38% or 14 of 37), however, reported that there was no coordination on warnings. Most Developing Country respondents (89% or 41 of 46) felt that better overall coordination between the two agencies would enhance issuance of forecasts and warnings and slightly more of them (95% or 43 of 45) considered that improved technical coordination would result in enhanced joint products and services.

10.5 NMHS Infrastructure, Products and Services

The following sections summarize the information contained in survey response related to observational networks, telecommunications systems, warning and forecast production systems and their products, dissemination systems and related aspects of the overall operational capacities of Developing Countries' NMHSs.

10.5.1 Observation and Monitoring Networks and Systems

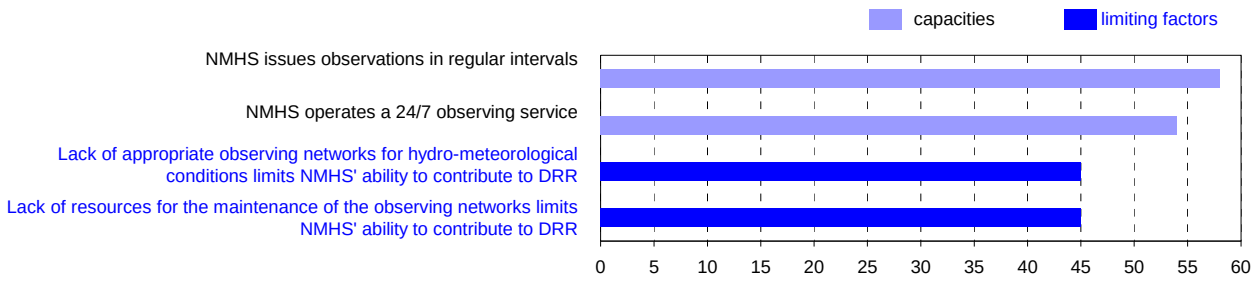

Figure 150. Observation and monitoring networks and systems in Developing Countries.

Almost all Developing Countries' NMHS who contributed to the survey (97% or 58 of 60) stated that they had an operational observing capacity that issued observations at regular intervals and most of them (92% or 54 of 59) reported that the observing service operated 24-hourly/year round. Almost half (42% or 24 of 57) of survey respondents indicated that their observation network included sea level monitoring stations. However, over three quarters of them (78% or 45 of 58) also considered that a lack of appropriate hydrometeorological observing networks limited their ability to contribute to disaster risk reduction. Furthermore, over a third (38% or 22 of 58) identified the availability of a dedicated 24-hour/yea-round observing service as an additional limiting factor. Major challenges in maintaining observation networks were also stressed by three quarters (76% or 45 of 59) of the Developing Country NMHSs who contributed to the WMO country-level survey. Among these, they cited limited financial (85% or 51 of 60) resources, limited other resources (83% or 50 of 60) (e.g. replacement parts, personnel, etc), lack of professional staff with appropriate training (66% or 39 of 59) and hazard-related damage (49% or 28 of 57).

10.5.2 Telecommunications and Informatics

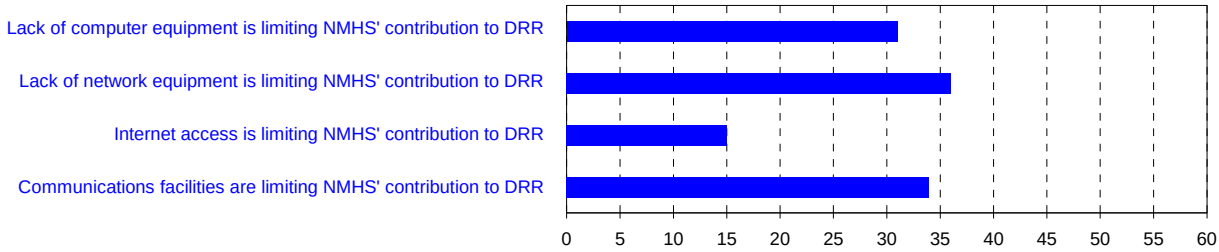

Figure 151. Telecommunication and informatics in Developing Countries.

Most Developing Countries NMHSs who contributed to the survey (93% or 55 of 59) reported that their telecommunications systems were available 24-hourly/year-round. Partial confirmation was provided by responses indicating that most forecasting staff (91% or 52 of 57) in Developing Countries had access to real time hydrometeorological data. However, almost two thirds of survey respondents (63% or 34 of 54) went on to identify that their ability to deliver critical products for disaster risk reduction was limited by communications facilities. Other limitations on NMHS capacities were cited in major areas of informatics, with most respondents (91% or 51 of 56) identifying application software, network equipment (69% or 36 of 52) and computers (57% or 31 of 54) and some, identifying inadequate Internet access (28% or 15 of 53). Finally, a large majority of Developing Country NMHSs (90% or 53 of 59) considered that upgrading the operational infrastructure for forecasting and warning services would enhance disaster risk reduction capacities in their countries.

10.5.3 Data Exchange

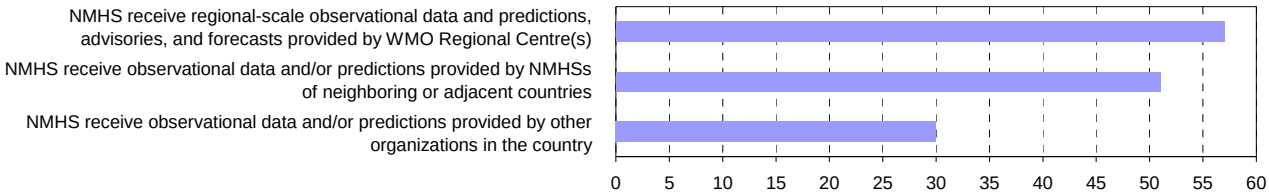

Figure 152. Data exchange in Developing Countries.

Survey contributions from NMHSs in Developing Countries identified that most (91% or 52 of 57) forecasting staff had real time access to hydrometeorological data. Most survey respondents (95% or 57 of 60) also stated that their forecasters used regional scale observational data and forecasts provided by WMO Regional Specialized Meteorological Centres and data from neighbouring countries (86% or 51 of 59) and half of them (50% or 30 of 60) used data and predictions from other organizations in their countries. Two thirds of them (66% or 37 of 56) received real time marine observations from the GTS and some (42% or 14 of 33) also relayed sea level observations on that global network. However, almost two thirds of contributors to the survey (63% or 34 of 54) indicated that their NMHSs were limited in their ability to deliver critical products and services for disaster risk reduction by communications facilities. Equally, significant numbers stated that their NMHSs were limited by data rescue (66% or 38 of 58), quality assurance (63% or 37 of 59), customization of data for stakeholders (64% or 37 of 58) and/or by ability to archive and update (57% or 48 of 53). A large majority of NMHSs in Developing Countries considered that they required better coordination with neighbouring NMHSs (96% or 53 of 55) on hydrometeorological data exchange to enhance their countries disaster risk activities. Furthermore, a smaller but

significant number (91% or 23 of 24) indicated the need for enhanced coordination with RSMCs on data exchange.

10.5.4 Forecast and Warning Capability

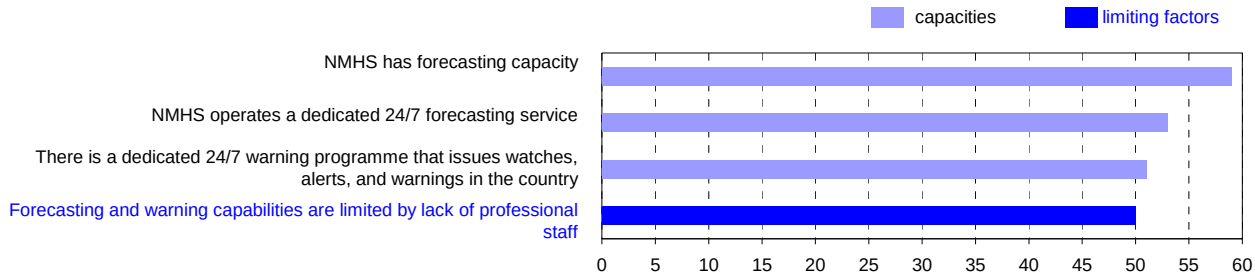

Figure 153. Forecast and warning capabilities in Developing Countries.

Almost all NMHSs (98% or 59 of 60) in Developing Countries who contributed to the country-level survey indicated that they had an operational forecasting capability and most (88% or 53 of 60) of these stated that this was a dedicated 24-hourly/year-round forecast service. Most respondents (98% or 49 of 50) said that a meteorologist was required to be on-site to operate this service. A solid majority of responding NMHSs (85% or 51 of 60) also reported that they had a dedicated hazard warning programme that issued watches, alerts and warnings on a 24-hourly/year- round basis. Most who responded to the question (92% or 46 of 50) indicated that a meteorologist was on site during the operational hours of the warning programme. More than three quarters of contributing NMHSs (80% or 45 of 56) from Developing Countries stated that they provided a marine forecast and warning service to mariners and coastal zone users and a minority of them (16% or 9 of 55) also prepared marine forecasts for the Global Maritime Distress and Safety System (GMDSS). However, most Developing Country contributors to the survey indicated that their NMHS was limited in its ability to deliver critical products and services for disaster risk reduction by application software (91% or 51 of 56), by professional staff (88% or 50 of 57) or by computers (57% or 31 of 54). All survey contributors from Developing Countries (100% or 56 of 56) considered that upgrading their NMHS operational forecasting and warning services would enhance disaster risk reduction in their countries. In particular, almost all of them (95% or 56 of 59) advocated the upgrading or technical training of professional staff.

10.5.5 Forecast and Warning Products

Table 9 in Annex 4 summarizes information on hazard warnings and products issued by NMHSs in Developing Countries. The survey responses indicated that the hydrometeorological hazards affecting the greatest number of Developing Countries were, in declining order, strong winds, drought, thunderstorms and lightning, aviation hazards, flash floods, heat waves, river flooding, tropical cyclones, smoke, dust or haze, dense fog, coastal flooding, cold waves, storm surges, forest or wild land fires, hailstorms and landslides or mudslides[30]. Additional hazards identified as of concern to many Developing Countries included sandstorms, tsunami, earthquakes, heavy snow, desert locust swarms, waterborne hazards, marine hazards volcanic events and tornadoes while a few reported that they were also affected by avalanches, freezing rain and airborne hazardous substances.

[30] The survey responses do not provide information on the magnitudes of the impacts associated with individual hazards, simply that they occur in the reported number of countries.

Examination of the data in Table 9 reveals that a majority of affected NMHSs issued warnings for the most common of the above hazards. However, it is also noticeable that many more NMHSs issued warnings for aviation hazards and restrictions to visibility (i.e. smoke, dust or haze and dense fog) than did so for forest and wild land fires, landslides or mudslides, even though the latter were reported to affect greater numbers of Developing Countries. The same pattern applied in relation to tornadoes, a particularly extreme phenomenon, for which less than half of the affected NMHSs issued warnings. This evidence suggests that NMHSs in Developing Countries should review their warning programmes for hydrometeorological hazards to ensure that these include all phenomena that have significant potential to cause disasters.

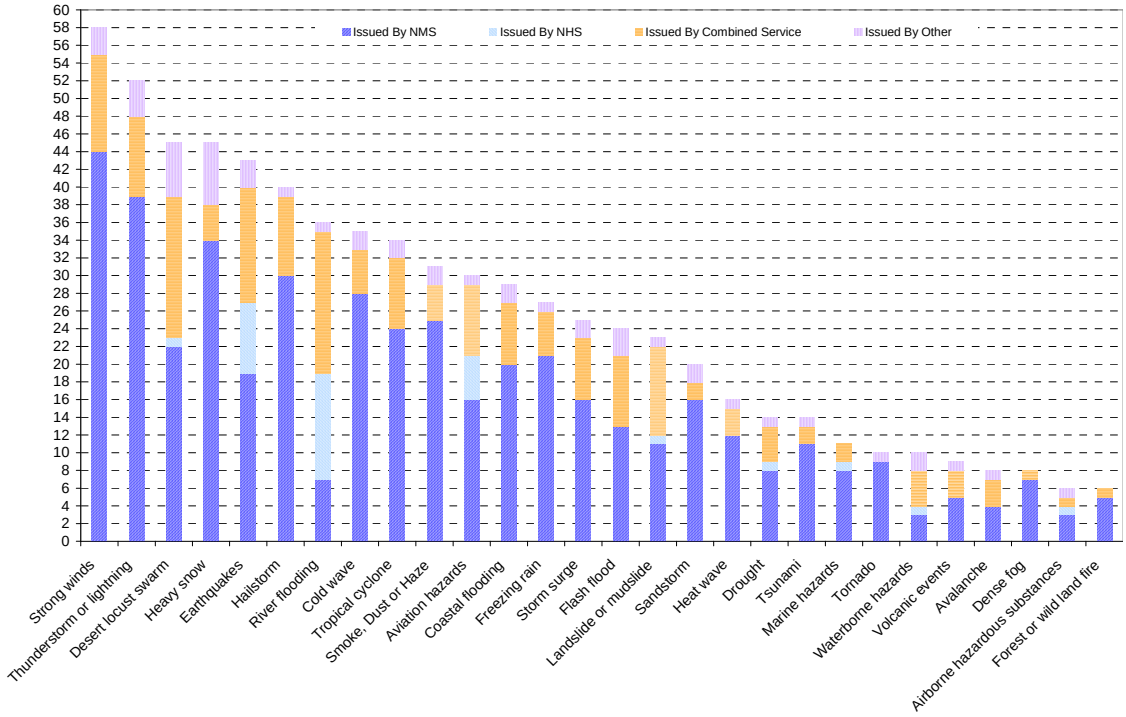

Figure 154. Agencies mandated for issuance of warnings in Developing Countries.

Paralleling the situation for other country groupings, the survey responses indicated that NMSs in Developing Countries were responsible for the issuance of most warnings for hydrometeorological hazards. Exceptions exist, however, for river flooding, where NHSs and combined NMHSs each issued warnings in twice as many countries as do NMSs, and for flash floods, where slightly more warnings emanated from NHSs and combined NMHSs than from NMS. Similarly, combined NMHSs and NHSs taken together were responsible for roughly as many warnings for coastal flooding, waterborne hazards, and landslides or mudslides than were NMSs. The survey data also indicated that the NMHSs, (or NMSs or NHSs) were the sole issuers of warnings in a majority of Developing Countries but that competing warning services were also present in a significant number of them. In addition, the responses suggested that official warnings for the major hydrometeorological hazards include information regarding their potential impacts in a majority of Developing Countries. Finally, the fact that a very large majority of Developing Country NMHSs considered that further improvements to their warnings were necessary demonstrates an awareness of shortcomings in national hydrological and meteorological warning programmes. This should provide a receptive environment for review and, where appropriate, re-alignment or expansion of NMHSs warning programmes to ensure that they provide the best possible support to their national disaster risk reduction programmes.

10.5.6 Coordination of Warnings

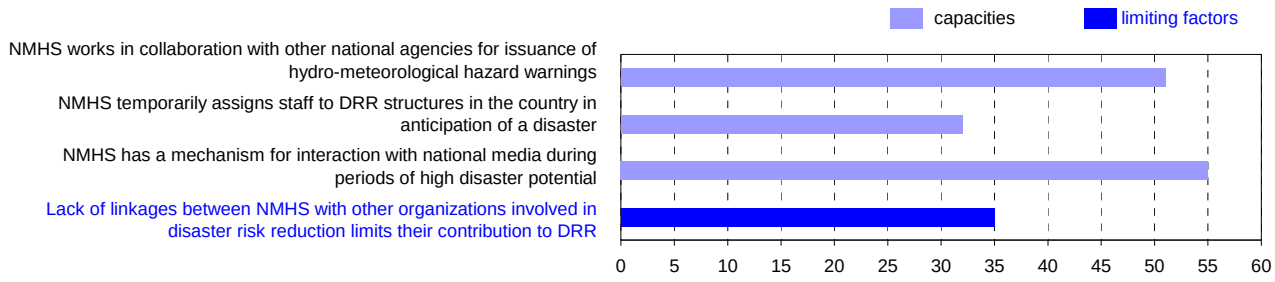

Figure 155. External coordination for issuance of warnings in Developing Countries.

Early warnings of hydrometeorological hazards represent a vital contribution to disaster risk reduction. In Developing Countries, most NMHSs (85% or 51 of 60) reported that they worked in collaboration with other agencies (e.g. agriculture, aviation, etc) with respect to hazard warnings and most of these (74% or 37 of 50) discussed the hazard's characteristics and potential impacts with these agencies prior to issuing a warning. In addition, a large majority of survey respondents (93% or 55 of 59) stated that they had a mechanism for interaction with their country's media during periods of high disaster potential. Over half of them (54% or 32 of 59) indicated that they temporarily assigned staff to disaster risk management structures in anticipation of a disaster. About a quarter them (28% or 16 of 58) pointed out that there were other public or commercial entities that provided competing warning services in their countries. Most survey contributors from Developing Countries (96% or 52 of 54) considered that their NMHSs required better coordination of watches and warnings with neighbouring NMHSs and over three quarters of them (84% or 46 of 55) also advocated improved coordination of watches and warnings with WMO Regional Specialized Meteorological Centres.

10.5.7 Products and Services for Selected Socio-Economic Sectors

As a further refinement, Figure 156 illustrates the provision by NMHSs of specialized alerts, warnings and other products to significant socio-economic sectors in Developing Countries that can be seriously affected by hazardous events. In the context of disaster risk reduction, it is noteworthy from Figure 156 that only roughly a third (36%) of Developing Country NMHSs indicated that they provided support to development and housing, under a half (46%) to land-use planning and roughly a half (51%) to the fresh water sector.

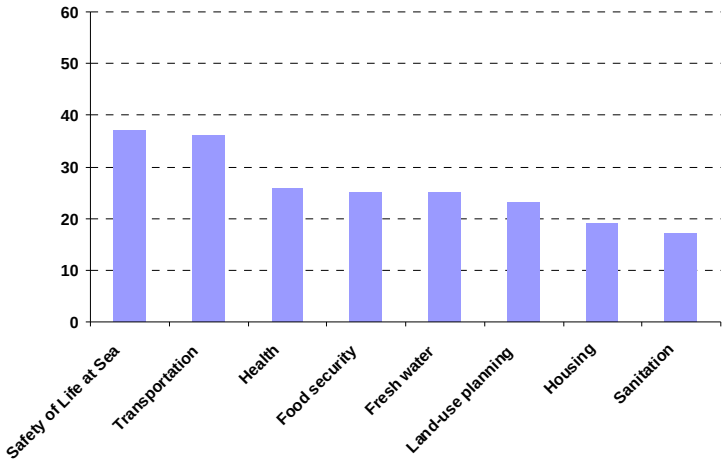

Figure 156. NMHS provision of services to selected economic sectors in Developing Countries.

10.5.8 Dissemination Systems and Target Audiences

The following Figures 157 and 158 summarize the survey responses relating to the dissemination of hazard products by NMHSs in the Developing Countries. They provide information on the types of products that are disseminated, to whom they are provided and on the methods of dissemination that are used to convey the products to the recipients. The same information is also presented in numerical form in Table 8 of Annex 5 where the figures represent the number of responding NMHSs who reported that they provided the specified product to the indicated target audience or, as appropriate, utilized a particular means of dissemination.

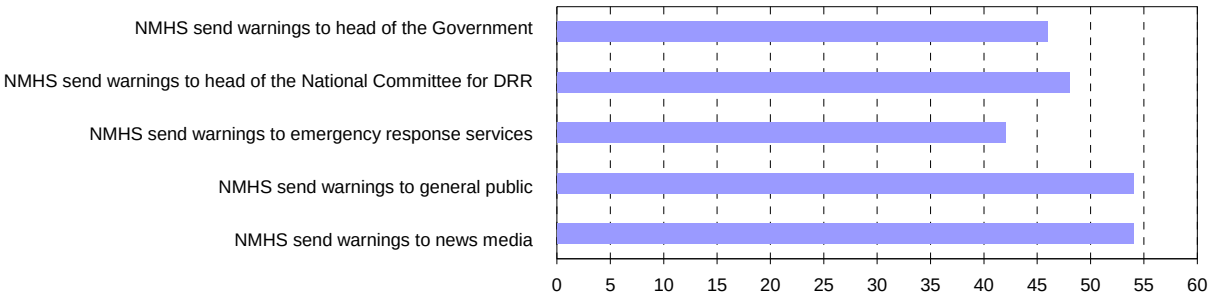

Figure 157. Warning target audience in Developing Countries.

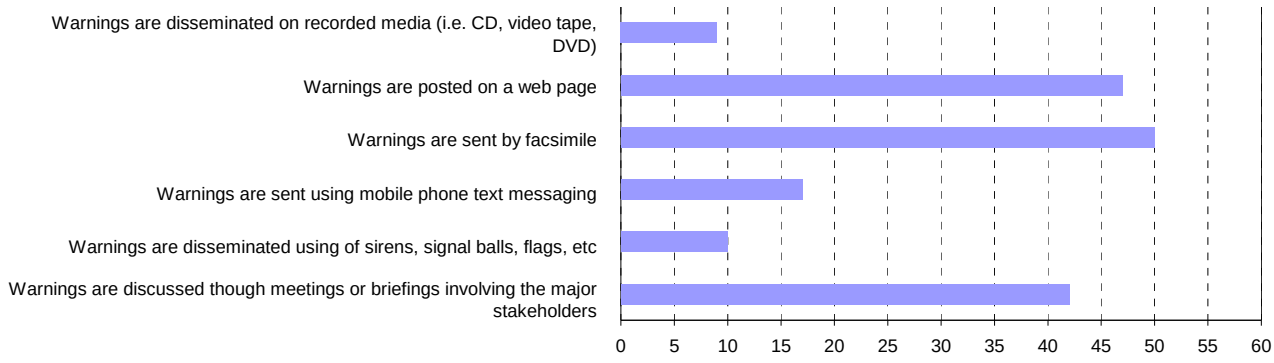

Figure 158. Warning dissemination methods in Developing Countries.

As might be expected, a very high percentage of survey contributors from Developing Countries indicated that they disseminated hazard warnings to the public and the media and to relevant government authorities. Moreover, a substantial percentage of these NMHSs disseminated warnings and other products to external partners in disaster risk reduction such as national Red Cross and Red Crescent Societies and others. The major dissemination methods in Developing Countries were via facsimile, web page, briefings and Internet downloads. Substantial numbers of Developing Countries respondents to the survey also used hard copy mailings and some used sirens and other signal devices.

10.5.9 Product Utility and Product Improvement

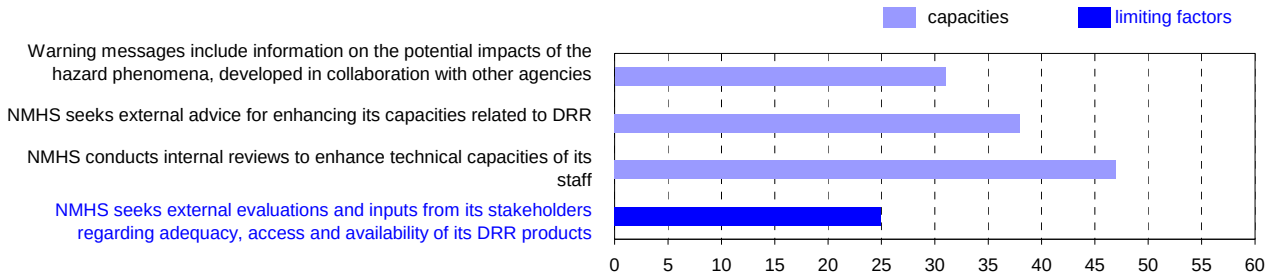

Figure 159. Ongoing feedback and improvement of products in Developing Countries.

Most (85% or 51 of 60) NMHSs in Developing Countries indicated that they worked with other agencies with respect to hazard warnings. Most of them (94% or 45 of 48) sought advice to enhance monitoring and forecasting and similar numbers (92% or 44 of 48) sought advice to enhance watches and warnings or overall products and services (86% or 42 of 49). About half (53% or 31 of 58) of the Developing Country NMHSs who included information on potential risks (impacts) in warning statements indicated that they worked with other agencies to develop risk information. Roughly two thirds of them (65% or 39 of 60) stated that their NMHS had a quality control mechanism to enhance their warning capabilities and content. Of these, three quarters (76% or 34 of 45), stated that the mechanism provided for regular interaction with stakeholders (disaster risk authorities) while slightly fewer (69% or 31 of 45) said it provided for feedback from stakeholders and the public after an event had occurred. Almost half of the survey contributors from Developing Countries (49% or 22 of 45) indicated that the mechanism provided for training for stakeholders to understand the hazards, warnings and their implications and almost as many (44% or 20 of 45) said that similar training was provided to the general public. Just under half (43% or 25 of 58) also reported that their NMHSs sought external evaluations and inputs from stakeholders regarding the adequacy, relevance, method of access and availability of their disaster risk reduction products.

A substantial majority (87% or 52 of 60) of NMHSs from Developing Countries who responded to the survey, however, believed that the lack of public understanding of the effects of hazards limited the public response to them and most of these (82% or 49 of 60) felt that the same lack of understanding applied to watches and warnings. Three quarters (75% or 44 of 59) also considered that the lack of joint training between NMHS staff and disaster risk managers limited their disaster risk reduction efforts and the same number (76% or 45 of 59) identified the lack of joint training with emergency authorities and managers as a limiting factor. Finally, most Developing Country NMHSs (92% or 55 of 60) felt that educational modules for media, public and disaster risk authorities would enhance their effectiveness in disaster risk reduction.

10.5.10 Internal NMHS Training and Capacity Enhancement

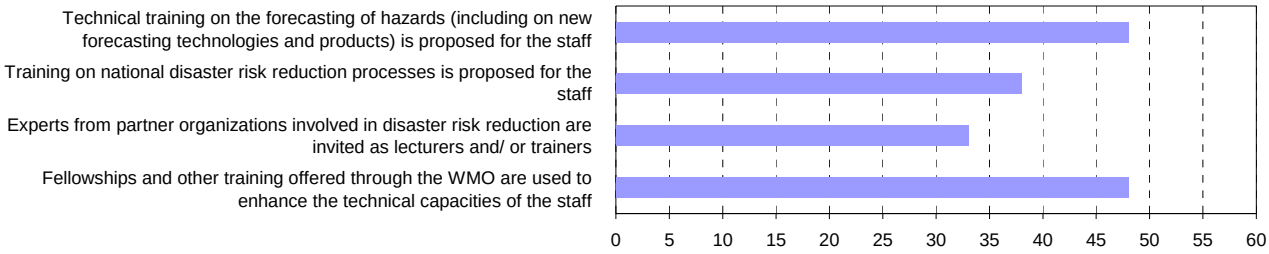

Figure 160. Training and capacity building of NMHS' staff in Developing Countries.

Over three quarters of survey contributors (80% or 48 of 60) from Developing Countries indicated that they provided ongoing technical training to staff on forecasting of hazards, including up to date training on new forecasting technologies and products. A similar number (80% or 47 of 59) also reported that they conducted internal reviews and sought staff inputs to enhance their capacity building and technical training activities. Just as many (80% or 48 of 60) stated that they utilized Fellowships and other training offered through WMO to enhance the technical capacities of their staff. Two thirds of them (66% or 38 of 58) provided training to staff on their country's disaster risk reduction processes and related topics and many of these (56% or 33 of 59) invited experts from partner organizations involved in disaster risk reduction as lecturers and/or trainers. Almost two thirds of survey contributors (65% or 39 of 60) also conducted evaluations of the suitability of communications, workstations, and software. A slightly larger number (68% or 41 of 60) implemented upgrades to these systems to support disaster risk reduction. However, less than half of the NMHSs (45% or 26 of 58) from Developing Countries reported that they held or participated in joint training activities for NMHS staff and emergency response agencies.

Balancing the preceding, almost three quarters of survey respondents from Developing Countries (70% or 39 of 56) indicated that lack of forecaster training at the NMHSs reduced the effectiveness of their warning service. Two thirds of them (66% or 39 of 59) also reported that (lack of) professional staff with appropriate training limited both their ability for real time monitoring of hazards and their ability to provide hazard data products. Three quarters (75% or 44 of 59) stated that a lack of joint training with disaster risk managers limited their contributions to disaster risk reduction. Similar numbers cited lack of joint training with media (77% or 46 of 60) and emergency authorities and managers (76% 45 of 59) as limiting factors. Perhaps not surprisingly, all contributing NMHSs from Developing Countries (100% or 56 of 56) considered that upgrading and improving their operational forecasting and warning services would enhance their disaster risk capacities. The same number (95% or 56 of 59) also considered that upgrading and improving the technical training of the professional forecasting staff would enhance these capacities and almost as many (91% or 51 of 56) advocated the conduct of cross-border training activities with neighbouring NMHSs, targeted at common hydrometeorological hazards.

10.5.11 Outreach Activities

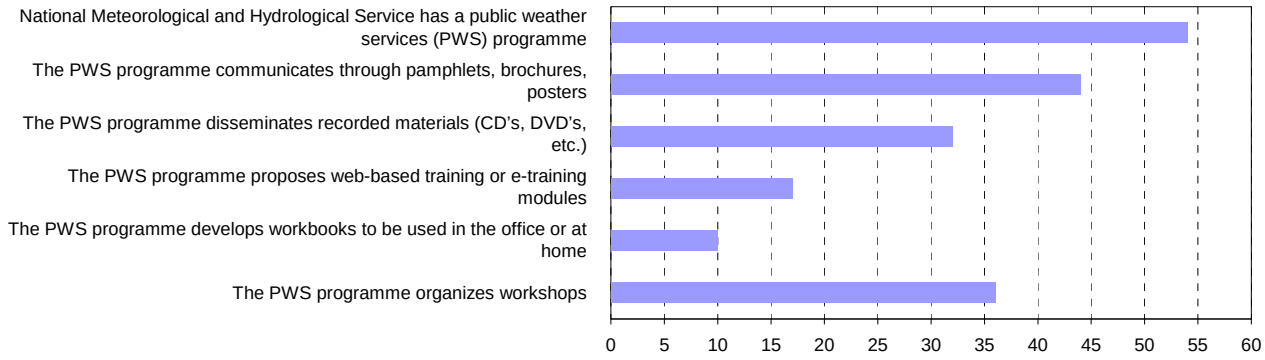

Figure 161. Outreach activities in Developing Countries.

Outreach activities aimed at the general public and other stakeholders are an important component of any effective disaster risk reduction programme. Within NMHSs, outreach activities are often part of a public weather services programme. In Developing Countries, most NMHSs (90% or 54 of 60) who responded to the survey identified that they had such a public weather services programme. Almost half (49% or 22 of 45) the survey contributors stated that their NMHS quality control programme included training for the stakeholders to understand the hazards, warnings and their implications. Just over half of respondents (55% or 33 of 60) also indicated that they provided education and training on hazards, watches, warnings, etc to disaster risk reduction managers and authorities and operational emergency response managers but a lower number (37% or 22 of 60) provided training to the media. Over a third of survey contributors (37% or 22 of 60) identified that they provided training targeted at the trainers (i.e. of disaster risk authorities, emergency response staff, media, etc) and almost as many (33% or 20 of 60) indicated that they provided educational modules and training programmes targeted at the general public. Under half of Developing Country respondents (45% or 26 of 58), however, pursued joint training activities with emergency response agencies. The following materials and methods were identified as being used in NMHS public outreach programmes - pamphlets, brochures, posters (75% or 44 of 59), workshops (63%), recorded materials (CDs, DVDs, etc) (54%), Web-based training (30%), workbooks for office or home use (17%) and E-training modules (7%).

Almost all (87% or 52 of 60) survey contributors from Developing Countries judged that the lack of public understanding of the effects of hazards limited public response to warning services. In addition, three quarters of them (75% or 44 of 59) felt that the lack of joint training with disaster risk managers limited their disaster risk reduction efforts. Similar numbers (76% or 45 of 59) felt that lack of joint training with emergency authorities and managers and with the media (77% or 46 of 60) limited their disaster risk reduction efforts. As a consequence, almost all NMHSs (92% or 55 of 60) in Developing Countries considered that educational modules that they could target at media, public and disaster authorities would enhance their effectiveness in disaster risk reduction.

10.6 NMHS Contingency Planning

Almost three quarters (73% or 43 of 59) of NMHSs in Developing Countries reported that their NMHS had a contingency plan to maintain the continuity of products and services in the event of organizational emergencies such as power failure or communications disruption. Almost half of these (45% or 20 of 44) stated that their contingency plans involved an agreement or protocol with neighbouring NMHSs to support them in the event of catastrophic failure. In addition, over half (58% or 35 of 60) stated that they conducted or participated in drills and exercises to ensure disaster preparedness. However, a large majority of Developing Country contributors to the WMO country-level survey (93% or 51 of 55) identified needs for improved coordination with

neighbouring NMHSs, specifically citing the need for support from them in the event of disruption of services due to the impact of a disaster.

10.7 Overarching Factors

Developing Countries' NMHSs participating in the WMO country-level survey were asked to respond to a series of questions directed at obtaining expressions of opinion from them regarding overarching factors or realities that either limited or could enhance their ability to make optimal contributions to disaster risk reduction. To varying degrees, the responses to these questions also served to validate statements, expressions of opinion and/or recommendations contained in responses to earlier sections of the survey. The following summarizes the inputs that fall under the above broad category:

10.7.1.1 NMHS Visibility

Most contributing NMHSs in Developing Countries (81% or 48 of 59) considered that they needed higher visibility and recognition within government as a major contributing agency to disaster risk reduction. Almost two thirds of them (65% or 37 of 57) also felt that their contributions to disaster risk reduction were limited by the lack of understanding by government authorities of the value provided by the NMHSs. Almost all survey respondents (97% or 57 of 59) from Developing Countries considered that improved ministerial level understanding of the socio-economic benefits of hydrometeorological products and services would increase the visibility of the NMHSs at the national level.

10.7.1.2 Organization and Governance

Almost one third of NMHSs in Least Developed Countries (29% or 17 of 58) considered that their national organizational structure for disaster risk reduction limited their potential contributions in this area. Nearly two thirds of them (62% or 36 of 58) considered that the effectiveness of their contributions to disaster risk reduction was also limited by the lack of clear legislation or policies regarding the role of the NMHSs (e.g. as the sole issuer of warnings). In addition, over two thirds of survey contributors (67% or 32 of 48) from countries with separate NMSs and NHSs believed that there was a need for legislation or partnership agreements to better define the role each agency played in disaster risk reduction.

10.7.1.3 Coordination and Partnership

Almost two thirds (60% or 35 of 58) of NMHSs in Developing Countries who contributed to the WMO country-level survey considered that their contributions were limited by a lack of linkages between their NMHSs and other organizations involved in disaster risk reduction. In addition, most of them (93% or 55 of 59) thought that better coordination with neighbouring or adjacent countries would improve their contribution to their own nation's disaster risk reduction activities. A substantial majority (86% or 49 of 57) also considered that better coordination with WMO Regional Specialized Meteorological Centres would improve their contribution.

10.7.1.4 Resources and Capacity

Most NMHSs from Developing Countries (93% or 50 of 54) indicated that resources and infrastructure limited their ability to deliver critical products and services for disaster risk reduction, specifically identifying professional staff (88% or 50 of 57) and financial resources (88% or 49 of 56) as key limiting factors. In consequence, all (100% or 56 of 56) survey respondents from this group of countries considered that upgrading and improving their NMHSs operational forecasting and warning services would enhance the disaster risk reduction capacity within their country.

10.8 Concluding Assessments and Recommendations for Developing Countries

The following summarizes assessments and conclusions related to the analysis of the survey responses from NMHSs in Developing Countries that has been presented in this chapter. In order

to facilitate identification of subject areas, the titles associated with individual assessments and conclusions presented below match those used during the analyses of Developing Country survey responses outlined in the preceding pages.

10.8.1 Access to Data on Hazards and their Impacts

NMHSs need to have easy access to official information on hazards and on the impacts of disasters in order to provide support for planning activities and to facilitate monitoring the effectiveness of their own services in support of disaster risk reduction. As Annex 3 illustrates, while a majority of Developing Country NMHSs maintain records of the most common hazards such as strong winds or drought, the number declines rapidly for less frequently occurring hazards. As the agencies responsible for monitoring and prediction of hydrometeorological hazards within their countries, NMHSs (or NMSs and NHSs) may, reasonably, be expected to maintain records of occurrences of significant hazards. Equally, it is important that NMHS have ready access to official information on the impacts of disasters. The survey responses indicate that this is not the case in up to one third of Developing Countries.

10.8.2 Value Added Services based on Historical Hazard Data

Respondents' recommendation for expansion of value added services in support of risk assessment are strongly reinforced by earlier responses that indicate that close to one half of Developing Country NMHS do not provide some such services. The implications of this recommendation are that significant training and capacity development will need to be undertaken in most NMHSs in Developing Countries to acquire or further develop the capability to deliver the added value services under discussion.

10.8.3 Legislation and Governance

The responses suggest that NMHSs should press for clear policy direction from their governments regarding their roles and responsibilities in those Developing Countries where a lack of clarity limits their potential contributions to disaster risk reduction.

10.8.4 National Structures/Mechanisms for Disaster Risk Reduction

The responses suggest that in over a quarter of Developing Countries NMHSs capacities are not well integrated into national disaster risk reduction organizational structures and processes. The degree to which NMHSs are integrated into these structures and processes and their operational relationships with civil protection agencies, planning authorities and important non-governmental partners, exercise a significant influence on their ability to contribute effectively to disaster risk reduction. For optimum effectiveness, state of the art NMHS scientific, technical and operational capacities must be mainstreamed into national planning, decision-making and disaster response structures and systems and, in addition, be well connected to important non-governmental partners.

10.8.5 NMHS Contributions to the National Disaster Risk Reduction Effort

Experience elsewhere indicates that the respondents' advocacy of a "readiness system" could, if implemented, enhance NMHSs contributions to disaster risk reduction. This suggestion should be pursued at the national level. Furthermore, continuing efforts should be made to promote the contributions that NMHS can make to disaster risk reduction and to encourage disaster authorities to build on NMHS capacities. In parallel, however, the capacities of NMHS must, where necessary, be enhanced to ensure that they can, in fact, deliver state of the art products and services in support of disaster risk reduction.

10.8.6 NMHS Collaboration with other Partners

Responses indicate that many, perhaps half of, NMHSs in Developing Countries do not pursue collaboration with important national, regional and international partners in the disaster community. Expanded collaboration and partnerships can benefit NMHS through broader utilization of their

products and services, increase their visibility and result in more effective contributions to disaster risk activities. NMHS should be proactive in expanding their partnerships with the broader disaster community both within and outside government circles.

10.8.7 The Organization and Priorities of NMHSs

The respondents' recommendation for enhancement of coordination between NMSs and NHSs appears entirely valid in light of the earlier responses. Close coordination between meteorological and hydrological authorities is an essential foundation for the provision of timely, accurate and consistent hydrometeorological hazard warnings and other services.

10.8.8 Operational Coordination between NMSs and NHSs

The survey responses summarized above clearly indicate that needs exist for enhanced operational coordination between NMSs and NHSs in most Developing Countries. The survey respondents' recommendation should, therefore, be pursued at the country level through actions to achieve more effective operational coordination between the meteorological and hydrological communities, particularly with respect to hazard warnings and other critical products.

10.8.9 Observation and Monitoring Networks and Systems

The survey responses indicate that most NMHSs in Developing Countries consider that their observing networks are not optimal for disaster risk reduction and, in the case of about a third of respondents, even raise questions about the reliability or continuity of their 24-hourly/year-round observation programmes. Moreover, most respondents indicated that there were inadequate resources and trained staff to maintain their observing networks. These challenges were, in about half of the responding NMHSs, compounded by hazard related damage to observation stations. These realities draw attention to the need for the sustained provision of resources to NMHSs in Developing Countries, at levels sufficient to operate adequate observing networks and programmes. Reliable, round the clock, observations, made available in real-time, are the essential raw material needed for the production of early warnings, forecasts and other real-time products to support disaster risk reduction. Consequently, every effort must be made to ensure that adequate observational networks and systems are put in place and maintained in reliable operation on a 24-hourly/yea-round basis.

10.8.10 Telecommunications and Informatics

The responses indicate that 24-hourly/year-round telecommunications capability is not in place in at least four Developing Countries. Furthermore, almost two thirds of responding NMHSs have identified telecommunications facilities as limiting their ability to deliver critical products, with even more citing significant deficiencies in computer hardware, network equipment, and application software. Internet access is also identified as problematic in about a quarter of the responding countries. These realities strongly reinforce the respondents' recommendation that upgrading of operational telecommunications and informatics infrastructure is required in most Developing Countries NMHSs.

10.8.11 Data Exchange

The respondents' recommendations for improved coordination with neighbouring NMHSs and RSMCs on data exchange make good sense since collaboration and coordination are fundamental to effective and efficient exchange of data and products. In addition to implementation of the respondents' recommendation for improved coordination and collaboration with RSMCs and neighbouring NMHSs, however, the survey responses indicate that improved data exchange will require enhancements to telecommunications, quality assurance and archiving systems in many NMHSs in Developing Countries. Furthermore, complementary capacity building will be required in relation to data processing and customization of products.

10.8.12 Forecast and Warning Capability

The respondents' recommendations are validated by the responses summarized earlier in this section. Clearly, there are general needs for upgrading of professional staff, computing capacity and applications software. The responses indicate that six or seven Developing Countries' NMHSs do not operate their forecast and warning services service on a round-the-clock basis and that one NMHS does not have forecasting capacity. These situations represent a serious deficiency in relation to provision of hazard warnings, forecasts and other support to disaster risk reduction. Major enhancements to forecasting infrastructure along with provision of appropriate training for professional staff and sustained provision of continuing resources will clearly be required before a significant number of NMHSs in Developing Countries will be able to contribute optimally to disaster risk reduction within their countries.

10.8.13 Forecast and Warning Products

The respondents' recommendation regarding the need to improve their warning products and services is well supported.

10.8.14 Coordination of Warnings

The respondents' strong recommendation for improved coordination with neighbouring NMHSs and RSMCs in relation to watches and warnings makes good sense. Such coordination reduces the risk of ambiguous or, in the worst case, conflicting warning messages from different sources reaching the same audience. A compounding issue here is the increased potential for confusion that arises when commercial or other entities also issue hazard warnings, as is the case in over a quarter of Developing Countries. As a general principle, therefore, it is desirable to work towards a situation where official warnings for hydrometeorological hazards emanate from a single recognized issuing authority within each country**.** Ideally, prepared by NMHSs with the scientific and technical capacity to make such predictions, hydrometeorological warnings may, in some circumstances, benefit from assessment and interpretation by civil defence authorities as to their likely impacts before being relayed to local communities, perhaps accompanied by advice on actions that people should take to minimize loss of life and property.

10.8.15 Products and Services for Selected Socio-Economic Sectors

Experience around the globe demonstrates that the socio-economic sectors discussed earlier could benefit significantly from the incorporation of hydrometeorological information and products into their planning and decision-making processes. Sensible land-use planning to minimize risk of flooding and other hazards, engineering design of housing and other developments to withstand expected wind loads, design of drainage systems to accommodate heavy rainfalls or rapid snowmelt and other similar measures contribute to hardening societies and communities against disastrous impacts of hydrometeorological events. Equally, early warnings of hazards enable people to take avoidance or mitigating actions to prevent disasters. The survey responses indicate that some vulnerable target sectors do not receive special hydrometeorological services in one half or more Developing Countries. Consequently, Developing Country NMHSs have the opportunity to make major contributions to disaster risk reduction by enhancing the provision of relevant value-added products and services to planning, development, water resources and other key socio-economic sectors.

10.8.16 Dissemination Systems and Target Audiences

Reliable and timely dissemination of early warnings of hazards to stakeholders and the public at large is among the most useful services that NMHSs can provide in support of disaster risk reduction. Consequently, every effort should be made to ensure that warnings and other relevant products reach important target audiences. In the context of disaster risk reduction, national Red Cross/Red Crescent Societies and similar non-government bodies should be targeted for receipt of hazard warnings on virtually the same level as government disaster authorities. Efforts to enable

such important external partners to access and utilize early warnings of hazards and other relevant NMHS products should be strongly encouraged in all Developing Countries.

10.8.17 Product Utility and Product Improvement

The respondents' recommendation regarding the value of educational modules is validated by the survey responses. The responses indicate that continuing emphasis is needed on increasing the awareness and understanding of stakeholders, including the public at large, disaster risk authorities and the staff of emergency agencies, regarding hazards, their impacts, and the content of watches, warnings and other disaster products. As a specific initiative, most respondents identified the need for and value of joint training for staff of NMHSs and those of disaster management and emergency response agencies and this also makes good sense.

10.8.18 Internal NMHS Training and Capacity Enhancement

The respondents' recommendations directly address the deficiencies and limitations identified in the survey responses. Perhaps not surprisingly, responses from NMHSs in Developing Countries show general needs for extensive training and capacity development to bring their capabilities up to the standard required for effective support to disaster risk reduction. Roughly one quarter of respondents, for example, reported that they did not provide regular training to staff on forecasting techniques and about a third of them did not provide training to their staff on their countries' disaster risk reduction strategy and processes. Consequently, the needs are real but the efforts to address them are at present inadequate.

10.8.19 Outreach Activities

Survey responses indicate that one half or less of the Developing Countries' NMHSs undertake significant outreach activities directed at the media, disaster management authorities and the public at large. The respondents' recommendation for greater emphasis on outreach activities is, therefore, supported by other survey responses though it is somewhat narrowly focussed on a single outreach tool or mechanism. When taken in combination with needs for internal NMHS staff training and development, the responses and the recommendation draw attention to wide ranging needs for capacity development in these countries across the whole spectrum of NMHSs fields of activity.

10.8.20 NMHS Contingency Planning

The survey responses indicate that over a quarter of NMHSs in Developing Countries do not have a contingency plan to provide back-up capability. Establishment of such a plan is a prudent step for all NMHSs to ensure maintenance of critical hazard warnings and products and services in the event of emergencies. In many instances, a partnership agreement with a neighbouring NMHS can be an effective, low cost, approach to ensuring that back-up capability is in place.

CHAPTER 11
LEAST DEVELOPED COUNTRIES

11 LEAST DEVELOPED COUNTRIES (LDC)

11.1 Abstract – Least Developed Countries

Survey responses from 25 Least Developed Countries (LDCs) indicate that virtually all of them operate observation and telecommunications networks. In most cases, however, these networks are inadequate with widespread deficiencies in equipment, computing capacity and Internet access. Most LDC NMHSs have some forecasting capability and just under half have emergency contingency plans. Two thirds of them operate warning programmes for hydrometeorological hazards but fewer than half issue warnings for some significant hazards. Only a minority have combined NMHSs and most cite needs for better coordination between their National Meteorological Services (NMSs) and National Hydrological Services (NHSs) and with neighbouring NMHSs and other key stakeholders. Though possessing limited expertise and data archives, most provide some value added services. Roughly half of them target services to the planning, housing and fresh water sectors. All LDC NMHSs stress urgent needs to upgrade their operational infrastructures, enhance their professional expertise and improve coordination with key partners. Most point to inadequate training as reducing their capabilities for hazard monitoring, forecasting and warnings preparation. Almost all of them also suggest that outreach activities and joint training programmes with stakeholders should be expanded. In most of these countries, the NMHSs participate in national disaster risk coordination committees but the majority complain of inadequate recognition and roughly half feel constrained by these structures and by a lack of clarity regarding their roles. The preceding survey results validate the following conclusions and recommendation directed towards strengthening the capacities of NMHSs in Least Developed Countries:

- All Least Developed Countries NMHSs should be integrated into their national disaster risk reduction systems. Many that are not already members, should seek membership in their national coordinating committees for disaster risk management. All of them should press for clear direction regarding their roles and responsibilities and pursue strengthened partnerships with other disaster stakeholders.
- Most Least Developed Countries NMHSs need to improve and expand their archiving systems for hazard data and ensure their access to impacts data. There are associated requirements for capacity development in data rescue, quality assurance and data management and archiving.
- Most Least Developed Countries NMHSs require significant capacity development and training in disaster risk applications such as hazard and impact analysis, hazard mapping, risk zone analysis and product customization.
- Most NMHSs observing and telecommunications networks are inadequate and at least five do not maintain 24-hourly observation programmes. High priority should be made to establish and maintain adequate hydrometeorological observation and telecommunications infrastructures and programmes in all Least Developed Countries, with particular emphasis on ensuring their 24-hourly operation.
- Least Developed Countries NMHSs' hazard warning capacities should be strengthened since at least three do not have operational forecast and warning services, several more do not operate these services on a 24-hourly basis, and inadequacies exist in the remainder. Needs exist in all these countries for significant upgrading of forecasting infrastructures and professional staff capacities which includes major requirements for capacity building, technology transfer and investments in infrastructures and provision of continuing operating funds.
- NMHSs in Least Developed Countries have widespread needs for extensive training and capacity development since many do not provide training to their staff on forecasting techniques nor on their countries' disaster risk reduction strategy and processes.
- In all LDCs, NMHSs' hydrometeorological hazard warning programmes should be implemented or expanded to address all hydrometeorological hazards with disaster-causing potential and warnings should be routed to all important stakeholders.

- In all LDCs, official warnings of hydrometeorological hazards should emanate from a single competent issuing authority, ideally the NMHS. In some circumstances, however, they may benefit from assessment and interpretation by civil defence authorities before being widely disseminated.
- Verification programmes for hydrometeorological hazard warnings should be implemented by all Least Developed Countries NMHSs to monitor warning accuracy and timeliness, assess improvements in skill, and demonstrate NMHSs' warning capabilities to stakeholders.
- More than half of Least Developed Countries NMHSs who have not done so should establish back-up arrangements to maintain hazard warnings and other services in emergency situations, possibly through partnership agreements with other NMHSs.
- LDC NMHSs should encourage the establishment of national readiness systems within their countries.
- Operational coordination should be enhanced between NMSs and NHSs in Least Developed Countries. In addition, LDC NMHSs should be proactive in expanding partnerships with neighbouring NMHSs, Regional Specialized Meteorological Centres (RSMCs) and other governmental and external disaster risk stakeholders.
- NMHSs in all Least Developed Countries have an opportunity to make major contributions to disaster risk reduction by enhancing the provision of relevant products and services to planning, development, water resources and other key socio-economic sectors.
- All Least Developed Countries NMHSs should increase emphasis on education and outreach directed at key stakeholders and the public at large and on joint training with disaster authorities.
- Least Developed Countries NMHSs urgently need support from WMO across a broad spectrum of areas including infrastructure development, technology transfer, staff training and capacity building, and resource mobilization if they are to build the capacities to provide effective support for disaster risk reduction.

The present chapter centres on the assessment of the survey responses from NMHSs in Least Developed Countries. Its internal structure follows the sequence outlined earlier in section 2.6.1.

11.2 The Response to the Survey

As noted earlier, 25 Least Developed Countries (LDCs) responded to the WMO country-level survey and these are listed in Annex 2.

11.3 The Hazards affecting Least Developed Countries

Figure 162 below lists the number of responding Least Developed Countries who identified themselves as being affected by the specified hazards.

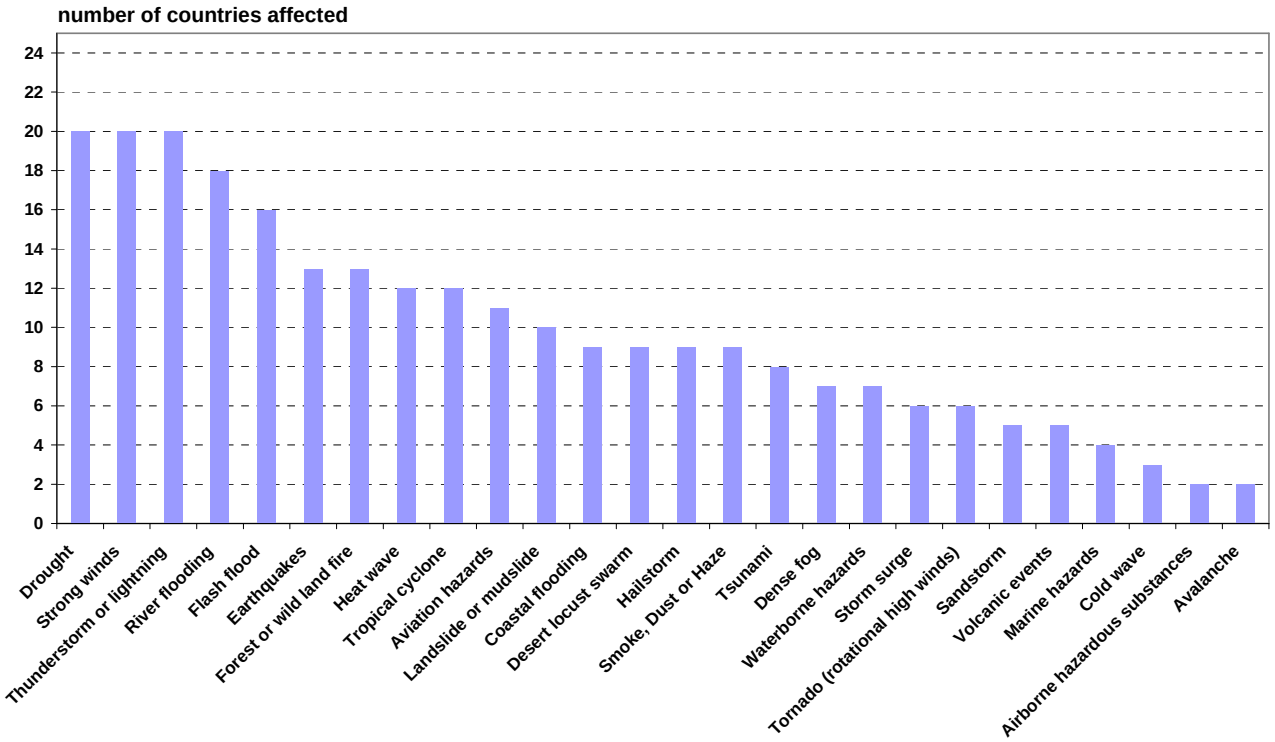

Figure 162. Number of responding Least Developed Countries who identified themselves as being affected by specified hazards.

11.3.1 Access to Data on Hazards and their Impacts

Annex 3 presents an overview of the hazard databases maintained by survey respondents in Least Developed Countries and includes some supplementary information on related metadata and impacts information. Most NMHSs in Least Developed Countries (84% or 21 of 25) who contributed to the WMO country-level survey stated that another agency was responsible for providing official information on the impacts of disasters in their country. Most of them (72% or 18 of 25) said that they had access to such official, reliable, information. In addition, however, just over one quarter (28% or 7 of 25) of survey contributors reported that they maintained their own

internal database of official information on the impacts of hazards that affected their countries and most of them (63% or 5 of 8) regularly updated this database[31].

11.3.2 Value Added Services based on Historical Hazard Data

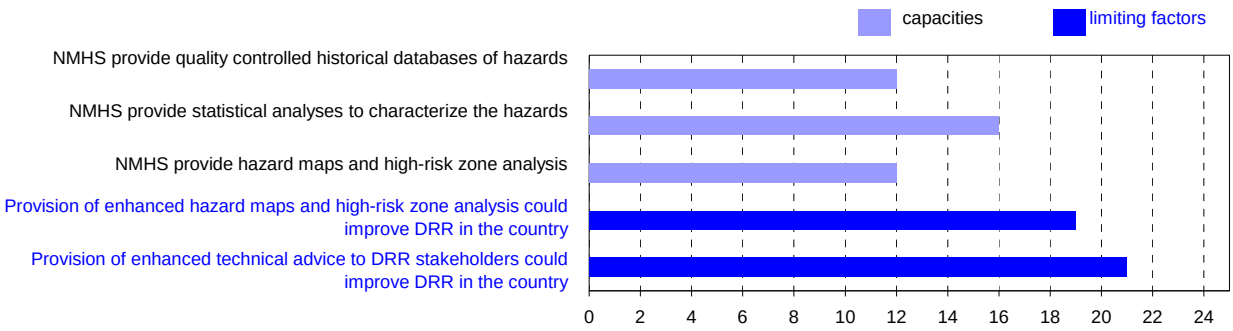

Figure 163. Provision of hazard information by NMHSs in Least Developed Countries.

The following draws attention to the extent of value added services provided by NMHSs in Least Developed Countries who maintain historical archives of hydrometeorological hazards. Most Least Developed Countries NMHSs who contributed to the WMO Disaster Risk Reduction country-level survey (73% or 16 of 22) stated that that they provided technical advice on hazards and (70% or 16 of 23) provided statistical analyses to characterize them. Over half of the respondents (52% or 12 of 23) reported that they maintained quality controlled historical databases of hazards and undertook hazard mapping and high-risk zone analysis. Less than half of them (43% or 10 of 23), however, stated that they provided analyses of the potential impacts of hazards.

Most contributing NMHSs from Least Developed Countries identified factors that limited their ability to provide hazard data products. They cited as limiting factors professional staff with appropriate training (91% or 21 of 23), data rescue (87% or 20 of 23), ability to archive and update (74% or 17 of 23), quality assurance (70% or 16 of 23) and customization of data for stakeholders (68% or 15 of 22). Most of them also considered that the provision of enhanced value added services in support of hydrometeorological risk assessment would strengthen their contributions to disaster risk reduction activities. The following specialized services were identified as useful enhancements - analyses of the potential impacts of hazards (95% or 21 of 22), provision of technical advice (95% or 21 of 22) and hazard mapping and high-risk zone analysis (90% or 19 of 21).

11.4 The National Context for Disaster Risk Reduction

National legislative, governance and organizational structures for disaster risk reduction establish the context within which NMHSs make their contributions to safety of life and property. The following sections summarize survey responses from Least Developed Countries' regarding their countries' national systems for disaster risk reduction, the impact of these systems on the NMHSs and the extent of NMHSs contributions to them.

[31] It is important to note, that, to date, no systematized, universally accepted, methodology or protocol has been established on a global basis for the creation and maintenance of hazard and hazard impacts databases.

11.4.1 Legislation and Governance

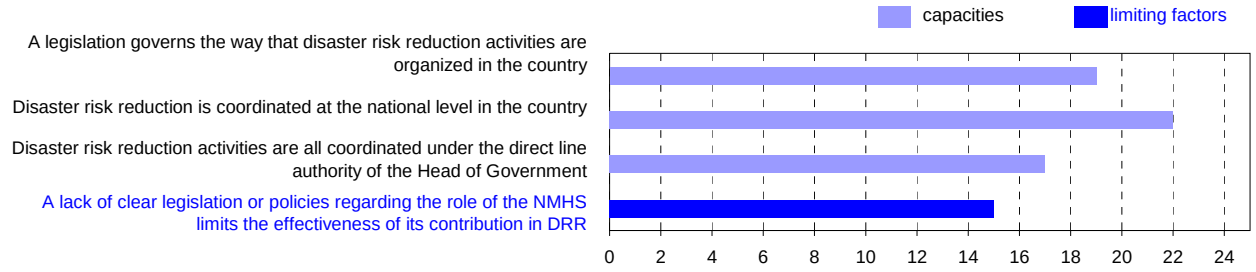

Figure 164. Legislation and coordination in support of disaster risk reduction at the national level in Least Developed Countries.

Most Least Developed Countries NMHSs who contributed to the WMO survey (88% or 22 of 25) reported that disaster reduction activities were coordinated at the national level, in a majority of cases (71% or 17 of 24) under the direct line authority of the head of government. The organization of these activities was governed by legislation in about three quarters of the countries (76% or 19 of 25). In just under half (48%), coordination was centred under one ministry. At the same time, almost two thirds of the respondents (65% or 15 of 23) considered that a lack of clear legislation or policies regarding the role of their NMHS (e.g. as the sole issuer of hydrometeorological hazard warnings) limited their contributions to disaster risk reduction.

11.4.2 National Structures/Mechanisms for Disaster Risk Reduction

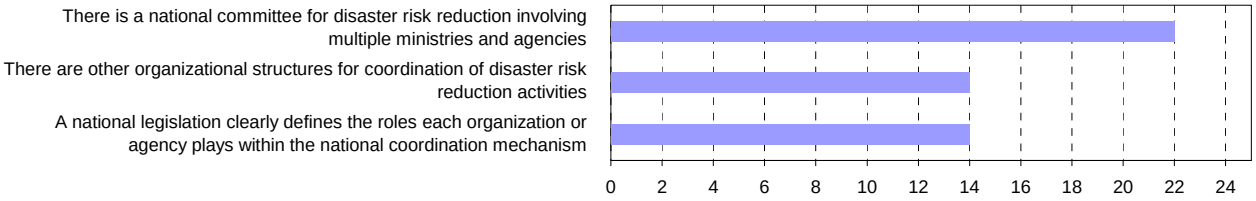

Figure 165. National structures for coordination of disaster risk reduction in Least Developed Countries.

Most NMHSs from Least Developed Countries who responded to the survey (88% or 22 of 25) indicated that their country had a national committee for disaster risk reduction that involved multiple ministries and agencies. Furthermore, most of them (92% or 23 of 25) stated that they were members of their national coordinating committee. Over half or the survey respondents (56% or 14 of 25) reported that the roles of each participating agency in the national coordination mechanism were defined by legislation but also pointed out that other organizational structures for coordination also existed in their countries. Just under half of Least Developed Country NMHSs who responded to the question (42% or 10 of 24) felt that their contributions to disaster risk reduction were limited by their national disaster management structure and larger number (71% or 17 of 24) identified inadequate linkages with other involved organizations as limiting.

11.4.3 NMHS Contributions to National Disaster Risk Reduction Systems

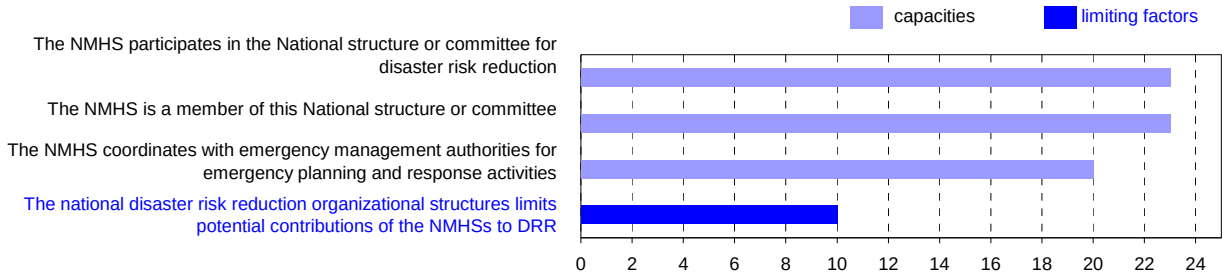

Figure 166. NMHS participation in national structures for disaster risk reduction in Least Developed Countries.

Almost all Least Developed Countries NMHSs who contributed to the survey (96% or 24 of 25) indicated that they provided support to agencies responsible for disaster risk reduction at the national level. Almost as many (92% or 23 of 25) also provided support to disaster prevention, emergency planning and preparedness and emergency response operations with a smaller number (50% or 12 of 24) supporting post-disaster reconstruction. A majority of survey respondents from Least Developed Countries (88% or 21 of 24) extended their support to provincial or state government disaster-related activities and about three quarters of them (74% or 17 of 23) also provided support to municipal or local levels. However, almost three quarters (71% or 17 of 24) of contributing NMHSs pointed to inadequate linkages with other involved organizations (e.g. emergency planners, emergency response agencies) as limiting their contributions to disaster risk reduction. Finally, most Least Developed Country NMHSs (87% or 20 of 23) considered that their contributions would be enhanced by a “readiness system” that required appropriate responses by authorities to information issued by the NMHSs.

11.4.4 NMHS Collaboration with other Partners

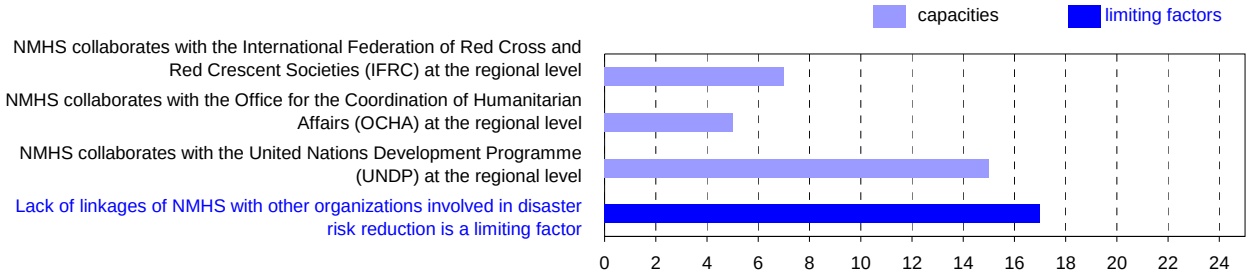

Figure 167. NMHS collaboration with partner agencies at the regional level in Least Developed Countries.

Almost all survey contributors (91% or 21 of 23) from Least Developed Countries reported that they coordinated with emergency management authorities for emergency planning and response at the national level. Most of them (79% or 19 of 24) also participated in disaster-related activities on the level of a WMO Region or a regional economic grouping. Substantial numbers participated in activities of international organizations (78% or 14 of 18), interacted with the office of their national United Nations Coordinator (64% or 16 of 25), participated in disaster reduction activities of the UNDP (71% or 15 of 21) collaborated with their National Red Cross and Red Crescent Societies (54% or 13 of 24) and the IFRC (37% or 7 of 19), or participated in activities of the Office for the Coordination of Humanitarian Affairs (29% or 5 of 17).

11.4.5 The Organization and Priorities of NMHS

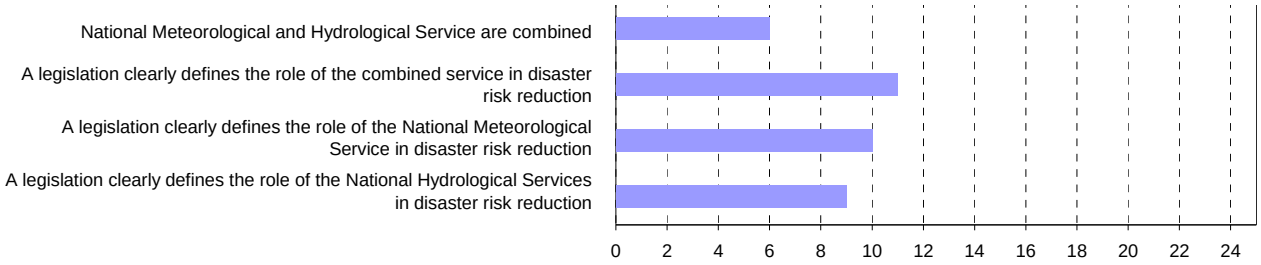

Figure 168. Organizational structure of meteorological and hydrological services in Least Developed Countries.

The priorities of individual NMHSs are, inevitably, influenced by the missions and priorities of their parent government ministries or departments. In consequence, the orientation of NMHSs may be more broadly focussed in some countries than in others. A parent department with a civil aviation mandate might, for example, emphasize provision of NMHS services to aviation while one with a natural resources or environment mandate might encourage its NMHS to provide warnings and other services to a broader range of sectors. As illustrated in earlier chapters of this report, NMHSs, NMSs and NHSs report to a wide variety of parent ministries or departments. The internal organization of National Meteorological and Hydrological Services can also influence their ability to deliver well-coordinated hydrometeorological warnings and other services in support of disaster risk reduction. Almost one quarter of survey contributors (24% or 6 of 25) from Least Developed Countries stated that they had a combined National Meteorological and Hydrological Service. Most respondents (61% or 11 of 18) indicated that their country had national legislation that clearly defined the NMHS role in disaster risk reduction. About half of those with a separate NMSs (48% or 10 of 21) and NHSs stated that they had legislation that clearly defined the role of the NMSs in disaster risk reduction. A similar number of Least Developed Country survey contributors (45% or 9 of 20) reported legislation that applied to the role of the NHSs[32]. At the same time, a majority (63% or 15 of 23) of survey contributors thought that legislation or partnership agreements were needed to better define the respective roles of their NMSs and NHSs in disaster risk reduction. In addition, most NMHSs from Least Developed Countries (95% or 18 of 19) considered that better technical coordination between their NMS and NHS would result in enhanced joint products and services, with a slightly smaller majority (84% or 16 of 19) advocating that better coordination would result in enhanced issuance of warnings.

[32] The survey questions relating to legislation may have caused some confusion among respondents as there is a notable inconsistency between the number of respondents who stated that they had a combined NMHS and the number who reported that they had legislation that clearly defined the NMHS role in disaster risk reduction.

11.4.6 Operational Coordination between NMS and NHS

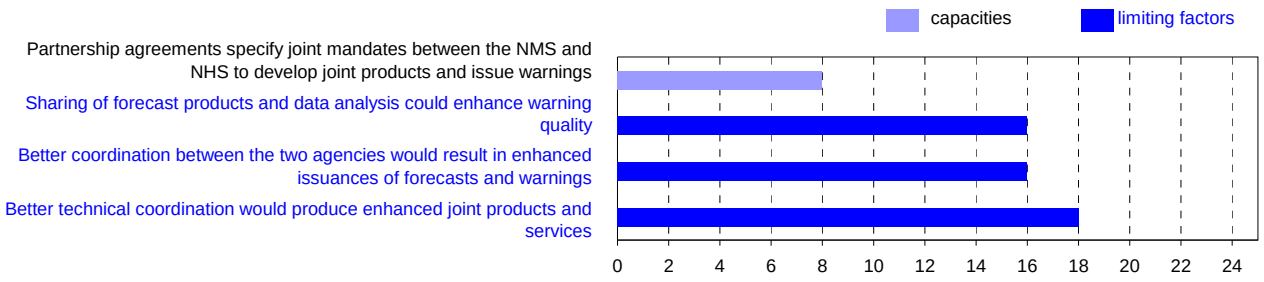

Figure 169. Coordination between NMS and NHS in Least Developed Countries.

Just over a third (38% or 8 of 21) of survey contributors from Least Developed Countries with separate NMSs and NHSs identified that a partnership agreement was in place specifying mandates between their NMS and NHS to develop joint products and issue warnings. A much larger number (73% or 16 of 22) indicated that the two agencies shared forecast products and data analyses that could enhance warning quality. Many of these (48% or 10 of 21) stated that coordination took place before warnings were issued for hazards of mutual concern and a similar number (52% or 11 of 21) indicated that coordination also took place for any hazard warning was issued. Some NMHSs from Least Developed Countries (20% or 3 of 15), however, reported that there was no coordination on warnings. Most LDC NMHSs who responded to the WMO survey (84% or 16 of 19) considered that better overall coordination between the two agencies would enhance issuance of forecasts and warnings. Slightly more of them (95% or 18 of 19) also considered that improved technical coordination would result in enhanced joint products and services.

11.5 NMHS Infrastructure, Products and Services

The following sections summarize the information contained in survey responses related to observational networks, telecommunications systems, warning and forecast production systems and their products, dissemination systems and related aspects of the overall operational capacities of NMHSs in Least Developed Countries.

11.5.1 Observation and Monitoring Networks and Systems

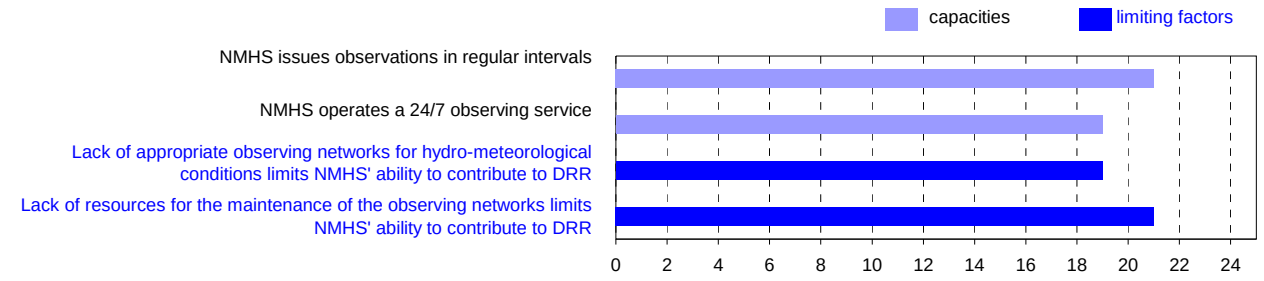

Figure 170. Observation and monitoring networks and systems in Least Developed Countries.

Most Least Developed Countries NMHSs who contributed to the WMO survey (88% or 21 of 24) stated that they had an operational observing capacity that issued observations at regular intervals and most of them (86% or 19 of 22) reported that the observing service operated 24-hourly/year-round. A third (33% or 7 of 21) of the respondents indicated that their observation network included

sea level monitoring stations. However, most of them (86% or 19 of 22) also considered that a lack of appropriate hydrometeorological observing networks limited their ability to contribute to disaster risk reduction and many (67% or 14 of 21) identified the availability of a dedicated 24-hourly/year-round observing service as an additional limiting factor. Major challenges in maintaining observation networks were also stressed by a majority of survey contributors from Least Developed Countries, citing limited professional staff with appropriate training (100% or 23 of 23), limited resources (96% or 23 of 24) (e.g. financial, replacement parts, personnel, etc) and mentioning hazard-related damage (55% or 11 of 20).

11.5.2 Telecommunications and Informatics

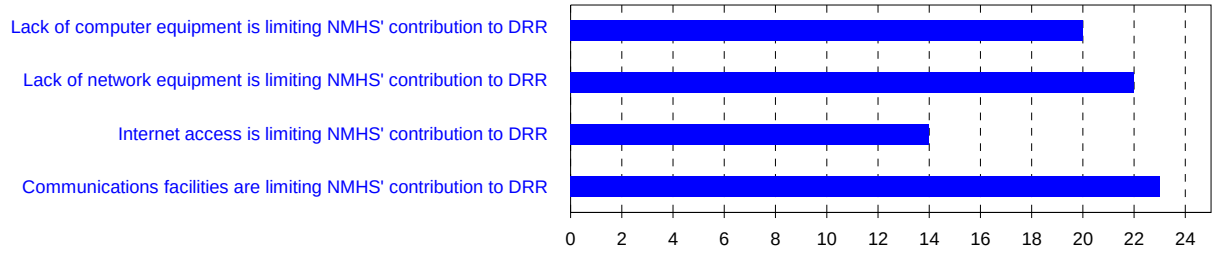

Figure 171. Telecommunication and informatics in Least Developed Countries.

Most Least Developed Countries NMHSs who contributed to the WMO survey (83% or 19 of 23) reported that their telecommunications systems were available 24-hourly/year-round. Some confirmation was provided by responses indicating that most forecasting staff in Least Developed Countries (79% or 19 of 24) had access to real time hydrometeorological data. However, almost all survey respondents (96% or 23 of 24) went on to identify that their ability to deliver critical products for disaster risk reduction was limited by communications facilities. Other limitations on NMHSs capacities were cited in major areas of informatics, with three quarters of contributors identifying network equipment (92% or 22 of 24), application software (87% or 20 of 23), computers (87% or 16 of 36) and inadequate Internet access (64% or 14 of 22). Finally, almost all responding NMHSs from LDCs (95% or 21 of 22) considered that upgrading their operational infrastructure for forecasting and warning services would enhance disaster risk reduction capacities in their countries.

11.5.3 Data Exchange

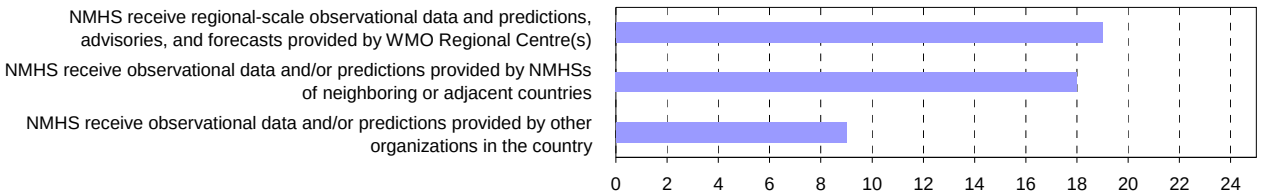

Figure 172. Data exchange in Least Developed Countries.

Survey contributions from NMHSs in Least Developed Countries identified that most (79% or 19 of 24) of their forecasting staff had real time access to hydrometeorological data. Most LDC respondents to the survey (86% or 19 of 22) stated that their forecasters used regional scale observational data and forecasts provided by WMO Regional Specialized Meteorological Centres and data from neighbouring countries (82% or 18 of 22) while some (41% or 9 of 22) used data and predictions from other organizations in their countries. Less than half (40% or 8 of 20) received real time marine observations from the GTS and a few (21% or 3 of 14) relayed sea level observations on that global network. However, most LDC contributors to the WMO survey (96% or

23 of 24) indicated that their NMHSs were limited in their ability to deliver critical products and services for disaster risk reduction by communications facilities. Equally, significant numbers stated that their NMHSs were limited by ability to archive and update (74% or 17 of 23), by quality assurance (70% or 16 of 23) and by customization of data for stakeholders (68% or 15 of 22). A substantial majority of LDC NMHSs who contributed to the survey considered that they required better coordination with RSMCs (96% or 23 of 24) and with neighbouring NMHSs (92% or 22 of 24) on hydrometeorological data exchange to enhance their countries disaster risk activities.

11.5.4 Forecast and Warning Capability

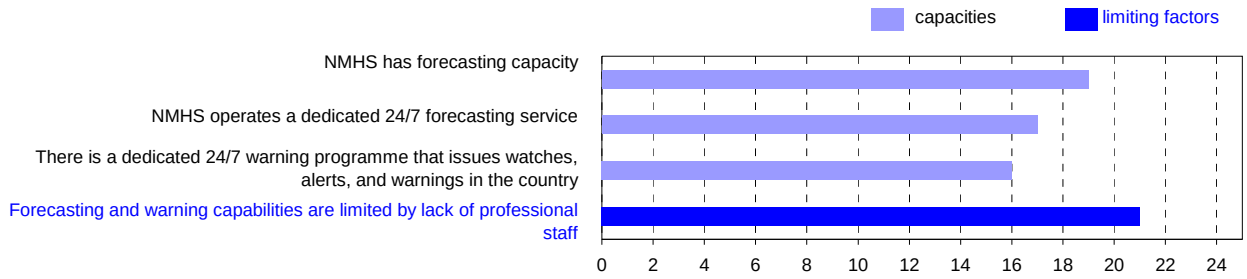

Figure 173. Forecast and warning capabilities in Least Developed Countries.

Most NMHSs (86% or 19 of 22) in Least Developed Countries who responded to the WMO Disaster Risk Reduction country-level survey indicated that they had an operational forecasting capability. A solid majority (80% or 16 of 20) of them stated that this was a dedicated 24-hourly/year-round forecast service. Most of them (81% or 17 of 21) also said that a meteorologist was required to be on-site to operate this service. Two thirds of survey respondents from LDCs (67% or 16 of 24) also reported that they had a dedicated hazard warning programme that issued watches, alerts and warnings on a 24-hourly/year-round basis. Most who responded to the question (88% or 15 of 17) indicated that a meteorologist was on site during the operational hours of the warning programme. Just over half of the NMHSs who contributed answers (57% or 12 of 21) stated that they provided a marine forecast and warning service to mariners and coastal zone users. One of these (5% or 1 of 20) also prepared marine forecasts for the Global Maritime Distress and Safety System (GMDSS). Most LDC contributors to the survey (91% or 21 of 23) indicated that their NMHS was limited in its ability to deliver critical products and services for disaster risk reduction by professional staff and most (87% or 20 of 23) cited application software and computers as limiting factors. Almost all of them (96% or 22 of 23) considered that upgrading their NMHSs operational forecasting and warning services would enhance disaster risk reduction in their countries. In particular, almost all (96% or 23 of 24) respondents advocated the upgrading or technical training of professional staff.

11.5.5 Forecast and Warning Products

Table 10 in Annex 4 summarizes information on hazard warnings and products issued by NMHSs in Least Developed Countries. The survey responses indicated that the hydrometeorological hazards affecting the greatest number of Least Developed Countries (LDC) were, in declining order, strong winds, thunderstorms and lightning, droughts, river flooding, flash floods, forest and wild land fires, earthquakes, tropical cyclones, heat waves, aviation hazards, landslides or mudslides, hailstorms, coastal flooding, smoke, dust or haze, desert locusts and tsunami[33]. In addition, dense fog, waterborne hazards, tornadoes and storm surges affected roughly one quarter

[33] The survey responses do not provide information on the magnitudes of the impacts associated with individual hazards, simply that they occur in the reported number of countries.

of these countries while volcanic events, sandstorms, marine hazards and cold waves were also a concern in some cases.

Examination of the data in Table 10 reveals that a majority of affected NMHSs issued warnings for the most common of the above hazards. However, the data also indicate that less than half of affected NMHSs issue warnings for some significant hazards, most notably forest and wild land fires, landslides or mudslides, tornadoes, hailstorms, and waterborne and marine hazards. Once again, the survey responses suggest that some hazards with significant disaster-causing potential, such as these, have been given insufficient priority in NMHSs warning programmes in some Least Developed Countries. This appears particularly evident when matched against the reported attention devoted to issue of warnings of aviation hazards and restrictions to visibility.

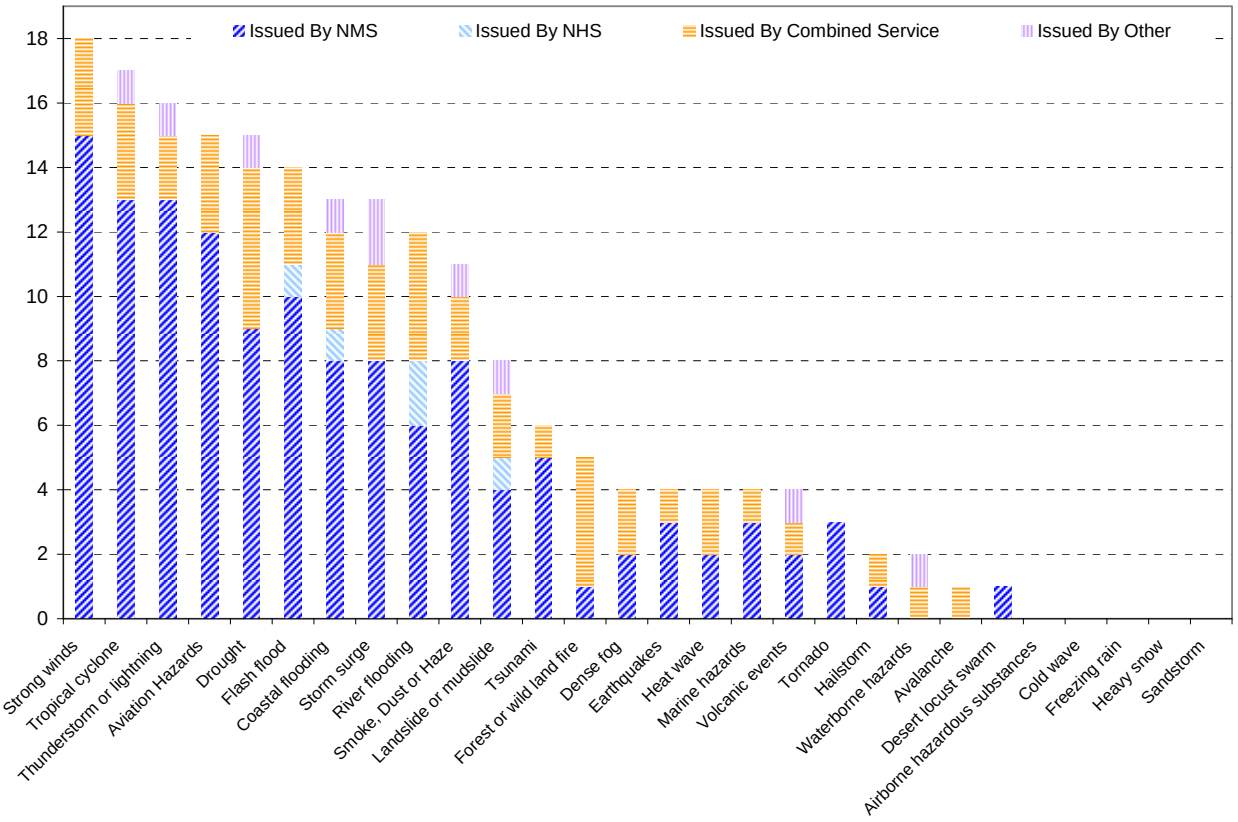

Figure 174. Agencies mandated for issuance of warnings in Least Developed Countries.

Paralleling the situation for other country groupings, the survey responses indicated that NMSs issued the vast majority of warnings for hydrometeorological hazards in Least Developed Countries. Exceptions were river flooding, flash floods and coastal flooding where NHSs and, to a lesser extent, combined NMHSs were reported to be major players. The data also indicated that, where the major hazards are concerned, the NMHSs, (or, as the case may be, NMSs or NHSs) were the sole issuers of warnings of hydrometeorological hazards in about two thirds of Least Developed Countries but that competing warning services were in place in the remainder. The responses suggest that official warnings for the major hazards include information regarding their potential impacts in about third to one half of Least Developed Countries. Finally, Least Developed Countries' NMHSs who contributed to the survey, almost universally, considered that further improvements to their warnings were necessary, opening the door for expansion of these programmes to address the deficiencies in warnings coverage for identified earlier.

11.5.6 Coordination of Warnings

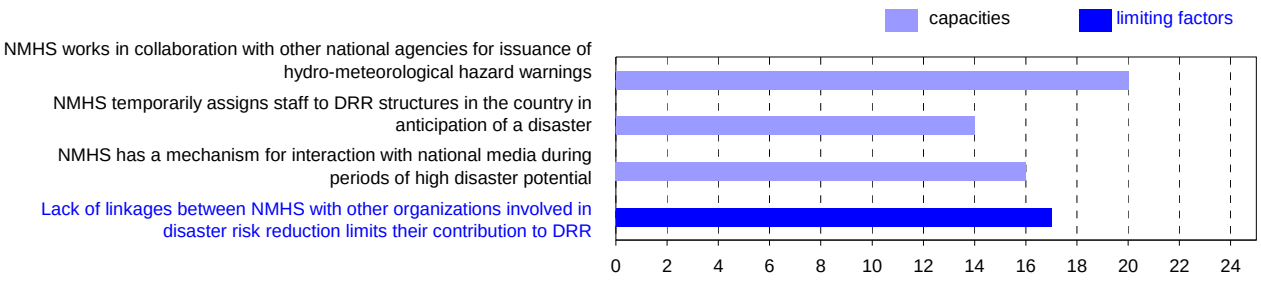

Figure 175. External coordination for issuance of warnings in Least Developed Countries.

Early warnings of hydrometeorological hazards represent a vital contribution to disaster risk reduction. In Least Developed Countries, most NMHSs (83% or 20 of 24) who responded to the WMO country-level survey reported that they worked in collaboration with other agencies (e.g. agriculture, aviation, etc) with respect to hazard warnings. Most of these (77% or 17 of 22) discussed the hazard's characteristics and potential impacts with these agencies prior to issuing a warning. In addition, a majority of survey respondents (70% or 16 of 23) stated that they had a mechanism for interaction with their country's media during periods of high disaster potential. Over half of them (58% or 14 of 24) indicated that they temporarily assigned staff to disaster risk management structures in anticipation of a disaster. About a quarter of the NMHSs who provided input (26% or 6 of 23) pointed out that there were other public or commercial entities that provided competing warning services in their countries. All LDC respondents (100% or 23 of 23) considered that their NMHSs required better coordination of watches and warnings with WMO Regional Specialized Meteorological Centres and almost all (92% or 22 of 24) advocated improved coordination neighbouring NMHSs.

11.5.7 Products and Services for Selected Socio-Economic Sectors

Figure 176 illustrates the provision by NMHSs of specialized alerts, warnings and other products to significant socio-economic sectors in Least Developed Countries that can be seriously affected by hazardous events. In the context of disaster risk reduction, it is noteworthy from Figure 176 that just over a third (41%) of responding NMHSs indicated that they provided support to the housing sector, over a half (55%) to land-use planning and roughly two thirds (67%) to the fresh water sector.

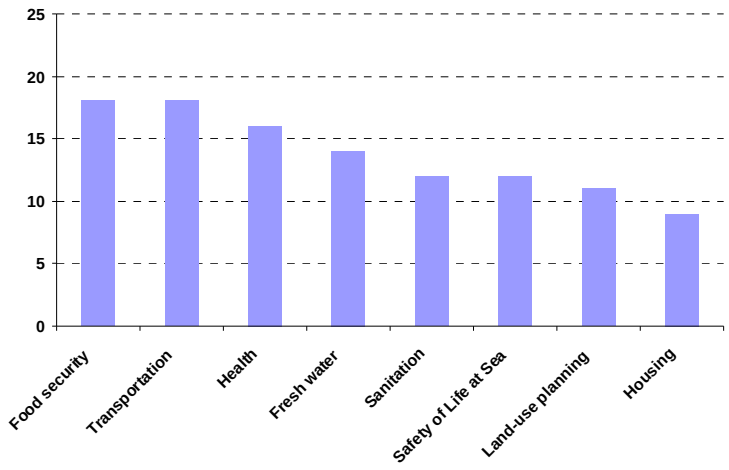

Figure 176. NMHS provision of services to selected economic sectors in Least Developed Countries.

11.5.8 Dissemination Systems and Target Audiences

The following Figures 177 and 178 summarize the survey responses relating to the dissemination of hazard products by NMHSs in Least Developed Countries. They provide information on the types of products that are disseminated, to whom they are provided and on the methods of dissemination that are used to convey the products to the recipients. The same information is also presented in numerical form in Table 9 of Annex 5 where the figures represent the number of responding NMHSs who reported that they provided the specified product to the indicated target audience or, as appropriate, utilized a particular means of dissemination.

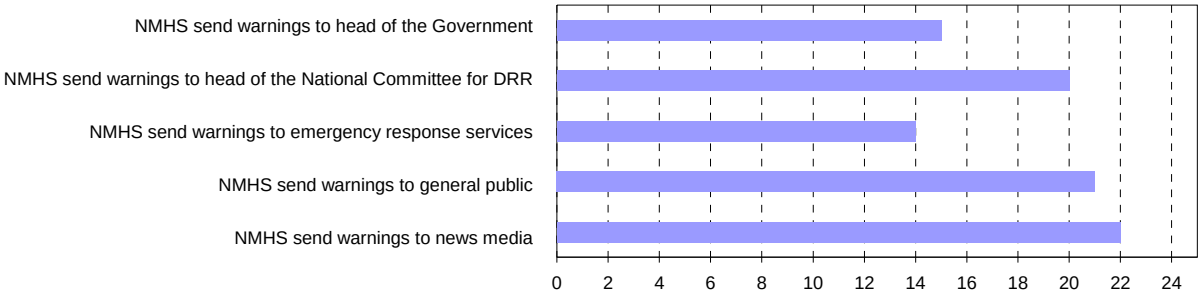

Figure 177. Warning target audience in Least Developed Countries.

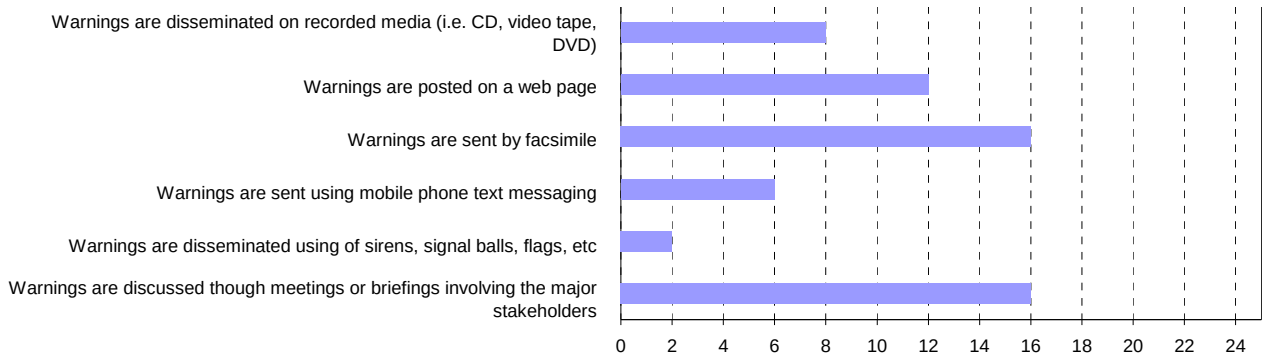

Figure 178. Warning dissemination methods in Least Developed Countries.

A very high percentage of survey contributors from Least Developed Countries indicated that they disseminated hazard warnings to the public and the media and to relevant government authorities. Moreover, roughly half of them also disseminated warnings and other products to external partners in disaster risk reduction, such as national Red Cross and Red Crescent Societies and others. The major dissemination methods in Least Developed Countries were via facsimile, briefings, hard copy mailings and web pages and Internet downloads. Some Least Developed Countries also used sirens and other signal devices.

11.5.9 Product Utility and Product Improvement

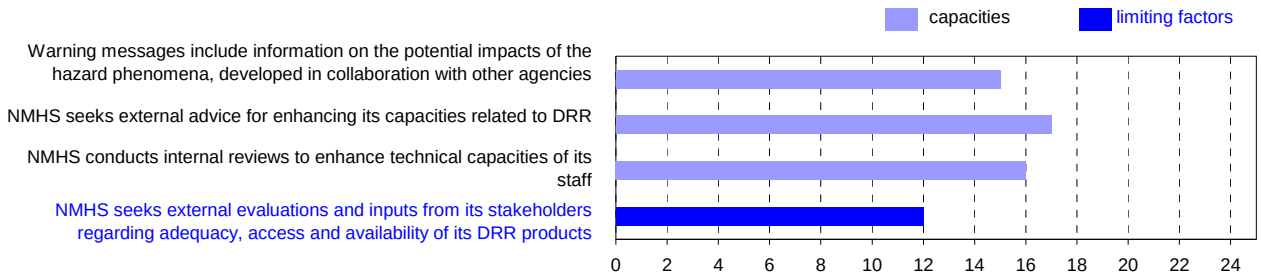

Figure 179. Ongoing feedback and improvement of products in Least Developed Countries.

Most (83% or 20 of 24) of NMHSs in Least Developed Countries who contributed input to the WMO Disaster Risk Reduction country-level survey indicated that they worked with other agencies with respect to hazard warnings. Most (82% or 18 of 22) sought advice to enhance monitoring and forecasting and a slightly smaller number (76% or 16 of 21) sought advice to enhance watches and warnings or overall products and services (73% or 16 of 22). About two thirds (68% or 15 of 22) of NMHSs who included information on potential risks (impacts) in warning statements indicated that they worked with other agencies to develop risk information. Just over half of the contributors (54% or 13 of 24) stated that their NMHS had a quality control mechanism to enhance their warning capabilities and content. Of these, a majority stated that the quality control mechanism provided for regular interaction with stakeholders (disaster risk authorities) (71% or 12 of 17), training for stakeholders to understand the hazards, warnings and their implications (71% or 12 of 17), and feedback from stakeholders and the public after an event had occurred (65% or 11 of 17). Half of the survey respondents (50% or 12 of 24) also reported that their NMHSs sought external evaluations and inputs from stakeholders regarding the adequacy, relevance, method of access and availability of their disaster risk reduction products. Almost all of them (96% or 22 of 23), however, believed that the lack of public understanding of hazards, watches and warnings limited the public response to them. Almost all (92% or 22 of 24) also considered that the lack of joint training between NMHS staff and disaster risk managers limited their disaster risk reduction efforts and a slightly smaller number (83% or 20 of 24) advocated the need for joint training with emergency authorities and managers. Furthermore, almost the vast majority (92% or 22 of 24) felt that educational modules for media, public and disaster risk authorities would enhance their effectiveness in disaster risk reduction.

11.5.10 Internal NMHS Training and Capacity Enhancement

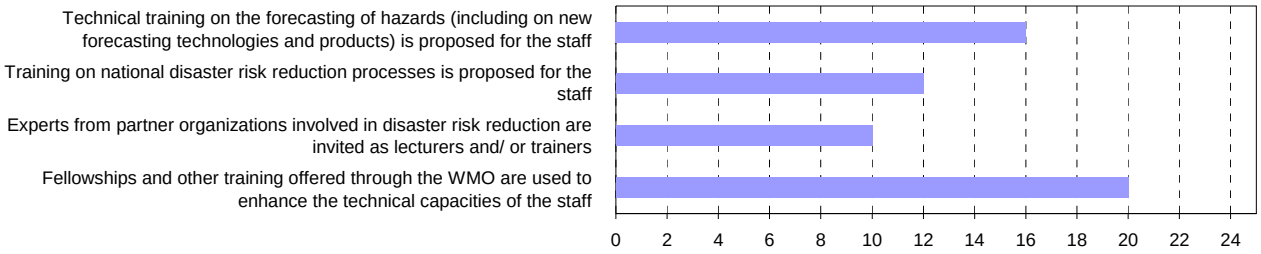

Figure 180. Training and capacity building of NMHS' staff in Least Developed Countries.

Two thirds of contributing NMHSs (67% or 16 of 24) from Least Developed Countries indicated that they provided ongoing technical training to staff on forecasting of hazards, including up to date training on new forecasting technologies and products. A similar number (67% or 16 of 24) also reported that they conducted internal reviews and sought staff inputs to enhance their capacity building and technical training activities. In addition, a majority of them (83% or 20 of 24) stated that they utilized Fellowships and other training offered through WMO to enhance the technical capacities of their staff. Half (50% or 12 of 24) provided training to staff on their country's disaster risk reduction processes and related topics and many of them (42% or 10 of 24) invited experts from partner organizations involved in disaster risk reduction as lecturers and/or trainers. Over a third of survey respondents from LDCs (39% or 9 of 23) also conducted evaluations of the suitability of communications, workstations, and software and (41% or 9 of 22) implemented upgrades to these systems to support disaster risk reduction. However, less than half (43% or 10 of 23) reported that they held or participated in joint training activities for NMHS staff and emergency response agencies.

Balancing the preceding, three quarters of LDC survey contributors (75% or 18 of 24) indicated that a lack of forecaster training at their NMHS reduced the effectiveness of their warning service. A similar number reported that (lack of) professional staff with appropriate training limited their ability for real time monitoring of hazards. Most (92% or 22 of 24) stated that a lack of joint training with disaster risk managers limited their contributions to disaster risk reduction and a slightly smaller number (83% or 20 of 24) cited lack of joint training with media and emergency authorities and managers limiting factors. Furthermore, most respondents (91% or 21 of 23) identified that their ability to provide hazard data products was limited by the lack of professional staff with appropriate training. Not surprisingly, almost all contributing NMHSs from LDCs (96% or 22 of 23) considered that upgrading and improving their operational forecasting and warning activities would enhance their disaster risk capacities. Slightly more (96% or 23 of 24) believed that upgrading and improving the technical training of the professional forecasting staff would enhance these capacities and also advocated the conduct of cross-border training activities with neighbouring NMHSs, targeted at common hydrometeorological hazards.

11.5.11 Outreach Activities

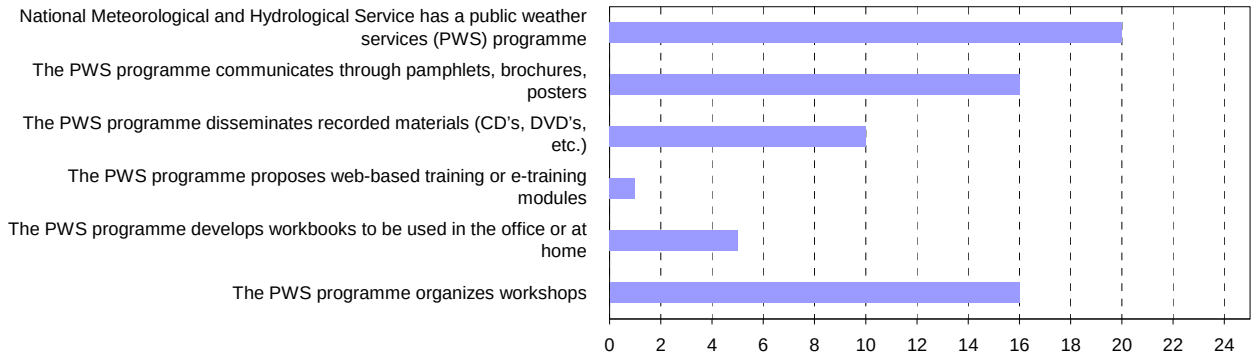

Figure 181. Outreach activities in Least Developed Countries.

Outreach activities aimed at the general public and other stakeholders are an important component of any effective disaster risk reduction programme. Within NMHSs, outreach activities are often part of a public weather services programme. In Least Developed Countries, most NMHSs (83% or 20 of 24) who responded to the survey identified that they had a public weather services programme. Over two thirds (71% or 12 of 17) of them stated that their NMHS quality control programme included training for the stakeholders to understand the hazards, warnings and their implications. About half of them (48% or 11 of 23) provided education and training on hazards, watches, warnings, etc to disaster risk reduction managers and authorities and operational emergency response managers and a similar number (46% or 11 of 24) provided training to the media. Over a third of survey contributors from LDCs (38% or 9 of 24) identified that they provided training targeted at the trainers (i.e. of disaster risk authorities, emergency response staff, media, etc) and the same number (39% or 9 of 23) indicated that they provided educational modules and training programmes targeted at the general public. Under half of them (43% or 10 of 23), however, pursued joint training activities with emergency response agencies. The following materials and methods were identified as being used in NMHSs public outreach programmes - pamphlets, brochures, posters (76% or 16 of 21), workshops (76%), recorded materials (CDs, DVDs, etc) (48%), workbooks for office or home use (24%), Web-based training (5%), and E-training modules (5%).

Almost all survey contributors from Least Developed Countries(91% or 21 of 23) judged that the lack of public understanding of the effects of hazards limited the public response to warning services. In addition, almost all (92% or 22 of 24) felt that the lack of joint training with disaster risk managers limited their disaster risk reduction efforts. Similar numbers (83% or 20 of 24) considered that a lack of joint training with emergency authorities and managers and with the media limited their disaster risk reduction efforts. As a consequence, almost all NMHSs (92% or 22 of 24) in Least Developed Countries considered that educational modules that they could target at media, public and disaster authorities would enhance their effectiveness in disaster risk reduction.

11.5.12 NMHS Contingency Planning

Just under half (46% or 11 of 24) the NMHS in Least Developed Countries reported that their NMHS had a contingency plan to maintain the continuity of products and services in the event of operational emergencies such as power failure or communications disruption. More than half of these (43% or 6 of 14) stated that their contingency plans involved an agreement or protocol with neighbouring NMHS to support them in the event of catastrophic failure. In addition, just over one third (38% or 9 of 24) also stated that they conducted or participated in drills and exercises to ensure disaster preparedness. However, almost all LDC survey contributors (96% or 23 of 24) identified needs for improved coordination with neighbouring NMHSs, specifically citing the need for support from them in the event of disruption of services.

11.6 Overarching Factors

Least Developed Countries' NMHSs participating in the country-level survey were asked to respond to a series of questions directed at obtaining expressions of opinion from them regarding overarching factors or realities that either limited or could enhance their ability to make optimal contributions to disaster risk reduction. To varying degrees, the responses to these questions also served to validate statements, expressions of opinion and/or recommendations contained in responses to earlier sections of the survey. The following summarizes the inputs that fall under the above broad category:

11.6.13 NMHS Visibility

Most NMHSs in Least Developed Countries (79% or 19 of 24) considered that they needed higher visibility and recognition within government as a major contributing agency to disaster risk reduction. Over two thirds (70% or 16 of 23) felt that their contributions to disaster risk reduction were limited by the lack of understanding by government authorities of the value provided by the NMHSs. Almost all LDC survey respondents (96% or 23 of 24) considered that improved ministerial level understanding of the socio-economic benefits of hydrometeorological products and services would increase the visibility of the NMHSs at the national level.

11.6.14 Organization and Governance

Close to half of contributing NMHSs in Least Developed Countries (42% or 10 of 24) considered that their national organizational structure for disaster risk reduction limited their potential contributions in this area. Almost two thirds of them (65% or 15 of 23) also considered that the effectiveness of their contributions to disaster risk reduction was limited by the lack of clear legislation or policies regarding the role of the NMHSs (e.g. as the sole issuer of warnings). In addition, over three quarters of survey respondents (79% or 15 of 19) from LDC countries with separate NMSs and NHSs considered that there was a need for legislation or partnership agreements to better define the role each agency played in disaster risk reduction.

11.6.15 Coordination and Partnership

Over two thirds (71% or 17 of 24) of LDC NMHSs considered that their contributions to disaster risk reduction were limited by a lack of linkages between their NMHS and other involved organizations. In addition, almost all LDC survey respondents (96% or 22 of 23) considered that better coordination with neighbouring or adjacent countries would improve their contribution to their own nation's disaster risk reduction activities. The same number (92% or 22 of 23) also considered that better coordination with WMO Regional Specialized Meteorological Centres would improve their contribution

11.6.16 Resources and Capacity

All NMHSs from Least Developed Countries who responded to the survey questions (100% or 21 of 21) indicated that resources and infrastructure limited their ability to deliver critical products and services for disaster risk reduction, specifically identifying financial resources (92% or 22 of 24) and professional staff (91% or 21 of 23) as key limiting factors. In consequence, almost all of them (96% or 22 of 23) considered that upgrading and improving NMHSs operational forecasting and warning services would enhance the disaster risk reduction capacity within their country.

11.7 Concluding Assessments and Recommendations for Least Developed Countries

The following summarizes assessments and conclusions related to the analysis of the survey responses from NMHSs in Least Developed Countries (LDC) presented in this chapter. In order to facilitate the identification of subject areas, the titles associated with the individual assessments and conclusions presented below match those used during the analyses of Least Developed Country survey responses outlined in the preceding pages.

11.7.14 Access to Data on Hazards and their Impacts

NMHSs need to have easy access to official information on hazards and on the impacts of disasters in order to provide support for planning activities and to facilitate monitoring the effectiveness of their own services in support of disaster risk reduction. As Annex 3 illustrates, a majority of Least Developed Countries NMHSs maintain records of the most common hazards such as strong winds but the percentage varies with hazard and the number who maintain records declines rapidly for less frequently occurring hazards. As the agencies responsible for monitoring and prediction of hydrometeorological hazards within their countries, NMHSs (or NMSs and NHSs) may, reasonably, be expected to maintain records of occurrences of significant hazards. Equally, it is important that NMHSs have ready access to official information on the impacts of disasters. The survey responses indicate that this is not the case over a quarter of Least Developed Countries.

11.7.15 Value Added Services based on Historical Hazard Data

Survey contributors' recommendations for provision of enhanced value added services are strongly supported by earlier responses. The implications of these recommendations are that extensive training and capacity development will need to be undertaken in many NMHSs in Least Developed Countries to provide them with the capability to deliver these added value services.

11.7.16 Legislation and Governance

The survey responses suggest that, in those Least Developed Countries where a lack of clarity undercuts their potential contributions to disaster risk reduction, NMHSs should press for clear policy direction from their governments regarding their roles and responsibilities.

11.7.17 National Structures/Mechanisms for Disaster Risk Reduction

The degree to which NMHSs are integrated into national disaster risk reduction structures and their operational relationships with civil protection agencies, planning authorities and important non-governmental partners exercise a significant influence on their ability to contribute effectively to disaster risk reduction. For optimum effectiveness, state of the art NMHS scientific, technical and operational capacities must be mainstreamed into national planning, decision-making and disaster response structures and systems and, in addition, be well connected to important non-governmental partners. Responses to the survey indicate that almost half of NMHSs in Least Developed Countries are not part of their national disaster risk reduction systems. Those NMHSs that are not members of their national coordinating committees or structures should endeavour to acquire membership in these bodies and seek to contribute effectively to national disaster risk reduction activities.

11.7.18 NMHS Contributions to National Disaster Risk Reduction Systems

Experience elsewhere indicates that the respondents' recommendation for the establishment of a "readiness system" could, if implemented, enhance NMHSs contributions to disaster risk reduction and this should be pursued at the national level. Continuing efforts should be made to promote the contributions that NMHS can make to disaster risk reduction and to encourage disaster authorities to build on NMHS capacities. In parallel, however, the capacities of NMHSs must, where necessary, be enhanced to ensure that they can in fact deliver state of the art products and services in support of disaster risk reduction.

11.7.19 NMHS Collaboration with other Partners

Survey responses indicate that significant numbers of NMHSs in Least Developed Countries do not pursue collaboration and coordination with significant national, regional and international partners in the disaster community. Expanded collaboration and partnerships can benefit NMHSs through broader utilization of their products and services, increase their visibility and result in more effective contributions to disaster risk activities. NMHSs should be proactive in expanding their partnerships with the broader disaster community both within and outside government circles.

11.7.20 The Organization and Priorities of NMHSs

The respondents' majority recommendation appears entirely valid in light of the earlier responses. Close coordination between meteorological and hydrological authorities is an essential foundation for the provision of timely, accurate and consistent hydrometeorological hazard warnings and other services.

11.7.21 Operational Coordination between NMSs and NHSs

The survey responses summarized above clearly indicate that needs exist for enhanced operational coordination between NMSs and NHSs in most Least Developed Countries. The survey respondents' recommendation should, therefore, be pursued at the country level through actions to achieve more effective operational coordination between the meteorological and hydrological communities, particularly with respect to hazard warnings and other critical products.

11.7.22 Observation and Monitoring Networks and Systems

The survey responses indicate that most NMHSs in Least Developed Countries consider that their observing networks are not optimal for disaster risk reduction and that at least five NMHSs do not maintain a dedicated 24-hour/year-round observation programme. Moreover, most respondents indicated that there were insufficient resources and trained staff to maintain their networks. These challenges were compounded by hazard related damage to observation stations in about half of the responding NMHSs. These realities draw attention to the need for sustained resourcing of NMHSs in Least Developed Countries at levels sufficient to operate and maintain adequate observing networks and programmes. Reliable, round the clock, observations, made available in real-time, are the essential raw material needed for the production of early warnings, forecasts and other products to support disaster risk reduction. Consequently, every effort must be made to ensure that adequate observational networks and systems are put in place and maintained in operation on a 24-hourly/year-round basis.

11.7.23 Telecommunications and Informatics

The survey responses indicate that 24-hourly/year-round telecommunications capability is not in place in 5 Least Developed Countries. Furthermore, almost all responding NMHSs have identified telecommunications facilities as limiting their ability to deliver critical products, with most also citing significant deficiencies in computer hardware, network equipment, and application software. Internet access is also identified as problematic in almost two thirds of the responding countries. These realities strongly reinforce the respondents' recommendation that upgrading of operational telecommunications and informatics infrastructure is required in most NMHSs in Least Developed Countries.

11.7.24 Data Exchange

The respondents' recommendations for improved coordination with neighbouring NMHSs and RSMCs on data exchange make good sense since collaboration and coordination are fundamental to effective and efficient exchange of data and products. In addition, however, the survey responses indicate that improved data exchange will also require enhancements to telecommunications, quality assurance and archiving systems in virtually all NMHS in Least Developed Countries. Furthermore, capacity building will be required in relation to data processing and customization of products.

11.7.25 Forecast and Warning Capability

The contributors' recommendations are validated by the survey responses summarized earlier in this chapter. Clearly, there are universal needs for upgrading of professional staff, computing capacity and applications software. The responses indicate that at least three Least Developed Countries' NMHS do not have operational forecast and warning services and several more do not operate their services on a round the clock basis. This is a serious deficiency in terms of provision

of hazard warnings, forecasts and other support to disaster risk reduction. Major enhancements to forecasting infrastructure, along with provision of appropriate training for professional staff, will clearly be required before a significant number of NMHS in Least Developed Countries will be able to contribute optimally to disaster risk reduction within their countries.

11.7.26 Forecast and Warning Products

The respondents' recommendation regarding the need to improve their warning products and services is soundly based.

11.7.27 Coordination of Warnings

The respondents' strong recommendation for improved coordination with neighbouring NMHSs and RSMCs in relation to watches and warnings makes good sense. Such coordination reduces the risk of ambiguous or, in the worst case, conflicting warning messages from different sources reaching the same audience. A compounding issue here is the increased potential for confusion that arises when commercial or other entities also issue hazard warnings. As a general principle, therefore, it is desirable to work towards a situation where official warnings for hydrometeorological hazards emanate from a single recognized issuing authority within each country**.** Ideally being prepared by NMHSs with the scientific and technical capacity to make such predictions, hydrometeorological warnings may, in some circumstances, benefit from assessment and interpretation by civil defense authorities as to their likely impacts before being relayed to local communities, perhaps accompanied by advice on actions that people should take to minimize loss of life and property.

11.7.28 Products and Services for Selected Socio-Economic Sectors

Experience around the globe demonstrates that the socio-economic sectors discussed earlier could benefit significantly from the incorporation of hydrometeorological information and products into their planning and decision-making processes. Sensible land-use planning to minimize risk of flooding and other hazards, engineering design of housing and other developments to withstand expected wind loads, design of drainage systems to accommodate heavy rainfalls or rapid snowmelt and other similar measures contribute to hardening societies and communities against disastrous impacts of hydrometeorological events. Equally, early warnings of hazards enable people to take avoidance or mitigating actions to prevent disasters. The survey responses indicate that some vulnerable target sectors do not receive special hydrometeorological services in a substantial proportion of Least Developed Countries. Consequently, NMHSs in Least Developed Countries have an opportunity to make major contributions to disaster risk reduction by enhancing the provision of relevant products and services to planning, development, water resources and other key socio-economic sectors.

11.7.29 Dissemination Systems and Target Audiences

Reliable and timely dissemination of early warnings of hazards to stakeholders and the public at large is among the most useful services that NMHSs can provide in support of disaster risk reduction. Consequently, every effort should be made to ensure that warnings and other relevant products reach all important target audiences. In the context of disaster risk reduction, national Red Cross/Red Crescent Societies and similar non-government bodies should be targeted for receipt of hazard warnings on virtually the same level as government disaster authorities. While about half of NMHSs in Least Developed Countries already disseminate warnings to such important external partners, these external agencies should be further encouraged to access and utilize early warnings of hazards and other relevant NMHS products in all countries.

11.7.30 Product Utility and Product Improvement

The survey contributors' recommendation regarding the value of educational modules is validated by the other survey responses summarized earlier. The responses indicate that continuing emphasis is needed on increasing the awareness and understanding of stakeholders, including the

public at large, disaster risk authorities and the staff of emergency agencies, regarding hazards, their impacts, and the content of watches, warnings and other disaster products. As a specific initiative, most respondents identified the need for and value of joint training for staff of NMHSs and those of disaster management and emergency response agencies. This also makes good sense.

11.7.31 Internal NMHS Training and Capacity Enhancement

The respondents' recommendations directly address the deficiencies and limitations identified in their earlier responses. Perhaps not surprisingly, responses from NMHSs in Least Developed Countries show general needs for extensive training and capacity development to bring their capabilities up to the standard required for effective support to disaster risk reduction. Roughly one third of respondents, for example, reported that they did not provide regular training to staff on forecasting techniques and roughly one half of them did not provide training to their staff on their countries' disaster risk reduction strategy and processes. Consequently, the needs are real but the efforts to address them are at present inadequate.

11.7.32 Outreach Activities

Survey responses indicate that NMHSs in fewer than half of the Least Developed Countries' undertake significant outreach activities directed at the media, disaster management authorities and the public at large. The respondents' recommendation is, therefore, supported by other survey responses, though it is somewhat narrowly focussed on a single outreach tool or mechanism. When taken in combination with needs for internal NMHS staff training and development, the responses and the recommendation reinforce the message that there are wide ranging needs for capacity development across the whole spectrum of NMHS fields of activity including public and stakeholder outreach activities.

11.7.33 NMHS Contingency Planning

The survey responses indicate that more than half of NMHSs in Least Developed Countries do not have a contingency plan to provide back-up capability in the event of emergencies. Establishment of such a plan is a prudent step for all NMHSs to ensure maintenance of critical hazard warnings and products and services in the event of emergencies. In many instances, a partnership agreement with a neighbouring NMHSs can be an effective, low cost, approach to ensuring that back-up capability is in place.

CHAPTER 12
SMALL ISLAND DEVELOPING STATES

12 SMALL ISLAND DEVELOPING STATES (SIDS)

Abstract – Small Island Developing States

Survey responses from NMHSs in 19 Small Island Developing States (SIDS) indicate that all of have observation and telecommunications networks and forecasting and warning programmes in place. Most of these are considered inadequate, however, with widespread deficiencies in network equipment, informatics and professional staff capacities. A sizeable majority identifies the lack of forecast training as reducing the effectiveness of their forecast and warning services. In addition, few, if any, have warnings programmes in place for less frequently occurring hazards. Without exception, they stress that improving their forecasting and warning infrastructures and services would enhance their countries' disaster risk reduction capacities. Though most have contingency plans to maintain services in emergencies, all of them advocate improved emergency coordination with neighbouring NMHSs. All of them also cite needs for better technical coordination between their National Meteorological Services (NMSs) and National Hydrological Services (NHSs), since few have combined NMHSs. Most also stress needs for improved coordination with WMO Regional Specialized Meteorological Centers (RSMCs) and other stakeholders. Only a minority possess hazard databases or provide targeted support to the housing sector, though somewhat more provide support to land-use planning and fresh water sectors. Without exception, SIDS NMHSs endorse the provision of value added services though most point out that they lack expertise in data management, archiving and data customization. Most of them also advocate expansion of educational and outreach efforts targeted at the public, media and other stakeholders. Virtually all identify inadequate financial and human resources as major limitations**.** While the NMHSs in most of the 19 SIDS are members of their national disaster risk coordination committees, most feel constrained by inadequate recognition or lack of clarity regarding their roles and some by the structures themselves. The preceding survey results underpin the following conclusions and recommendations aimed at enhancing the contributions to disaster risk reduction of NMHSs in Small Island Developing States:

- All NMHSs in Small Island Developing States should be active participants in their national disaster risk reduction systems. Those few who are not already members should seek membership in their national disaster risk coordinating committees. All of them should strive to ensure that these committee structures make effective use of NMHSs' hazard warning and related capacities.
- Most Small Island Developing States NMHSs need to improve their archiving systems for hazard data and their access to impacts data. This generates associated requirements for capacity development related to data rescue, quality assurance, data management and archiving.
- Most Small Island Developing States NMHSs require capacity development and training in disaster risk applications such as hazard and impact analysis, hazard mapping, risk zone analysis and product customization.
- Every effort should be made to establish and maintain adequate hydrometeorological observation and telecommunications networks in Small Island Developing States where virtually all such networks are inadequately resourced and five or six do not operate on a round the clock basis. This will require substantial investments in infrastructures and capacity development in most SIDS NMHSs, reinforced by continuing injection of adequate operating funds.
- Small Island Developing States NMHSs' hazard warning capacities should be strengthened. There are virtually universal needs for upgrading of forecasting infrastructures and professional staff expertise, with no warning services proved by three NMHSs and less than 24-hourly services provided in several others. Warning programmes should also be expanded to address all hydrometeorological hazards with disaster-causing potential and warnings should be routed to all important stakeholders.

- Official warnings of hydrometeorological hazards should emanate from a single competent issuing authority, ideally the NMHS. In some circumstances, they may benefit from assessment and interpretation by civil defence authorities before being widely disseminated.
- Verification programmes for hydrometeorological hazard warnings should be implemented by all NMHSs in Small Island Developing States to monitor warning accuracy and timeliness, assess improvements in skill, and demonstrate their' warning capabilities to stakeholders.
- The roughly one quarter of SIDS NMHSs who have not already done so should establish back-up arrangements to maintain hazard warnings and other services in emergency situations, possibly through partnership agreements with neighbouring NMHS.
- NMHSs in SIDS should encourage the establishment of national readiness systems within their countries.
- Operational coordination should be improved between NMSs and NHSs in SIDS and with neighbouring NMHSs and RSMCs. In some countries, this may require policy direction or partnership agreements to clarify their respective responsibilities of NMSs and NHSs, particularly in relation to issue of hazard warnings.
- Most Small Island Developing States NMHSs should increase emphasis on the provision of products and services to sensitive economic sectors such as land-use planning, housing and development and water resources which do not receive such services in one half of the SIDS.
- Most SIDS NMHSs should increase emphasis on education and outreach directed at key stakeholders and the public at large given that little attention has been paid to this critical area in many of the NMHSs. The conduct of joint training with disaster authorities is a related priority.
- Most Small Island Developing States NMHSs need wide ranging support from WMO in capacity building, infrastructure development and resource mobilization. Capacity development is particularly needed in relation to disaster risk tools and products in addition to more traditional areas such as infrastructure maintenance and operations, data management and forecast and warning production.

The present chapter centres on the assessment of the survey responses from NMHSs in Small Island Developing States. Its internal structure follows the sequence outlined earlier in section 2.6.1.

12.1 The Response to the Survey

As noted earlier, 19 Small Island Developing States (SIDS) responded to the WMO country- level survey and these are listed in Annex 2.

12.2 The Hazards affecting Small Island Developing States (SIDS)

Figure 182 lists the number of responding Small Island Developing States who identified themselves as being affected by the specified hazards.

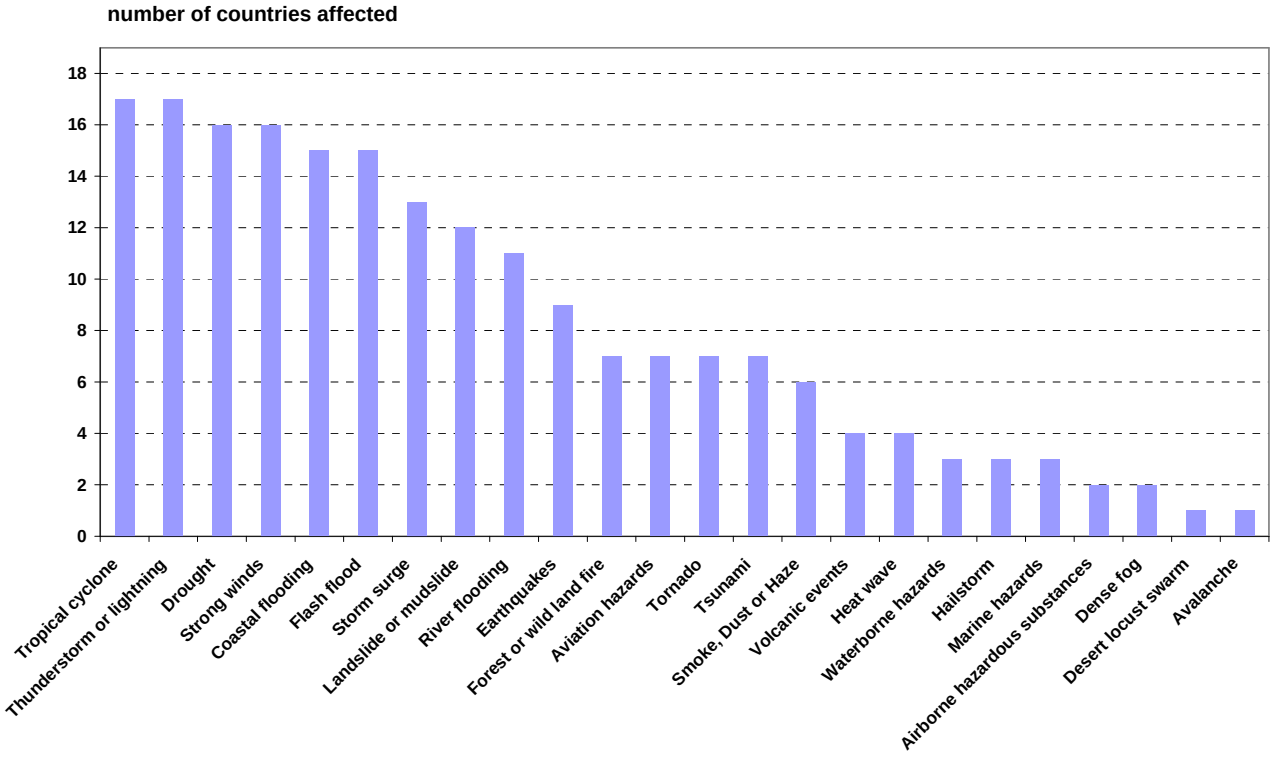

Figure 182. Number of responding Small Island Developing States (SIDS) who identified themselves as being affected by specified hazards.

12.2.1 Access to Data on Hazards and their Impacts

Annex 3 presents an overview of the hazard databases maintained by survey respondents in Small Island Developing States and includes some supplementary information on related metadata and impacts information. Most NMHSs in Small Island Developing States who contributed to the WMO Disaster Risk Reduction country-level survey (84% or 16 of 19) stated that another agency was responsible for providing official information on the impacts of disasters in their country. Most of them (79% or 15 of 19) also stated that they had access to such official, reliable, information. In addition, however, roughly one quarter (26% or 5 of 19) of the survey respondents reported that

they maintained their own internal database of official information on the impacts of hazards that affected their countries and regularly updated this database[34].

12.2.2 Value Added Services based on Historical Hazard Data

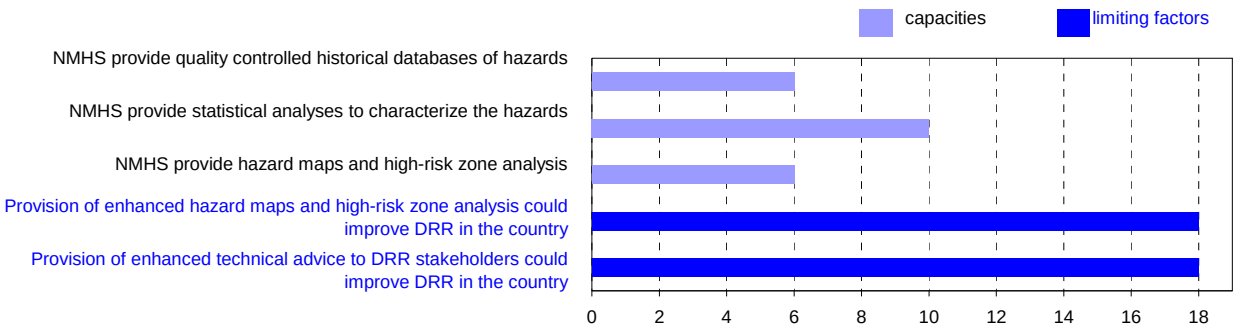

Figure 183. Provision of hazard information by NMHSs in Small Island Developing States.

The following draws attention to the extent of value added services provided by NMHSs in Small Island Developing States (SIDS) who maintain historical archives of hydrometeorological hazards. Almost three quarters of SIDS NMHSs who contributed to the country-level survey (71% or 12 of 17) stated that that they provided technical advice on hazards and roughly half (53% or 9 of 17) provided statistical analyses to characterize them. Less than a third of them (29% or 5 of 17), however, reported that they maintained quality controlled historical databases of hazards or provided analyses of the potential impacts of hazards and just one more (35% or 6 of 17) undertook hazard mapping and high-risk zone analysis. Most SIDS NMHSs identified a number of factors that limited their ability to provide hazard data products. They cited as limiting factors professional staff with appropriate training (94% or 17 of 18), data rescue (83% or 15 of 18), customization of data for stakeholders (78% or 14 of 18), ability to archive and update (72% or 13 of 18) and quality assurance (61% or 11 of 18). All SIDS respondents to the WMO survey also considered that the provision of enhanced value added NMHS services in support of hydrometeorological risk assessment would strengthen their contributions to disaster risk reduction activities. The following specialized services were identified as useful enhancements - analyses of the potential impacts of hazards (100% or 18 of 18), hazard mapping and high-risk zone analysis (100% or 17 of 17), and provision of technical advice (94% or 17 of 18).

12.3 The National Context for Disaster Risk Reduction

National legislative, governance and organizational structures for disaster risk reduction establish the context within which NMHSs make their contributions to safety of life and property. The following sections summarize survey Small Island Developing States' responses regarding their countries' national systems for disaster risk reduction, the impact of these systems on the NMHSs and the extent of NMHSs contributions to them.

[34] It is important to note, that, to date, no systematized, universally accepted, methodology or protocol has been established on a global basis for the creation and maintenance of hazard and hazard impacts databases.

12.3.1 Legislation and Governance

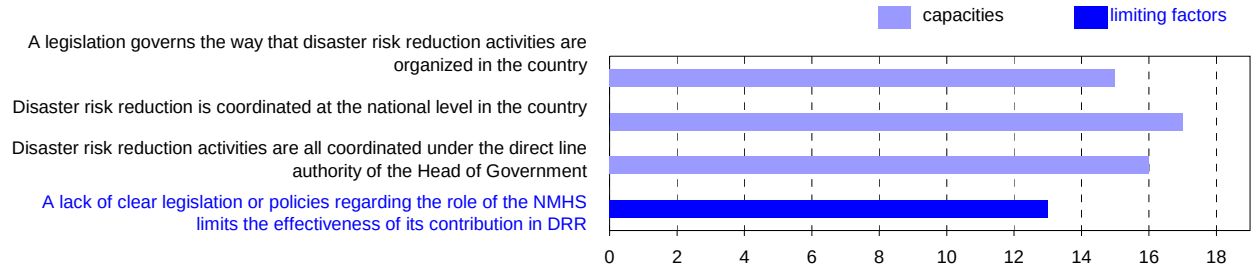

Figure 184. Legislation and coordination in support of disaster risk reduction at the national level in Small Island Developing States.

Most Small Island Developing States (SIDS) who contributed to the WMO Disaster Risk Reduction country-level survey (84% or 16 of 19) reported that disaster reduction activities were coordinated at the national level under the direct line authority of the head of government. The organization of these activities was governed by legislation in about three quarters of the countries (74% or 14 of 19) and in just over half (53% or 10 of 19) coordination was centred under one ministry. At the same time, however, about two thirds of the SIDS respondents (67% or 12 of 18) considered that a lack of clear legislation or policies regarding the role of the NMHS (e.g. as the sole issuer of hydrometeorological hazard warnings) limited their contributions to disaster risk reduction.

12.3.2 National Structures/Mechanisms for Disaster Risk Reduction

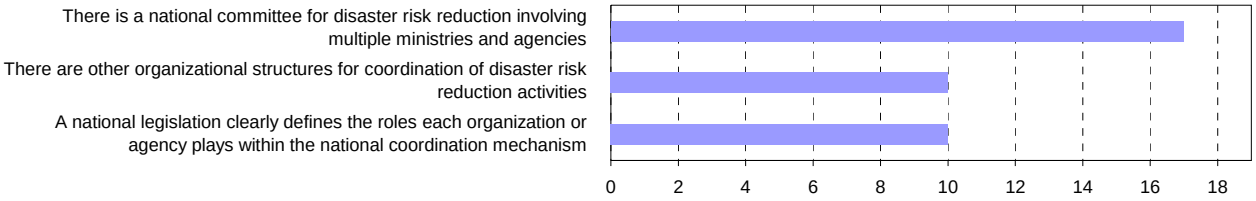

Figure 185. National structures for coordination of disaster risk reduction in Small Island Developing States.

Most Small Island Developing States NMHSs who responded to the WMO survey (84% or 16 of 19) indicated that their countries had a national committee for disaster risk reduction that involved multiple ministries and agencies and all of them stated that they were members of their national coordinating committee. Just over half the SIDS contributors to the survey (53% or 10 of 19) reported that the roles of each participating agency in their national coordination committees were defined by legislation. The same number (53% or 10 of 19) pointed out that other organizational structures for coordination also existed in their countries. However, just under half of these NMHSs (44% or 8 of 18) felt that their contributions to disaster risk reduction were limited by their national disaster risk reduction organizational structure.

12.3.3 NMHS Contributions to National Disaster Risk Reduction Systems

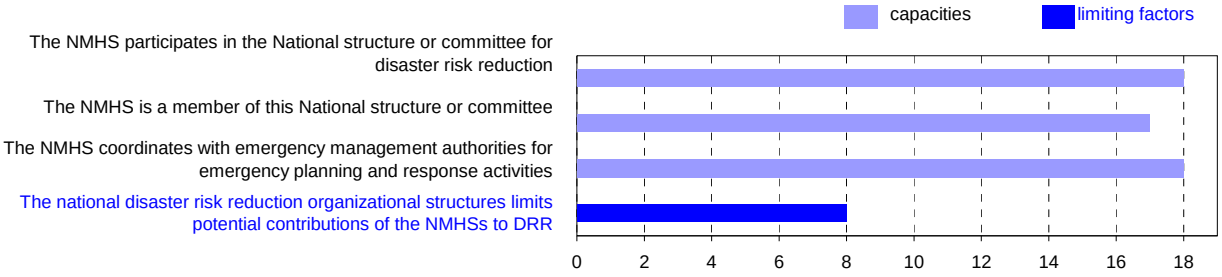

Figure 186. NMHS participation in national structures for disaster risk reduction in Small Island Developing States.

All Small Island Developing States NMHSs who contributed to the survey (100% or 19 of 19) indicated that they provided support to agencies responsible for disaster risk reduction at the national level. All of them (100% or 19 of 19) also provided support to emergency planning and preparedness and emergency response operations. Almost as many (95% or 18 of 19) provided support to disaster prevention but only about half (53% or 10 of 19) supported post-disaster reconstruction. The majority of SIDS NMHSs (94% or 16 of 27) extended their support to provincial or state government disaster-related activities and almost all who responded (88% or 15 of 17) also provided support to municipal or local levels. Almost two thirds (61% or 11 of 18) of responding NMHSs, however, pointed to inadequate linkages with other involved organizations (e.g. emergency planners, emergency response agencies) as limiting their contributions to disaster risk reduction. Finally, most SIDS NMHSs (94% or 17 of 18) considered that their contributions would be enhanced by a “readiness system” that required appropriate responses by authorities to information issued by the NMHSs.

12.3.4 NMHS Collaboration with other Partners

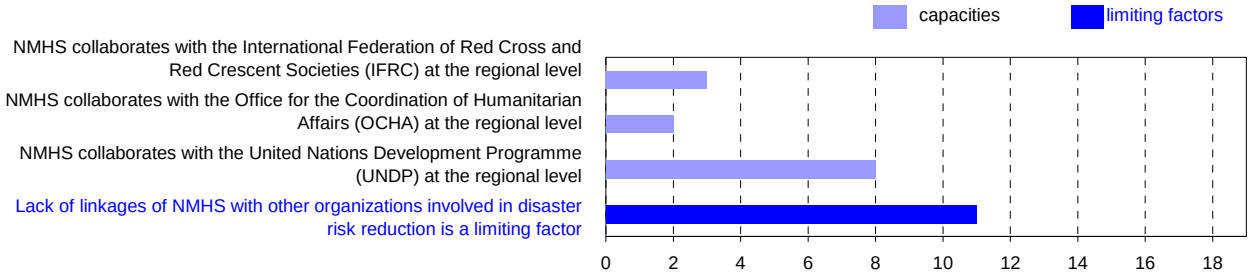

Figure 187. NMHS collaboration with partner agencies at the regional level in Small Island Developing States.

A solid majority (89% or 17 of 19) of SIDS NMHSs who contributed to the country-level survey indicated that they coordinated with emergency management authorities for emergency planning and response activities. In addition, almost two thirds of respondents (63% or 12 of 19) reported that they collaborated with their National Red Cross and Red Crescent Societies and almost as many (61% or 11 of 19) participated in disaster-related activities on the level of a WMO Region or a regional economic grouping. Smaller numbers interacted with the office of their national United Nations Coordinator (47% or 9 of 19) and/or participated in disaster related activities of international organizations (73% or 8 of 11), the UNDP (57% or 8 of 14), the IFRC (23% or 3 of 13), or the Office for the Coordination of Humanitarian Affairs (OCHA) (15% or 2 of 13).

12.3.5 The Organization and Priorities of NMHSs

The priorities of individual NMHSs are, inevitably, influenced by the missions and priorities of their parent government ministries or departments. In consequence, the orientation of NMHSs may be more broadly focussed in some countries than in others. A parent department with a civil aviation mandate might, for example, emphasize provision of NMHS services to aviation while one with a natural resources or environment mandate might encourage its NMHS to provide warnings and other services to a broader range of sectors. Where National Meteorological Services or combined National Meteorological and Hydrological Services [35] in Small Island Developing States are concerned, parent ministries include: Civil Aviation; Agriculture and Rural Development; Environment and Natural Resources; Infrastructure and Public Utilities; Public Utilities and Environment; Transport and Communication; Transport and Aviation; Local Government and the Environment; and Environment and Water Resources. Correspondingly, parent departments of National Hydrological Services include: Lands and Natural Resources; Agriculture, Forestry and Fisheries; Environment and Natural Resources; Environment and Water Resources; Lands; Works and Energy; Public Works and Utilities; Housing, Transport, Works and Water; Public Utilities and the Environment.

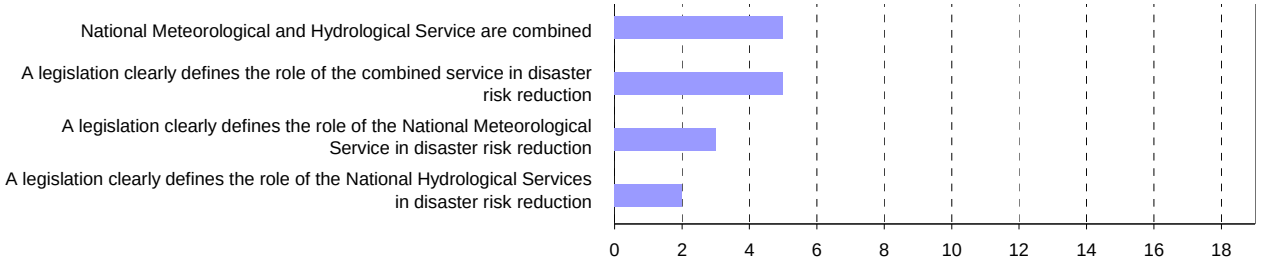

Figure 188. Organizational structure of meteorological and hydrological services in Small Island Developing States.

The internal organization of National Meteorological and Hydrological Services can also influence their ability to deliver well-coordinated hydrometeorological warnings and other services in support of disaster risk reduction. Roughly one quarter of survey contributors (26% or 5 of 10) from Small Island Developing States stated that they had a combined National Meteorological and Hydrological Service and about a third of respondents (36% or 5 of 14) indicated that their country had national legislation that clearly defined the NMHS role in disaster risk reduction. Less than a quarter of those with separate Services (20% or 3 of 15), however, indicated that legislation existed that clearly defined the role of their National Meteorological Service (NMS) in disaster risk reduction. Even fewer (15% or 2 of 13) indicated that such legislation was in place for their National Hydrological Service (NHS). At the same time, a majority (83% or 10 of 12) of SIDS contibutors to the WMO country-level survey thought that legislation or partnership agreements were needed to better define the respective roles of their NMSs and NHSs in disaster risk reduction. In addition, all of those who responded (100% or 11 of 11) considered that better technical coordination between their NMSs and NHSs would result in enhanced joint products and services, with a slightly smaller number (82% or 9 of 11) advocating that better coordination would result in enhanced issuance of warnings.

[35] Parent departments of NMS and NMHS have been grouped together due to ambiguities in responses regarding the existence or otherwise of combined NMHS.

12.3.6 Operational Coordination between NMSs and NHSs

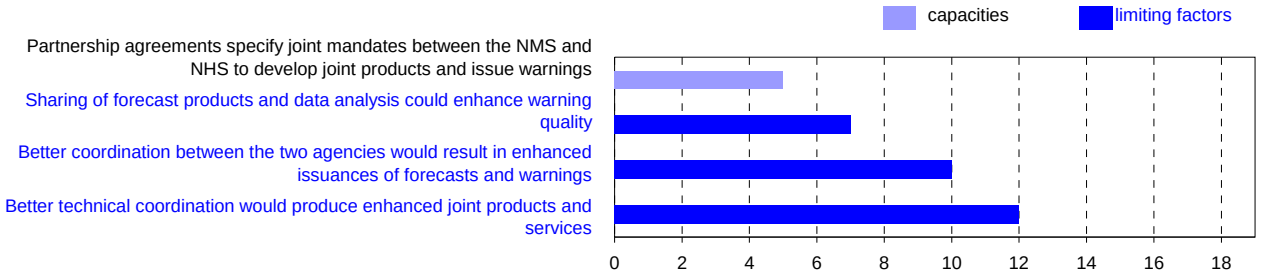

Figure 189. Coordination between NMS and NHS in Small Island Developing States.

A third (33% or 5 of 15) of survey respondents from Small Island Developing States that had separate NMSs and NHSs identified that a partnership agreement was in place specifying mandates between their NMSs and NHSs to develop joint products and issue warnings. Somewhat more (47% or 7 of 15) indicated that the two agencies shared forecast products and data analyses that could enhance warning quality. Just over half of these (29% or 4 of 141) stated that coordination took place before warnings were issued for hazards of mutual concern. In addition, almost as many (21% or 3 of 14) indicated that coordination also took place for any hazard warning was issued. Two NMHSs (20% or 2 of 10), however, reported that there was no coordination on warnings. All SIDS respondents to the question (100% or 11 of 11) considered that better technical coordination between their NMSs and NHSs would result in enhanced joint products and services. Furthermore, most SIDS (84% or 16 of 19) felt that better overall coordination between the two agencies would enhance issuance of forecasts and warnings.

12.4 NMHS Infrastructure, Products and Services

The following sections summarize the information contained in survey responses related to observational networks, telecommunications systems, warning and forecast production systems and their products, dissemination systems and related aspects of the overall operational capacities of NMHSs in Small Island Developing States.

12.4.1 Observation and Monitoring Networks and Systems

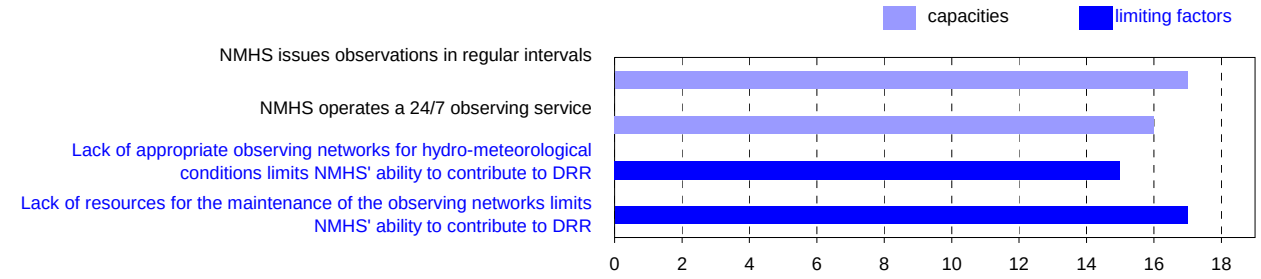

Figure 190. Observation and monitoring networks and systems in Small Island Developing States.

Most SIDS NMHSs who contributed to the WMO country-level survey (89% or 16 of 18) stated that they had an operational observing capacity that issued observations at regular intervals. Almost all of these (94% or 15 of 16) reported that the observing service operated 24-hourly/year-round. In addition, over half (56% or 10 of 18) of them indicated that their observation network included sea level monitoring stations. However, more than three quarters (78% or 14 of 18) considered that a

lack of appropriate hydrometeorological observing networks limited their ability to contribute to disaster risk reduction. Furthermore, almost half of these (33% or 6 of 18) identified the availability of a dedicated 24 hour/year round observing service as an additional limiting factor. Major challenges in maintaining observation networks were also highlighted by almost all SIDS NMHSs. They drew particular attention to inadequate resources (94% or 17 of 18) (e.g. financial, replacement parts, personnel, etc), lack of professional staff with appropriate training (89% or 16 of 18) and hazard-related damage (59% or 10 of 17).

12.4.2 Telecommunications and Informatics

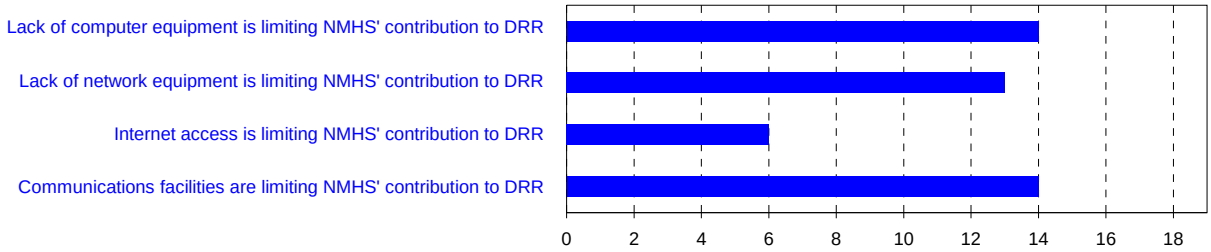

Figure 191. Telecommunication and informatics in Small Island Developing States.

Most SIDS NMHSs who responded to the WMO country-level survey (88% or 15 of 17) reported that their telecommunications systems were available 24-hourly/year-round. Partial confirmation was provided by responses indicating that most SIDS forecasting staff (72% or 13 of 18) had access to real time hydrometeorological data. However, a large majority of SIDS contributors to the survey (88% or 14 of 16) went on to identify that their ability to deliver critical products for disaster risk reduction was limited by communications facilities. Other limitations on NMHSs capacities were cited in major areas of informatics, with all respondents neither (100% nor 16 of 16) citing application software, over three quarters (81% or 13 of 16) identifying network equipment and computers and a substantial number (40% or 6 of 15), drawing attention to inadequate Internet access. Finally, almost all SIDS NMHSs (94% or 16 of 17) considered that upgrading the operational infrastructure for forecasting and warning services would enhance disaster risk reduction capacities in their countries.

12.1.1 Data Exchange

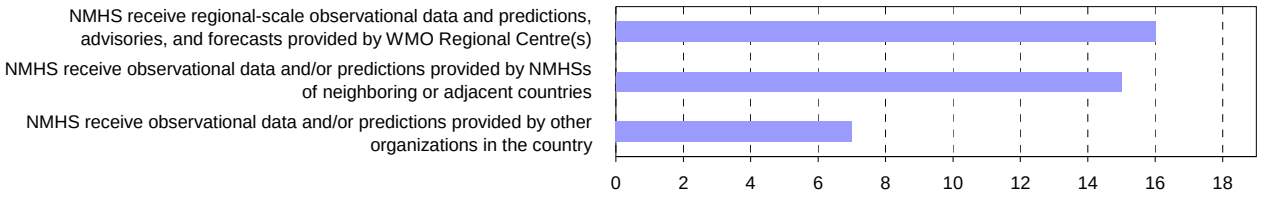

Figure 192. Data exchange in Small Island Developing States.

Survey contributions from NMHSs in Small Island Developing States identified that almost three quarters (72% or 13 of 18) of SIDS forecasting staff had real time access to hydrometeorological data. Most SIDS NMHSs who responded (94% or 15 of 16) stated that their forecasters also used regional scale observational data and forecasts provided by WMO Regional Specialized Meteorological Centres and data from neighbouring countries (82% or 14 of 17) and some (41% or 7 of 17) used data and predictions from other organizations in their countries. Over half (61% or 11 of 18) received real time marine observations from the WMO Global Telecommunications System (GTS) and some (31% or 4 of 13) relayed sea level observations on that global network. However, most SIDS contributors (88% or 14 of 16) indicated that their NMHSs were limited in their ability to

deliver critical products and services for disaster risk reduction by communications facilities. Equally, significant numbers stated that their NMHSs were limited by ability to archive and update (72% or 13 of 18), quality assurance (61% or 11 of 18) and by customization of data for stakeholders (78% or 14 of 18). In addition, a substantial majority of SIDS NMHSs considered that they required better coordination with RSMCs (93% or 13 of 14) and with neighbouring NMHSs (88% or 14 of 16) on hydrometeorological data exchange to enhance their countries disaster risk activities.

12.4.3 Forecast and Warning Capability

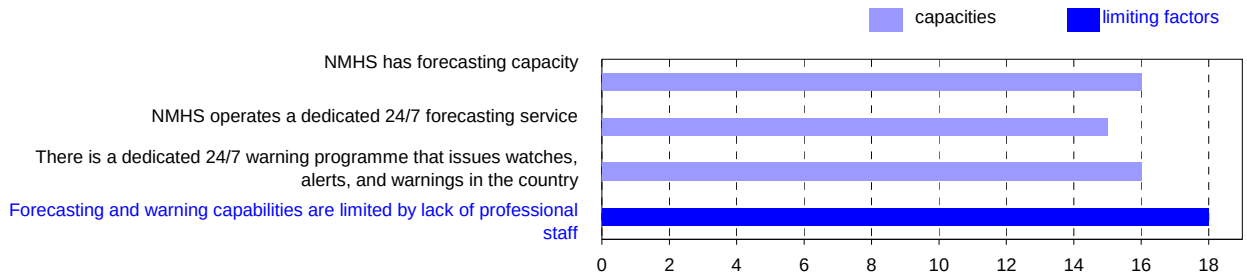

Figure 193. Forecast and warning capabilities in Small Island Developing States.

Almost all NMHSs (88% or 15 of 17) in Small Island Developing States who responded to the WMO country-level survey indicated that they had an operational forecasting capability. A solid majority (88% or 14 of 16) of them stated that this was a dedicated 24-hourly/year-round forecast service. Most SIDS respondents (88% or 15 of 17) said that a meteorologist was required to be on-site to operate this service. Most of them (83% or 15 of 18) also reported that they had a dedicated hazard warning programme that issued watches, alerts and warnings on a 24-hourly/year-round basis. Almost all of these (88% or 14 of 16) indicated that a meteorologist was on site during the operational hours of the warning programme. Most responding NMHSs (89% or 16 of 18) also stated that they provided a marine forecast and warning service to mariners and coastal zone users and one of them (5% or 1 of 20) also prepared marine forecasts for the Global Maritime Distress and Safety System (GMDSS). One NMHS (6% or 1 of 18) reported that other public or commercial entities in their country provided competing hazard warning services. Conversely, all SIDS survey contributors (100% or 17 of 17) indicated that their NMHS was limited in its ability to deliver critical products and services for disaster risk reduction by professional staff and all respondents (100% or 16 of 16) also cited application software as a limiting factor. In addition, over three quarters of them (81% or 13 of 16) stated that their ability was limited by computers. All SIDS NMHSs (100% or 17 of 17) also considered that upgrading their operational forecasting and warning services would enhance disaster risk reduction in their countries. More particularly, all who responded (100% or 18 of 18) advocated the upgrading or technical training of professional staff.

12.4.4 Forecast and Warning Products

Table 11 in Annex 4 summarizes information on hazard warnings and products issued by NMHSs in Small Island Developing States (SIDS) who contributed to the WMO country-level survey. The survey responses indicated that the hydrometeorological hazards affecting the greatest number of Small Island Developing States were, in descending order, strong winds, thunderstorms and lightning, droughts, river flooding, flash floods, forest and wild land fires, earthquakes, tropical cyclones, heat waves, aviation hazards, landslides or mudslides, hailstorms, coastal flooding,

smoke, dust or haze, desert locusts and tsunamis[36]. Examination of the data in Table 11 reveals that, while a majority of affected NMHSs issued warnings for the most common of the above hazards, the number of NMHSs issuing warnings then declined rapidly and progressively to almost none in the case of the least common hazards. The relatively limited range of hydrometeorological hazards for which warnings are issued in many SIDS countries suggests that consideration should be given to broadening NMHSs warning programmes to include all major hazards that have the potential to cause disasters and for which proven predictive techniques exist. This may, and likely will, require additional investments in infrastructure and capacity development in many SIDS NMHSs.

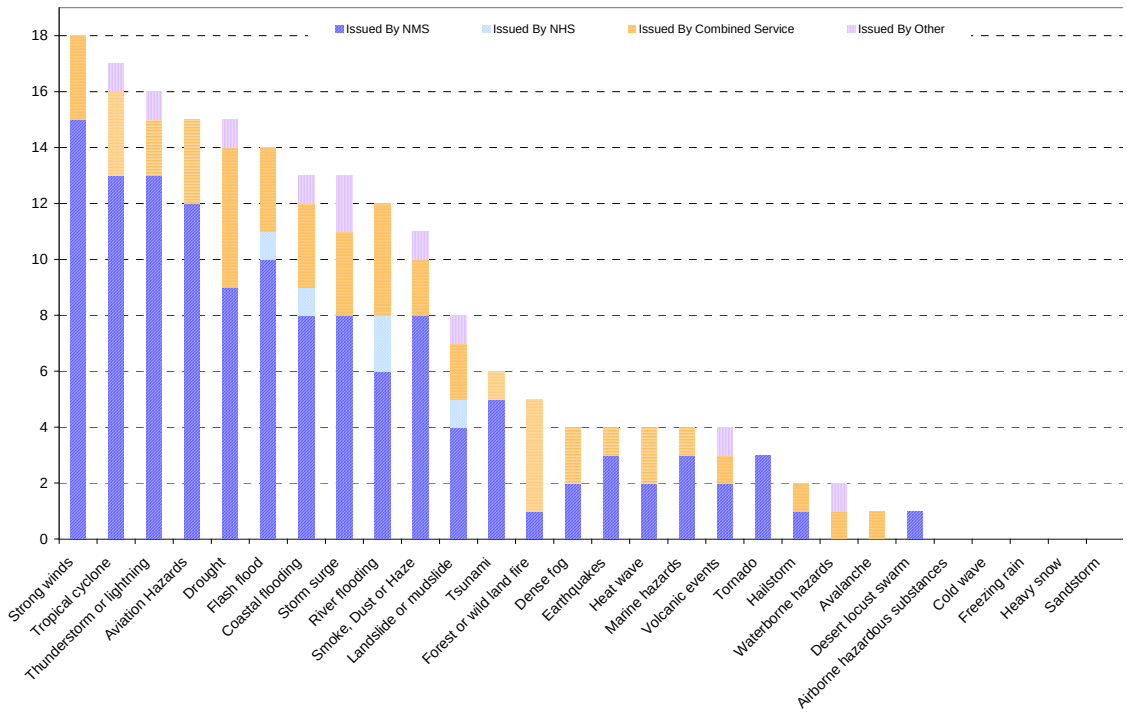

Figure 194. Agencies mandated for issuance of warnings in Small Island Developing States.

The survey responses indicated that National Meteorological Services (NMSs) in Small Island Developing States (SIDS) were responsible for the issuance the vast majority of warnings for hydrometeorological hazards. As with previous country groupings, exceptions were in the cases of river flooding, flash floods and coastal flooding where combined NMHSs and NHSs were major players. The survey data also indicated that the NMHSs (or, as the case may be, NMSs or NHSs) were the sole issuers of warnings for major hydrometeorological hazards in about two thirds of Small Island Developing States with competing warning services being present in the remainder. Official hazard warnings were indicated to include information regarding their potential impacts in about third to one half of SIDS countries. Finally, a very large majority of Small Island Developing States NMHSs who responded to the survey considered that further improvements to their warnings were necessary. This suggests that a receptive climate exists in these NMHSs towards enhancing their warning programmes to provide improved support for disaster risk reduction activities within their respective countries.

[36] The survey responses do not provide information on the magnitudes of the impacts associated with individual hazards, simply that they occur in the reported number of countries.

12.4.5 Coordination of Warnings

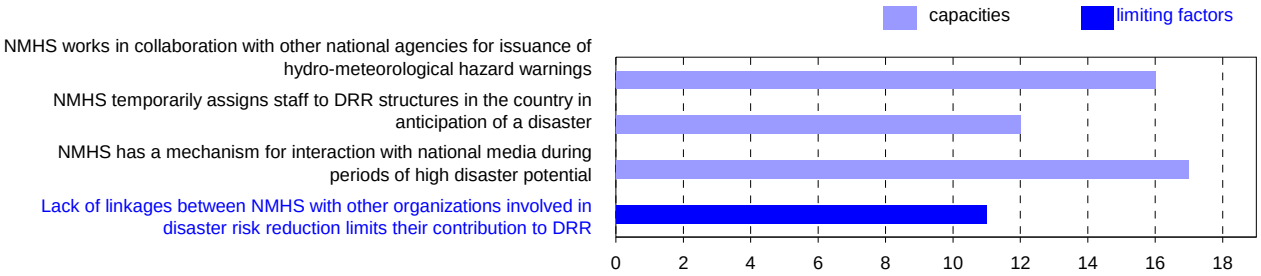

Figure 195. External coordination for issuance of warnings in Small Island Developing States.

Early warnings of hydrometeorological hazards represent a vital contribution to disaster risk reduction. In Small Island Developing States, most NMHSs who contributed to the WMO survey (83% or 15 of 18) reported that they worked in collaboration with other agencies (e.g. agriculture, aviation, etc) with respect to hazard warnings. Most of them (87% or 13 of 15) discussed the hazard's characteristics and potential impacts with these agencies prior to issuing a warning. In addition, a large majority (89% or 16 of 18) stated that they had a mechanism for interaction with their country's media during periods of high disaster potential. Over half of survey respondents (61% or 11 of 18) also indicated that they temporarily assigned staff to disaster risk management structures in anticipation of a disaster. One NMHS (6% or 1 of 18) pointed out that there were other public or commercial entities that provided competing warning services in their countries. Finally, all SIDS survey respondents (100% or 15 of 15) considered that their NMHSs required better coordination of watches and warnings with neighbouring NMHSs and well over three quarters of them (86% or 12 of 14) advocated improved coordination of watches and warnings with WMO Regional Specialized Meteorological Centres.

12.4.6 Products and Services for Selected Socio-Economic Sectors

Figure 196 illustrates the provision by NMHSs of specialized alerts, warnings and other products to significant socio-economic sectors in Small Island Developing States that can be seriously affected by hazardous events. In the context of disaster risk reduction, it is noteworthy from Figure 196 that just over a third (41%) of responding NMHSs indicated that they provided support to the housing sector, over a half (55%) to land-use planning and roughly two thirds (67%) to the fresh water sector.

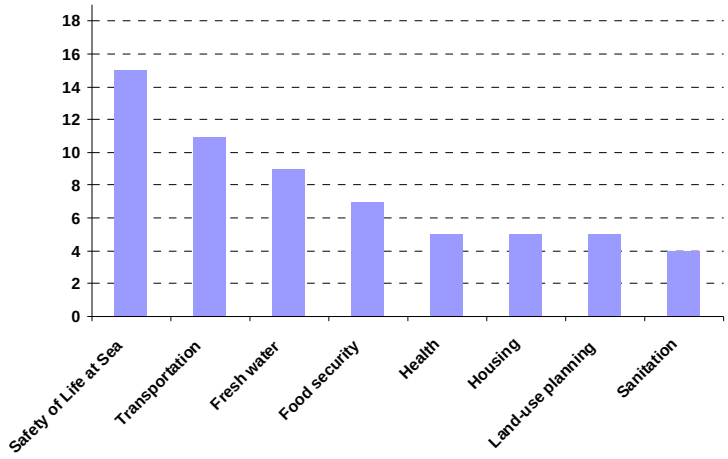

Figure 196. NMHS provision of services to selected economic sectors in Small Island Developing States.

12.4.7 Dissemination Systems and Target Audiences

The following Figures 197 and 198 summarize the survey responses relating to the dissemination of hazard products by NMHSs in Small Island Developing States. They provide information on the types of products that are disseminated, to whom they are provided and on the methods of dissemination that are used to convey the products to the recipients. The same information is also presented in numerical form in Table 10 of Annex 5 where the figures represent the number of responding NMHSs who reported that they provided the specified product to the indicated target audience or, as appropriate, utilized a particular means of dissemination.

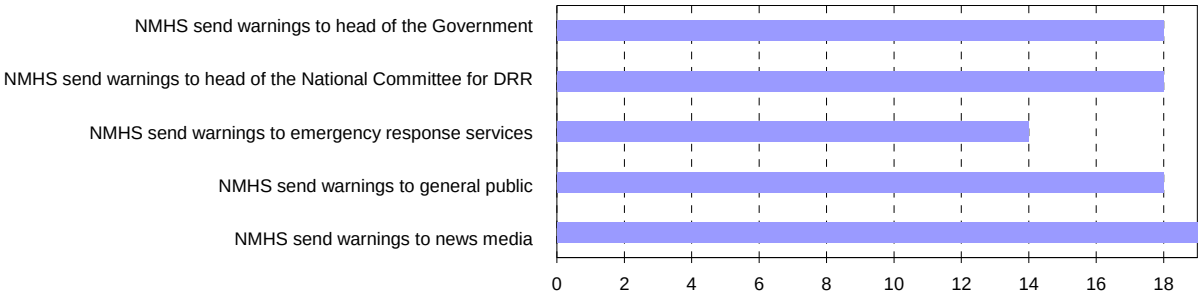

Figure 197. Warning target audience in Small Island Developing States.

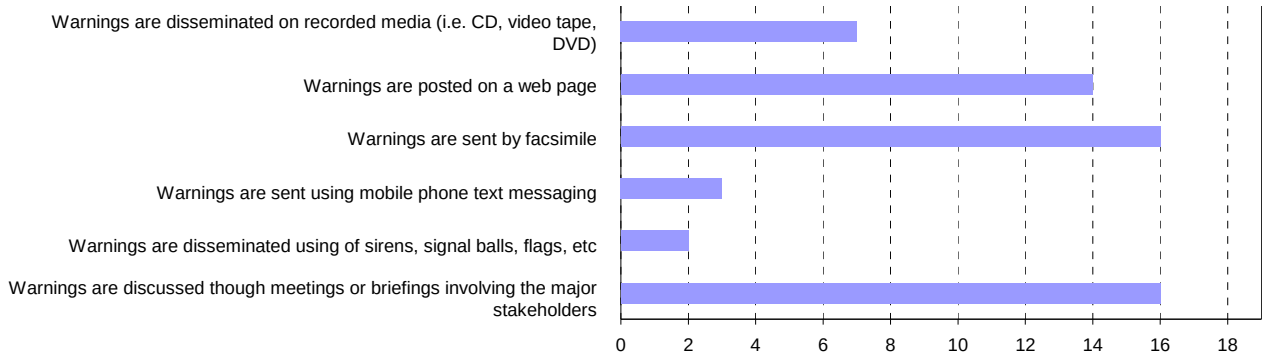

Figure 198. Warning dissemination methods in Small Island Developing States.

A very high percentage of survey contributors from Small Island Developing States indicated that they disseminated hazard warnings to the public and the media and to relevant government authorities. Moreover, over half of them disseminated warnings and other products to external partners in disaster risk reduction such as national Red Cross and Red Crescent Societies and others. The major dissemination methods in SIDS countries were via briefings, facsimile, briefings, web pages and Internet downloads and hard copy mailings. Some Small Island Developing States also used sirens and other signal devices to alert their populations.

12.4.8 Product Utility and Product Improvement

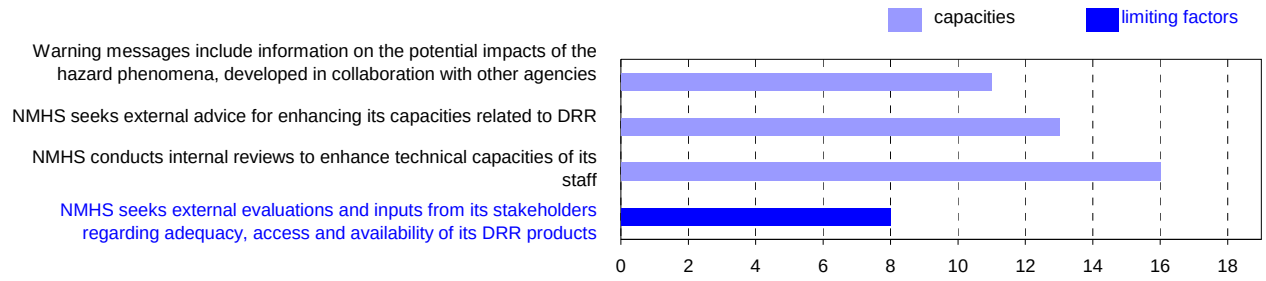

Figure 199. Ongoing feedback and improvement of products in Small Island Developing States.

Most contributing NMHSs in Small Island Developing States (83% or 15 of 18) indicated that they worked with other agencies with respect to hazard warnings. Most (88% or 14 of 16) sought advice to enhance monitoring and forecasting, enhance watches and warnings or overall products and services (82% or 14 of 17). Just over half of those (56% or 10 of 18) who included information on potential risks (impacts) in warning statements indicated that they worked with other agencies to develop risk information. In addition, about two thirds (67% or 12 of 18) of them stated that their NMHSs had a quality control mechanism to enhance their warning capabilities and content. Most SIDS NMHSs who contributed to the survey (81% or 13 of 16) stated that this mechanism provided for regular interaction with stakeholders (disaster risk authorities) and, in almost two thirds of cases (63% or 10 of 16), also provided for training for stakeholders to understand the hazards, warnings and their implications and for feedback from stakeholders after an event had occurred. Just over two thirds of SIDS survey respondents (67% or 10 15) stated that their mechanism also provided for training for the general public to understand hazards, warnings and their implications. In addition, just under half of them (44% or 8 of 18) indicated that their NMHSs sought external evaluations and inputs from stakeholders regarding the adequacy, relevance, method of access and availability of their disaster risk reduction products. However, almost SIDS contributors (89% or 16 of 18) believed that the lack of public understanding of watches, warnings and the effects of hazards limited the public response to them. Furthermore, over three quarters of them (78% or 14

of 18) considered that the lack of joint training between NMHS staff and disaster risk managers limited their disaster risk reduction efforts. Almost as many (72% or 13 of 18) stressed the need for joint training with emergency authorities and managers. In consequence, almost all SIDS NMHSs who contributed to the WMO country-level survey (94% or 17 of 18) felt that educational modules that NMHSs could target at media, public and disaster risk authorities would enhance their effectiveness in disaster risk reduction.

12.4.9 Internal NMHS Training and Capacity Enhancement

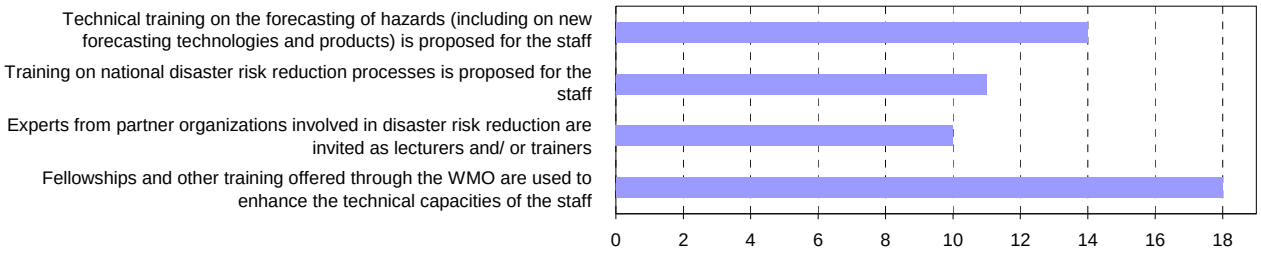

Figure 200. Training and capacity building of NMHS' staff in Small Island Developing States.

Almost three quarters of contributing NMHSs (72% or 13 of 18) from Small Island Developing States (SIDS) indicated that they provided ongoing technical training to staff on forecasting of hazards, including up to date training on new forecasting technologies and products. Even more (88% or 15 of 17) reported that they conducted internal reviews and sought staff inputs to enhance their capacity building and technical training activities. In addition, almost all SIDS respondents to the survey (94% or 17 of 18) stated that they utilized Fellowships and other training offered through WMO to enhance the technical capacities of their staff. Just over half of them (56% or 10 of 18) provided training to staff on their country's disaster risk reduction processes and related topics and almost all of these (50% or 9 of 18) invited experts from partner organizations involved in disaster risk reduction as lecturers and/or trainers. Furthermore, almost three quarters of SIDS survey respondents (71% or 12 of 17) stated that they conducted evaluations of the suitability of communications, workstations, and software to support disaster risk reduction and implemented upgrades to these systems. A smaller number of them (56% or 10 of 18) also held or participated in joint training activities for NMHS staff and emergency response agencies.

Counter balancing the preceding, three quarters of SIDS contributors to the WMO survey (76% or 13 of 17) indicated that a lack of forecaster training reduced the effectiveness of their warning service. An even larger number (89% or 16 of 18) reported that (lack of) professional staff with appropriate training limited their ability for real time monitoring of hazards. Over three quarters of contributors (78% or 14 of 18) also stated that a lack of joint training with disaster risk managers limited their NMHS disaster risk reduction efforts. A slightly smaller number (72% or 13 of 19) cited lack of joint training with emergency authorities and managers as a limiting factor. In addition, a substantial majority of survey respondents from SIDS (83% or 15 of 18 identified that the lack of joint training with media as a further limiting factor. Furthermore, almost all of them (94% or 17 of 18) identified that their ability to provide hazard data products was limited by the lack of professional staff with appropriate training. Not surprisingly in view of the preceding, all SIDS NMHSs who responded (100% or 17 of 17) considered that upgrading and improving their operational forecasting and warning activities would enhance their disaster risk capacities. More specifically, all contributing NMHSs (100% or 18 of 18) considered that upgrading and improving the technical training of the professional forecasting staff would enhance these capacities. Most of these (94% or 15 of 16) also advocated the value of cross-border training activities with neighbouring NMHS, targeted at common hydrometeorological hazards.

12.1.2 Outreach Activities

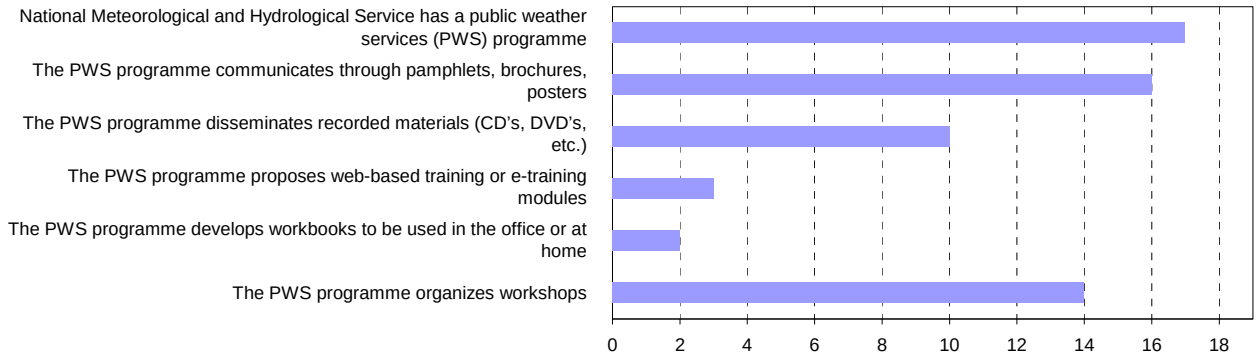

Figure 201. Outreach activities in Small Island Developing States.

Outreach activities aimed at the general public and other stakeholders are an important component of any effective disaster risk reduction programme. Within NMHSs, outreach activities are often part of a public weather services programme. In Small Island Developing States, most NMHSs (89% or 16 of 18) who contributed to the survey identified that they had a public weather services programme. Just over two thirds of them (71% or 12 of 17) provided education and training on hazards, watches, warnings, etc to disaster risk reduction authorities and operational emergency response managers on hazards, watches and warnings, etc. Equally, the same number (67% or 12 of 18) provided educational modules and training programmes targeted at the general public. A smaller number (61% or 11 of 18) participated in joint training activities with emergency response agencies and collaborated with schools and universities to develop educational programmes and curriculum for hydrometeorological hazards. Slightly fewer (39% or 7 of 18) provided training to the media. One half of SIDS respondents to the WMO survey (50% or 9 of 18) provided training targeted at the trainers (i.e. of disaster risk authorities, emergency response staff, media, etc). The following materials and methods were identified as being used in NMHSs public outreach programmes - pamphlets, brochures, posters (83% or 15 of 18), workshops (72%), recorded materials (56%), Web-based training (17%) and workbooks for office or home use (6% or 1 of 18).

On the other hand, almost all SIDS NMHSs who contributed to the WMO Disaster Risk Reduction country-level survey (89% or 16 of 18) judged that a lack of public understanding of the effects of hazards limited the public response to warning services. In addition, almost all of them (83% or 15 of 18) felt that the lack of joint training with the media limited their disaster risk reduction efforts. Moreover, slightly smaller numbers believed that lack of joint training with disaster risk managers (78% or 14 of 18) with emergency authorities and managers (72% or 13 of 18) was also limiting. As a consequence, virtually all NMHSs (94% or 17 of 18) from Small Island Developing States considered that educational modules that they could target at media, public and disaster authorities would enhance their effectiveness in disaster risk reduction.

12.5 NMHS Contingency Planning

Almost three quarters (72% or 13 of 18) NMHSs in Small Island Developing States reported that their NMHS had a contingency plan to maintain the continuity of products and services in the event of operational emergencies such as power failure or communications disruption. Most of these (63% or 10 of 16) indicated that their contingency plans involved an agreement or protocol with neighbouring NMHSs to support them in the event of catastrophic failure. In addition, just over three quarters (78% or 14 of 18) stated that they conducted or participated in drills and exercises to ensure disaster preparedness. However, all SIDS contributors (100% or 16 of 16) identified needs for improved coordination with neighbouring NMHSs, specifically citing the need for support from them in the event of disruption of services.

12.6 Overarching Factors

Small Island Developing States NMHSs participating in the country-level survey were asked to respond to a series of questions directed at obtaining expressions of opinion from them regarding overarching factors or realities that either limited or could enhance their ability to make optimal contributions to disaster risk reduction. To varying degrees, the responses to these questions also served to validate statements, expressions of opinion and/or recommendations contained in responses to earlier sections of the survey. The following summarizes the inputs that fall under the above broad category:

12.1.2.1 NMHS Visibility

Most NMHSs in Small Island Developing States who contributed to the WMO survey (78% or 14 of 18) believed that they needed higher visibility and recognition within government as a major contributing agency to disaster risk reduction. Over two thirds (67% or 12 of 18) also felt that their contributions to disaster risk reduction were limited by the lack of understanding by government authorities of the value provided by the NMHSs. All SIDS respondents (100% or 18 of 18) considered that improved ministerial level understanding of the socio-economic benefits of hydrometeorological products and services would increase the visibility of the NMHSs at the national level.

12.1.2.2 Organization and Governance

Close to half of contributing NMHSs in Small Island Developing States (44% or 8 of 18) indicated that the national organizational structure for disaster risk reduction limited their potential contributions in this area. Two thirds of them (67% or 12 of 18) felt that the effectiveness of their contributions to disaster risk reduction was limited by the lack of clear legislation or policies regarding the role of the NMHSs (e.g. as the sole issuer of warnings). In addition, a large majority of respondents (83% or 10 of 12) from SIDS countries that had separate NMSs and NHSs considered that there was a need for legislation or partnership agreements to better define the role each agency played in disaster risk reduction.

12.1.2.3 Coordination and Partnership

Close to two thirds (61% or 11 of 18) of NMHSs in Small Island Developing States considered that their contributions to disaster risk reduction were limited by a lack of linkages between their NMHS and other involved organizations. In consequence, a large majority of SIDS respondents to the WMO survey (89% or 16 of 18) believed that better coordination with adjacent countries would improve their contribution to their own nation's disaster risk reduction activities. More than two thirds of them (71% or 12 of 17) also felt that better coordination with WMO Regional Specialized Meteorological Centres would improve their contribution.

12.1.2.4 Resources and Capacity

Survey responses from most Small Island Developing States NMHSs (94% or 15 of 16) indicated that resources and infrastructure limited their ability to deliver critical products and services for disaster risk reduction. All SIDS NMHSs who responded to the survey question (100% or 17 of 17) identified professional staff as a limiting factor while a slightly smaller number (100% or 16 of 16) also cited financial resources as limiting. In consequence, all SIDS NMHSs (100% or 17 of 17) considered that upgrading and improving NMHSs operational forecasting and warning services would enhance the disaster risk reduction capacity within their country, unanimously (100% or 18 of 18) advocating the upgrading of professional staff.

12.7 Concluding Assessments and Recommendations for Small Island Developing States

The following summarizes assessments and conclusions related to the analysis of the survey responses from NMHSs in Small Island Developing States that has been presented in this chapter. In order to facilitate identification of subject areas, the titles associated with individual assessments

and conclusions presented below match those used during the preceding analyses of survey responses from Small Island Developing States.

12.7.1 Access to Data on Hazards and their Impacts

NMHSs need to have easy access to official information on hazards and on the impacts of disasters in order to provide support for planning activities and to facilitate monitoring the effectiveness of their own services in support of disaster risk reduction. As Annex 3 illustrates, a majority of Small Island Developing States NMHSs maintain records of the most common hazards such as strong winds or drought. However, the number declines rapidly for less frequently occurring hazards. As the agencies responsible for monitoring and prediction of hydrometeorological hazards within their countries, NMHSs (or NMSs and NHSs) may, reasonably, be expected to maintain records of occurrences of significant hazards. Equally, it is important that NMHSs have ready access to official information on the impacts of disasters. The survey responses indicate that this is not the case in up to one third of SIDS.

12.7.2 Value Added Services based on Historical Hazard Data

Survey contributors' unanimous recommendation for provision of enhanced value added services is strongly supported by earlier responses that illustrate very limited provision of such services by NMHSs from Small Island Developing States. The implications of these recommendations are, however, that extensive training and capacity development will need to be undertaken in many NMHSs in Small Island Developing States to provide them with the capability to deliver the value added services under discussion.

12.7.3 Legislation and Governance

The identification by a solid majority of SIDS respondents of the negative impact of the absence of clear legislation or policies regarding their NMHS role suggests that NMHSs should press for clear policy direction from their governments in those countries where a lack of clarity undercuts their potential contributions to disaster risk reduction.

12.7.4 National Structures/Mechanisms for Disaster Risk Reduction

The degree to which NMHSs are integrated into national disaster risk reduction structures and their operational relationships with civil protection agencies, planning authorities and important non-governmental partners exercise a significant influence on their ability to contribute effectively to disaster risk reduction. For optimum effectiveness, state of the art NMHS scientific, technical and operational capacities must be mainstreamed into national planning, decision-making and disaster response structures and systems and, in addition, be well connected to important non-governmental partners. Responses to the survey indicate that, while most responding SIDS NMHSs are members of their national disaster risk reduction organizational structure, almost half consider that the structure itself limits their potential contributions to disaster risk reduction in their countries. Clearly, those few NMHSs that are not members of their national coordinating committees or structures should endeavour to acquire membership in these bodies. Moreover, the responses suggest that all SIDS NMHSs should be proactive within their national committees, seeking to grain credibility within these committees by contributing responsively and effectively to national disaster risk reduction priorities and activities and to influence their processes to optimize benefits to their communities.

12.7.5 NMHS Contributions to National Disaster Risk Reduction Systems

Experience elsewhere indicates that the survey respondents' recommendation for the establishment of a "readiness system" could, if implemented, enhance NMHSs contributions to disaster risk reduction. Consequently, this initiative should be pursued at the national level. Continuing efforts should be made to promote the contributions that NMHSs can make to disaster risk reduction, build linkages with other involved organizations, and encourage disaster authorities to build on NMHSs capacities. In parallel, however, the capacities of NMHSs must, where

necessary, be enhanced to ensure that they can, in fact, deliver state of the art products and services in support of disaster risk reduction.

12.7.6 NMHS Collaboration with other Partners

The survey responses indicate that a significant number of NMHSs in Small Island Developing States do not pursue collaboration and coordination with significant national, regional and international partners in the disaster community. Expanded collaboration and partnerships can benefit NMHS through broader utilization of their products and services, increase their visibility, and result in more effective contributions to disaster risk activities. NMHSs should be proactive in expanding their partnerships with the broader disaster community both within and outside government circles.

12.7.7 The Organization and Priorities of NMHSs

The respondents' strong recommendation appears entirely valid. Close cooperation and coordination between National Meteorological Services and National Hydrological Services is an essential foundation for the provision of timely, accurate and consistent hydrometeorological hazard warnings and other services.

12.7.8 Operational Coordination between NMS and NHS

The survey responses summarized earlier clearly indicate that enhanced operational coordination between NMSs and NHSs would be beneficial in most or all SIDS countries. Furthermore, it is certainly required in those countries where no operational coordination takes place on the issue of hydrometeorological hazard warnings. The survey respondents' recommendation should, therefore, be pursued at the country level through actions to achieve more effective operational coordination between the meteorological and hydrological communities with respect to hazard warnings and other critical products for disaster risk reduction.

12.7.9 Observation and Monitoring Networks and Systems

The survey responses indicate that most NMHSs in Small Island Developing States consider that their observing networks are not optimal for disaster risk reduction and that five or six of them may not maintain a dedicated 24-hourly/year-round observation programme. Moreover, most responding NMHSs indicated that there were insufficient resources and trained staff to maintain their networks and in almost half of them this was compounded by hazard related damage to observation stations. These realities draw attention to the need for sustained resourcing of NMHSs in SIDS at levels sufficient to operate and maintain adequate observing networks and programmes. Reliable, round the clock, observations, made available in real-time, are the essential raw material needed for the production of early warnings, forecasts and other real-time products to support disaster risk reduction. Consequently, every effort must be made to ensure that adequate observational networks and systems are put in place and maintained in operation on a 24-hourly/year-round basis.

12.7.10 Telecommunications and Informatics

The responses suggest that 24-hourly/year round telecommunications capability is not in place in up to 5 SIDS NMHSs. Furthermore, most responding SIDS NMHSs identified telecommunications facilities as limiting their ability to deliver critical products. In addition, all respondents drew attention to significant deficiencies in informatics including application software, computer hardware and network equipment while Internet access has also been identified as problematic in at least half a dozen SIDS countries. These realities strongly reinforce the survey contributors' recommendation that upgrading of operational telecommunications and informatics infrastructure is required in most SIDS NMHSs if they are to contribute optimally to disaster risk reduction. Moreover, upgraded systems will need to be supported by sustained long term operational funding if the improvements in capacity are to be made permanent.

12.7.11 Data Exchange

The survey respondents' recommendations for improved coordination with neighbouring NMHSs and RSMCs on hydrometeorological data exchange make good sense since collaboration and coordination are fundamental to effective and efficient exchange of data and products. In addition to implementation of the respondents' recommendations, however, the survey responses indicate that improved data exchange will require enhancements to telecommunications, quality assurance and archiving systems in virtually all NMHSs in Small Island Developing Countries. Furthermore, capacity building will be required in relation to data processing and customization of products.

12.7.12 Forecast and Warning Capability

The contributors' recommendations regarding upgrading of forecasting and warning services are validated by the responses summarized earlier in this section. Clearly, there are virtually universal needs for upgrading of professional staff, computing capacity and application software. The survey responses indicate that at least three SIDS NMHSs do not have operational forecast and warning services and several more do not operate their services on a round-the-clock basis. This is a serious deficiency in relation to provision of hazard warnings, forecasts and other support to disaster risk reduction. Major enhancements to forecasting infrastructure along with provision of appropriate training for professional staff will clearly be required before a significant number of SIDS NMHSs will be in a position to contribute optimally to disaster risk reduction within their countries.

12.7.13 Forecast and Warning Products

The respondents' recommendation regarding the need to improve their warning products and services is solidly based.

12.7.14 Coordination of Warnings

The respondents' strong recommendations for improved coordination with neighbouring NMHSs and RSMCs in relation to watches and warnings makes good sense. Such coordination reduces the risk of ambiguous or, in the worst case, conflicting warning messages from different sources reaching the same audience. A compounding issue here is the increased potential for confusion that arises when commercial or other entities also issue hazard warnings, as is apparently the case in one SIDS country. As a general principle, therefore, it is desirable to work towards a situation where official warnings for hydrometeorological hazards emanate from a single recognized issuing authority within each country**.** Ideally prepared by NMHSs with the scientific and technical capacity to make such predictions, hydrometeorological warnings may, in some circumstances, benefit from assessment and interpretation by civil defence authorities as to their likely impacts before being relayed to local communities, perhaps accompanied by advice from authorities on actions that people should take to minimize loss of life and property.

12.7.15 Products and Services for Selected Socio-Economic Sectors

Experience around the globe demonstrates that the socio-economic sectors discussed earlier could benefit significantly from the incorporation of hydrometeorological information and products into their planning and decision-making processes. Sensible land-use planning to minimize risk of flooding and other hazards, engineering design of housing and other developments to withstand expected wind loads, design of drainage systems to accommodate heavy rainfalls and other similar measures contribute to hardening societies and communities against disastrous impacts of hydrometeorological events. Equally, early warnings of hazards enable people to take avoidance or mitigating actions to prevent disasters. The survey responses indicate that some vulnerable socio-economic sectors do not receive special hydrometeorological services in one half or more of the Small Island Developing States. Consequently, NMHSs in Small Island Developing States have the opportunity to make major contributions to disaster risk reduction by enhancing the provision of relevant products and services to planning, development, water resources and other key socio-economic sectors.

12.7.16 Dissemination Systems and Target Audiences

Reliable and timely dissemination of early warnings of hazards to stakeholders and the public at large is among the most useful services that NMHSs can provide in support of disaster risk reduction. Consequently, every effort should be made to ensure that warnings and other relevant products reach all important target audiences and the general public. In the context of disaster risk reduction, national Red Cross/Red Crescent Societies and similar non-government bodies should be targeted for receipt of hazard warnings on virtually the same level as government disaster authorities. While over half of NMHSs in Small Island Developing States already disseminate warnings to such important external partners, these external agencies should be further encouraged to access and utilize early warnings of hazards and other relevant NMHS products.

12.7.17 Product Utility and Product Improvement

The survey responses indicate that continuing emphasis is needed on increasing the awareness and understanding of SIDS stakeholders, including the public at large, disaster risk authorities and the staff of emergency agencies, regarding hazards, their impacts, and the content of watches, warnings and other disaster products, in parallel with efforts to make products more understandable, timely and accurate. They suggest that little emphasis has been placed on the educational dimension for the general public and other stakeholders in about half of the SIDS countries and that continued efforts are needed in the remainder. The survey contributors' recommendation regarding the need for and value of educational modules for the public, media and other stakeholders is validated by these responses. Most survey respondents also stressed the value of joint training for staff of NMHSs and those of disaster management and emergency response agencies. This makes good sense within the overall context of enhancing product utility through incorporation of feedback from key stakeholders and educating those clients regarding product format, content, accuracy, predictive skill and other relevant characteristics.

12.7.18 Internal NMHS Training and Capacity Enhancement

The survey respondents' recommendations for enhancement of staff training and conduct of cross border training directly address the deficiencies and limitations identified in the responses summarized earlier. As might be expected, responses from NMHSs in Small Island Developing States demonstrate general needs for extensive training and development to bring their forecast and warning capabilities and their knowledge of disaster management systems and requirements up to the standard required for effective support to disaster risk reduction. A large percentage of respondents, for example, reported that they did not provide regular training to their staff on forecasting techniques or on their countries' disaster risk reduction strategy and processes. Consequently, the needs are real in both areas but the efforts to address them are at present inadequate.

12.7.19 Outreach Activities

Survey responses indicate that NMHSs in almost a third of Small Island Developing States undertake, at best, very limited outreach activities directed at the media, disaster management authorities and the public at large. Moreover, the general viewpoint of SIDS NMHSs, as reflected in the survey responses, is that inadequate public and stakeholder awareness and understanding of hazards, warnings and other products and lack of joint training with key stakeholders significantly diminish the effectiveness of their contributions to disaster risk reduction. In short, very significant enhancement of outreach activities is appropriate in many SIDS countries. The respondents' recommendation regarding the value of educational modules is, therefore, well supported by other survey responses, though it is somewhat narrowly focussed on a single outreach tool or mechanism. When taken in combination with the requirements for internal staff training and development that have been identified earlier, the survey responses and the recommendation reinforce the message that enhanced training and capacity development within NMHSs should be matched by greater emphasis on outreach activities directed at the public and key stakeholder groups.

12.7.20 NMHS Contingency Planning

The survey responses indicate that over a quarter of responding NMHSs in Small Island Developing States do not have contingency plans to provide back-up service delivery capability in the event of emergencies. Establishment of a contingency plan is a prudent step for all NMHS to ensure maintenance of critical hazard warnings, products and services in the event of emergencies. In many instances, a partnership agreement with a neighbouring NMHS, such as is already in place in roughly half of the SIDS NMHS, can be an effective, low cost, approach to ensuring that back-up capability is in place. Consequently, the survey contributors' recommendation for enhanced coordination with neighbouring NMHS represents a well-supported approach to addressing the need to minimize disruption of hazard warnings and related services during emergency situations.

CHAPTER 13
DEVELOPED COUNTRIES

13 DEVELOPED COUNTRIES

13.1 Abstract

Survey responses from 25 Developed Countries displayed a broadly similar pattern to those from Europe but with some variations. Somewhat fewer Developed Country NMHSs draw attention to weaknesses in infrastructures, forecasting and hazard warning programmes or professional staff expertise. Fewer of them, however, have combined NMHSs and almost all have emergency contingency plans. Fewer of them perceive needs for improved coordination with neighbouring NMHSs and Regional Specialized Meteorological Centers (RSMCs). Though the NMHS or National Meteorological Service (NMS) or National Hydrological Service (NHS), as the case may be, is the sole issuer of hydrometeorological hazard warnings in a majority of Developed Countries, other competing warning services are often also available. Developed Countries' NMHSs also have relatively better capacities to provide stakeholders with value-added products. Fewer of them point to deficiencies in public and stakeholder understanding of hazards and products and more provide training to their staff and stakeholders. Furthermore, relative to Europe, a higher percentage has national disaster risk coordinating committees, generally with NMHS membership. In summary, therefore, Developed Countries NMHSs generally possess solid infrastructures and strong scientific and technical capabilities, reinforcing these through substantive training and capacity development programmes. At the same time, the above survey results suggest that improvements in partnerships, coordination, joint training with disaster authorities along with expanded outreach programmes and more widespread provision of value added services to key socio-economic sectors could enhance their contributions to disaster risk reduction.

13.2 Results of the Survey

For completeness, it was decided to briefly examine the survey responses from a representative group of Developed Countries' NMHSs to identify any common factors or anomalies that were associated with them. For the purposes of this analysis, the following countries were included in the Developed Country group: Japan, Spain, Luxembourg, Sweden, Belgium, Italy, Norway, Australia, Greece, Germany, France, Iceland, Portugal, United States, Canada, Monaco, Netherlands, Switzerland, United Kingdom, Denmark, Finland, New Zealand, Ireland, Israel and Austria. All members of the above group of Developed Countries (100% or 25 of the 25 countries) responded to the WMO country-level survey. Figure 202 below illustrates the number of Developed Countries who stated that they were affected by the specified hazards.

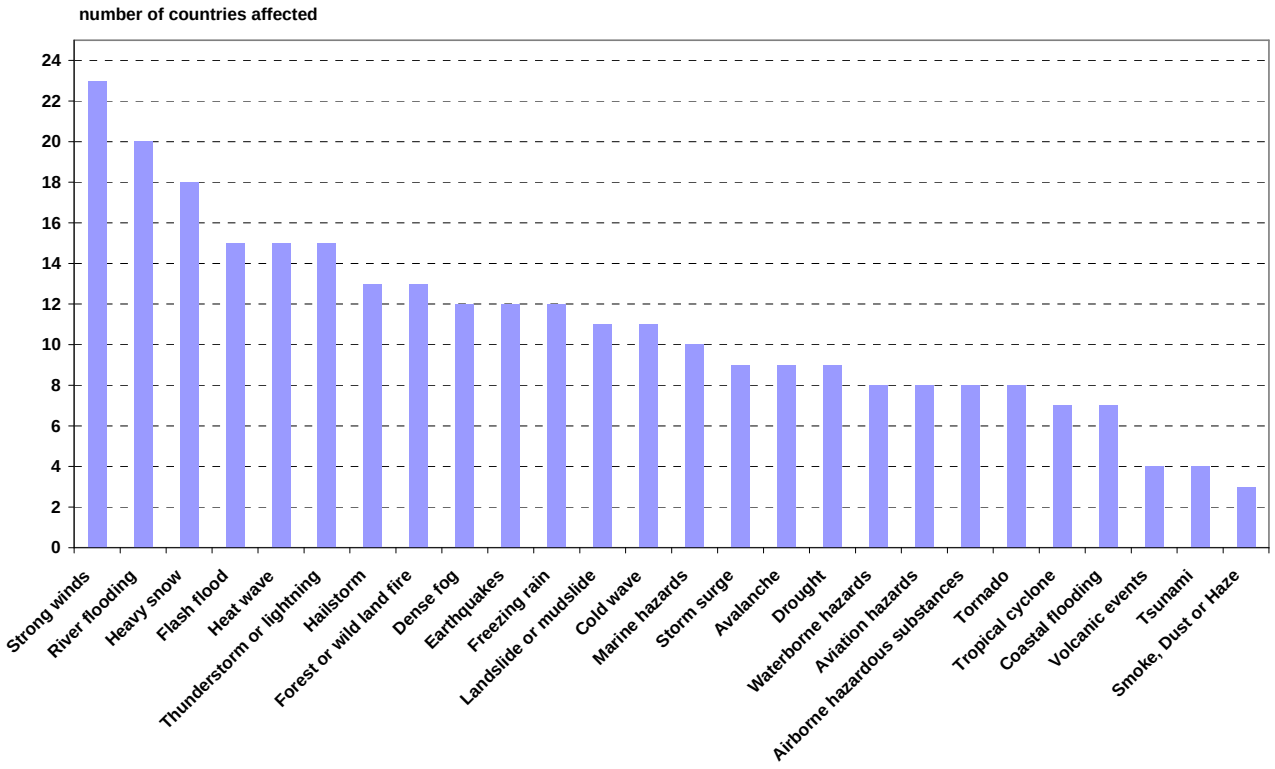

Figure 202. Number of responding Developed Countries who identified themselves as being affected by specified hazards.

As might be expected, given such a geographically distributed group of countries, a wide range of hydrometeorological hazards affected significant numbers of them. Also not surprisingly, strong winds, river flooding, heavy snow, flash floods, thunderstorms or lightning and heat waves figured prominently among the most widely occurring hazards[37].

Taken overall, the broad pattern of other responses from this group was rather similar to that from Europe. This also was not unexpected given that European countries comprised a large proportion of the Developed Countries included in the group. There were, however, some noteworthy variations from that overall pattern in the following areas. While endorsement of the benefits for disaster risk reduction of provision of value-added services based on hazard databases was at the European level, responses from the Developed Countries indicated that the latter were less limited in their ability to contribute to that priority by quality assurance, archiving and updating, customization of data products and availability of trained staff. Legislative and governance areas generally displayed the European pattern but with a higher percentage of Developed Countries indicating that they had national coordinating committees for disaster risk reduction. Where NMHSs contributions to disaster risk reduction were concerned, noticeably fewer Developed Country responses advocated implementation of national “readiness” systems. Only about one quarter of Developed Country respondents indicated that they had a combined NMHS as opposed to roughly one half in the case of Europe.

In relation to NMHS infrastructure, warning and forecast capacity, and products and services, the Developed Country responses were again broadly consistent with those from Europe but with some variations in emphasis. Survey responses from the Developed Country group revealed fewer weaknesses in observational networks, telecommunications and informatics, network

[37] The survey responses do not provide information on the magnitudes of the impacts associated with individual hazards, simply that they occur in the reported number of countries.

infrastructures and professional staff capabilities and in the forecasting and warning areas. Furthermore, significantly lower percentages of Developed Country NMHSs cited applications software, computers, network equipment, or Internet access as factors limiting their contributions to disaster risk reduction. Moreover, a lower percentage believed that upgrading operational warning and forecast services would enhance their contributions to disaster risk reduction. In addition, almost all Developed Countries' NMHSs had a contingency plan in place to maintain their services in emergencies.

The survey responses from Developed Countries summarized in Table 12 of Annex 4 illustrate that, in most instances, warnings of hydrometeorological hazards were issued by National Meteorological Services (NMS). However, river flooding, flash floods, coastal flooding and waterborne hazards represented exceptions where combined NMHSs and NHSs, taken together, issued as many or more warnings for these phenomena. In addition, less than half of the Developed Country warnings for the most common hazards included information on the potential impacts of the hazard. Responses also indicated that, while the NMS, NMHS, or NHS was the sole issuer of warnings in a majority of these Developed Countries, other competing warning services were frequently available.

A somewhat lower percentage of Developed Countries NMHSs than in Europe generally felt that a lack of public and stakeholder understanding of hazards and NMHS products was a limiting factor or endorsed the benefits of educational modules for these outreach targets. Conversely, a somewhat larger proportion of Developed Country respondents provided relevant training to NMHS staff and stakeholders. Developed Country respondents, as a group, also displayed noticeably lower levels of concern regarding the need for NMHS visibility and improved understanding by government authorities of the value of their services. In addition, their responses indicated less need to enhance coordination with neighbouring NMHSs and with RSMCs. On balance, therefore, the responses from Developed Countries' NMHSs, perhaps not unexpectedly, reflected better infrastructures and stronger technological and scientific capacities in relation to their abilities to contribute to disaster risk reduction, reinforcing these capabilities through substantive training and capacity development programmes. At the same time, survey responses drew attention to some areas where improvements could be made that would enhance NMHSs contributions to disaster risk reduction. These include strengthening of partnerships and coordination with stakeholders, increased emphasis on outreach and joint training with disaster authorities and expanded provision of value added services to key socio-economic sectors.

CHAPTER 14
OVERVIEW

14 Conclusions

The following paragraphs discuss the pattern of survey responses across the main groups of countries that were addressed in detail in the preceding chapters of this report. The aim here is to identify similarities and significant differences between the responses from the various WMO Regional Associations and from other major groupings such as Developing and Least Developed Countries and Small Island Developing States. Paralleling the organization of the country-level survey questionnaire itself, this cross-group review is structured under the following four themes - Governance, Organizational, Technical, and Training and Capacity Development.

- The Governance theme centres on the national legislative and governance context within which NMHS operate. It also includes less tangible aspects such as the level of recognition and understanding of the benefits of NMHSs in support of national risk reduction planning and related operations.
- The Organizational theme addresses the national coordination structures or mechanisms for disaster risk reduction and coordination and partnerships among NMHSs and other involved national agencies.
- The Technical theme focuses on the internal capacities of NMHSs to provide support for disaster risk reduction. It includes such aspects as their ability to produce standardized hazard data products, their capacities for hazard detection, warning and forecast issue, and the integration of warnings and other specialised services in support of emergency preparedness, response and relief operations.
- The Training and Capacity Development theme is largely self-explanatory: It addresses the technical training and capacity development of NMHS staff, multi-disciplinary training programmes directed at strengthening knowledge and operational linkages between NMHSs and other national agencies involved in disaster risk reduction, and public outreach programmes.

It is hoped that the preceding approach will assist in highlighting particular weaknesses or deficiencies in regions or country groupings and provide a more solid basis for planning initiatives to address these needs. As pointed out earlier, it will, however, more detailed analysis at the individual country level will generally be necessary in order to obtain sufficiently precise information to prioritize, target and obtain funding for specific enhancements to NMHSs infrastructures and capacities.

14.1 Inter-Regional and Inter-Group Comparison

The results of the inter-group assessment applied to the major country groupings are summarized in the following sections.

14.1.1 Governance

On a comparative basis, national-level coordination of disaster risk reduction activities was least frequent in the South-West Pacific, followed by Small Island Developing States, African countries and Least Developed Countries. Coordination under the direct line authority of the Head of Government was least frequent in Europe followed closely by the South-West Pacific, Least Developed Countries and North and Central America and the Caribbean. Coordination under a single ministry occurred most frequently in the South-West Pacific and Africa and least frequently in South America followed by Europe and Least Developed Countries. The survey responses indicated that national legislation clearly defined the roles of organizations involved in the national coordination mechanisms for disaster risk reduction in all responding countries in South America. The existence of such national legislation was, however, least frequent in Small Island Developing States followed by countries in Africa, Least Developed Countries, European countries and those in the South-West Pacific. The strongest expressions of the need for clear legislation or policies regarding the role of NMHS in disaster risk reduction came from Africa, North and Central America and the Caribbean and Small Island Developing States, followed closely by Least Developed

Countries, Developing Countries and South America. Conversely, countries in the South-West Pacific, Europe and Asia expressed the least need for clear legislation or policies.

14.1.2 Organizational

The survey responses indicated that national coordinating committees for disaster risk reduction were most widely established in North and Central America and the Caribbean and least common in Europe. Least Developed Country responses showed the second highest occurrence of national coordinating committees while the South-West Pacific countries had the second lowest presence. NMHS membership on such national coordinating committees was universal among responding countries in North and Central America and the Caribbean, South America and in Small Island Developing States and high in Africa, Asia, Developing and Least Developed Countries. .Conversely, the lowest NMHS membership rates on national committees were in Europe and the South-West Pacific. Possibly as a consequence, proportionately more responding NMHSs from Europe considered that their contributions to disaster risk reduction were limited by their national disaster management structures than was the case in other regions. Equally, respondents from Africa and South America felt least constrained by their national coordination structures. African NMHSs considered that their contributions to disaster risk reduction were limited by inadequate linkages with other involved organizations to a greater extent than did respondents from Europe and from Least Developed Countries, followed closely by Asia and South America, who felt least constrained by this factor.

Around the world, generally very high levels of NMHS support were expressed for the implementation of readiness systems that would require specific actions by authorities on receipt of receipt of hazard warnings except in Europe where support was more lukewarm. On a comparative basis, SIDS NMHSs expressed the highest level of support. The reported extent of NMHSs collaboration and coordination with national level agencies involved in disaster risk reduction was also very high across all regions and country groupings with the exception of Europe where it was noticeably less pervasive. Collaboration with other partners such as regional bodies, international organizations and non-government bodies such as national Red Cross and Red Crescent Societies varied considerably both across regions and country groupings and with respect to individual organizations. If a general pattern existed here, it was that collaboration and partnership was noticeably less well developed as one moved away from the national level or towards non-governmental organizations. Finally, NMHSs responses to the survey, in general, showed very high levels of endorsement for the view that improved coordination between National Meteorological Services and National Hydrological Services would result in enhanced warnings, forecasts and other products for disaster risk reduction. However, the survey responses from the South-West Pacific countries, though they were positive, displayed the most modest level of endorsement for this position.

14.1.3 Technical

This horizontal assessment of the operational capacities of NMHSs to support disaster risk reduction compares the following key components of NMHS infrastructure and warning and forecast production systems – observational capacities, telecommunications and informatics infrastructures, warning and forecast capabilities and data management/product generation capacities.

14.1.3.1 Observational Capacities

The lack of adequate observational networks was identified as a limiting factor on NMHSs ability to contribute to disaster risk reduction to varying degrees across all regions and country groupings. Survey responses identified it as least limiting in Europe. Conversely, lack of adequate networks was most widely identified as limiting in South America, followed by Asia and Least Developed Countries.

14.1.3.2 Telecommunications and Informatics

Telecommunications capabilities were also identified as a factor that limited NMHSs ability to contribute to disaster risk reduction by varying percentages of countries in all regions and country groupings. All responding NMHSs in North and Central America and the Caribbean and virtually all in Least Developed Countries, for example, cited telecommunications as a constraint. Conversely, the lowest level of support for this view was in Europe. In the broader informatics areas, most respondents in all regions and groups identified applications software as a major limiting factor and even in Europe approximately three quarters of respondents held this opinion. Similarly, a majority of respondents identified network equipment and computers as limiting factors but, once again, European countries were least widely affected with just over half of respondents citing these areas as problematic. Almost two thirds of NMHSs from Least Developed Countries identified Internet access as limiting their abilities to contribute to disaster risk reduction along with roughly half of the respondents from Africa and the South-West Pacific and somewhat fewer from Small Island Developing States and North and Central America and the Caribbean. In addition, at least some respondents from all of the remaining groups and regions also identified problems with Internet access.

14.1.3.3 Warning and Forecast Capacity

The distribution of hazard warning and forecast capacities showed a reasonably predictable pattern with most NMHSs in all groups and regions reporting that they had such capacity and that professional meteorologists were on staff to provide the services. Furthermore, in a majority of cases, they indicated that forecast and warning services were provided on a 24-hourly basis every day of the year. However, significantly smaller majorities of NMHSs in Least Developed Countries, Small Island Developing States and in Africa had warning and forecast capacities. Furthermore, even though all NMHSs in South America and most in the South-West Pacific stated that they had warning and forecast capacities, they also indicated that those capacities were not operational round-the-clock in a significant percentage of countries.

Coordination of warnings issue and content with key stakeholders, an important contributor to warnings effectiveness, was practiced to varying degrees across all regions and country groupings. South American, European, and North and Central American and Caribbean NMHSs reported the most widespread coordination with key stakeholders while such coordination occurred least generally in LDCs, SIDS and Asian countries. The need for better coordination of watches, warnings and other forecast products with neighbouring NMHSs and RSMCs was advocated by a large majority of respondents from all groups though the need for coordination with RSMCs was least strongly identified in North and Central America and the Caribbean.

A large, though variable, majority of respondents in all regions and groups considered that upgrading their warning and forecast services would enhance disaster risk reduction in their countries. Support for this view was universal in Africa, South America, North and Central America and the Caribbean and among Developing Countries and Small Island Developing States. European NMHSs, though largely supportive, were, however, less adamant regarding the need for upgrading of these services. All responding NMHSs identified professional staff as a primary target for upgrading efforts though forecasting infrastructure and forecasting tools and technologies were also identified by significant numbers, especially from South America, Asia and North and Central America and the Caribbean.

14.1.3.4 Training and Capacity Development

A majority of responding NMHSs in almost all groups identified the availability of professional staff with appropriate training as a factor that limited their ability to monitor hazards. The notable exception was Europe where less than half of respondents cited this factor. Across all regions and groups, half or more of respondents also indicated that a lack of forecaster training reduced the effectiveness of their hazard warning services except, once again, in Europe where just over a third endorsed this viewpoint. The lack of joint training with disaster risk authorities was

considered to limit NMHSs disaster risk reduction efforts by a substantial majority of respondents except in Europe and the South-West Pacific where just over half identified this issue. Inadequate or lack of joint training with the media was also widely identified as limiting the effectiveness of NMHSs contributions to disaster risk reduction with the notable exception of Asia where less than half the respondents held that view. Very strong endorsement was expressed among all groups for upgrading the training of professional staff to improve support for disaster risk reduction and for the conduct of cross border training with neighbouring NMHSs that addressed the forecasting of hazards of mutual concern.

An important, but often under-emphasized, component of capacity development is the provision of training and outreach to the recipients and users of NMHSs products and services. The survey responses highlighted a general need for expansion of outreach activities directed towards ensuring that stakeholders, including the public at large, are aware of and understand hazards, watches, warnings and other NMHS products and that they know how to act in response to NMHS warnings and advice. A very large majority of respondents identified that a lack of public awareness and understanding limited the public response to warnings, though a somewhat lower number (three quarters) held this opinion in Europe and Asia. The lack of joint training with disaster risk and emergency authorities and the media was also widely seen as an important limiting factor in relation to disaster risk reduction. This factor was least frequently identified as a constraint in Asia, Europe and the South-West Pacific, though even there roughly half of respondents drew attention to it. Not surprisingly, therefore, the provision of educational modules that NMHSs could target at the media, public, and disaster authorities was endorsed by a large majority of respondents, receiving unanimous endorsement in Africa and in North and Central America and the Caribbean.

14.2 General Conclusions and Recommendations

Taken overall, the detailed examination of responses to the WMO Disaster Risk Reduction country-level survey outlined in this report has confirmed the earlier identification of Common Gap Areas (GA) that need to be addressed on order to optimize NMHS and WMO support to disaster risk reduction. It has, in effect, provided further validation of widespread requirements for increased emphasis on the following critical Gap Areas:

- **The need to mainstream NMHSs and their technical capacities into national disaster risk management systems and development planning and legislation.**
- **The need to enhance NMHSs capacities for maintenance of standardized hazard databases, hazard analysis and mapping in support of risk assessment and planning applications.**
- **The need to enhance end-to-end NMHSs capacities for early detection of hydrological and meteorological hazards and preparation and dissemination of hazard warnings, supported by strong governance, organizational and operational capacities.**
- **The need to enhance NMHS capacities for provision of meteorological services in support of pre- and post-disaster emergency response and relief operations.**
- **The need to enhance partnerships between NMHS and other key agencies to achieve a more coordinated approach to natural disaster risk reduction.**
- **The need to undertake educational and training programmes for NMHS and their key stakeholders such as authorities, emergency response operators and media.**
- **The need to enhance NMHSs public outreach programmes and materials.**

There are wide variations in the type and severity of hazards to which individual countries and regions around the world are exposed, in their vulnerability to these hazards, and in the post-disaster resilience of their societies and economic infrastructures. Equally, there are variations in underlying governance and legislative frameworks and in national systems for disaster risk reduction. In addition, the capacities of NMHSs to support disaster risk reduction vary widely

between wealthy developed nations, with state of the art scientific and technical capabilities, modern technologies and well developed, consistently funded, infrastructures, and the many less fortunate countries that have inadequate financial and other resources, poorly developed and maintained infrastructures, and limited technical and scientific expertise. Despite these differences, however, the above Common Gap Areas encapsulate the general requirements of all NMHS in seeking to provide optimal support to disaster risk reduction. Only the emphasis on individual aspects varies between countries.

At the most fundamental level, the provision of truly effective hydrometeorological support for disaster risk reduction within a country depends on the existence of:

- **A national disaster risk management system that fully integrates and utilizes the early warning and other relevant capacities of its National Meteorological and Hydrological Service;**

and

- **An NMHS that possesses the infrastructure, resources, and scientific and technical internal expertise to provide state of the art meteorological and hydrological support for disaster risk reduction and has a real focus on the delivery of services to that priority area, including an understanding of the stakeholders' needs and a willingness to tailor its outputs to meet those needs.**

The first of the above elements requires a well-informed disaster management community that clearly understands the contributions that a capable NMHS can make to the prevention and mitigation of disasters. It also requires a disaster risk reduction system that can accommodate and utilize to good effect the data, information, products and services supplied by the NMHS. The second, equally essential, element requires that NMHSs develop and maintain the internal infrastructures and scientific and technical capacities to produce and deliver those products and services that turn potential contributions or support into reality. Meeting these fundamental requirements is dependent on ongoing investments in infrastructure, training and capacity development within NMHSs, combined with the development and maintenance of close collaboration and coordination with key partners in the disaster risk reduction community. It also requires that constant emphasis is placed on ensuring stakeholder and public awareness and understanding of NMHS warnings and other products and how to utilize these products to minimize risks.

For the NMHSs in the developed countries that operate from a solid funding and capacity base, responding to the preceding challenges will involve a modest strengthening of emphasis or increase in focus on disaster risk reduction. Where less well-developed and funded NMHSs are concerned, however, significant enhancements will often need to made to internal infrastructure and scientific and technical capacities in parallel with the sharpening of focus on disaster risk reduction. Investments in the development of NMHSs capacity and infrastructures will, moreover, need to be matched by the provision of adequate continuing funding if the enhanced capabilities to support disaster risk reduction are to be sustained over the long term.

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ANNEXES

Annex 1 – The Survey Questionnaire

WMO Country-Level Disaster Prevention and Mitigation Programme Survey

WMO, through its crosscutting Disaster Risk Reduction Programme has initiated the following “Country-level Disaster Risk Reduction Survey”. Your response to this survey would be critical in the development of the WMO strategic directions and crosscutting work plan to address your needs most effectively. Please complete this easy to complete survey, providing information related to your country or territory in the following areas: i) Key hazards ii) The legislative and organizational aspects of disaster risk reduction and how your agency is linked in this process iii) Capabilities (i.e., strengths and weaknesses), iv) Gaps and needs to support disaster risk reduction activities.

Respondent information

Last Name:

First Name:

Title:

Country:

WMO Region:

Organization:

E-mail address:

Telephone number:

Section I: Hazards that affect your country and hazard data

1. Listing and ranking of hazards that affect your Country		
Hazards	**Please indicate if this hazard occurs in your country**	**Please rank the top 10 hazards (where 1 is the highest impact and 10 is the lowest) that cause the highest impact in terms of loss of life, number of people affected, or economic losses?**
Tornado (rotational high winds)	Yes ☐ No ☐	Rank:
Flash flood	Yes ☐ No ☐	Rank:
Strong winds	Yes ☐ No ☐	Rank:
Hailstorm	Yes ☐ No ☐	Rank:
Thunderstorm or lightning	Yes ☐ No ☐	Rank:
Heavy snow	Yes ☐ No ☐	Rank:
Freezing rain	Yes ☐ No ☐	Rank:
Dense fog	Yes ☐ No ☐	Rank:
Tropical cyclone	Yes ☐ No ☐	Rank:
Storm surge	Yes ☐ No ☐	Rank:
Coastal flooding	Yes ☐ No ☐	Rank:
Heat wave: period of abnormally high temperatures	Yes ☐ No ☐	Rank:
Cold wave: period of abnormally low temperatures	Yes ☐ No ☐	Rank:
Drought	Yes ☐ No ☐	Rank:
River flooding	Yes ☐ No ☐	Rank:
Marine hazards (storm, sea ice, icebergs, etc.)	Yes ☐ No ☐	Rank:
Sandstorm	Yes ☐ No ☐	Rank:
Landslide or mudslide	Yes ☐ No ☐	Rank:
Airborne hazardous substances (i.e., nuclear, biological, chemical, etc.)	Yes ☐ No ☐	Rank:
Waterborne hazards (i.e., nuclear, biological, chemical, oil spills, etc.)	Yes ☐ No ☐	Rank:
Desert locust swarm	Yes ☐ No ☐	Rank:
Hydrometeorological hazards to aviation (i.e., turbulence, icing)	Yes ☐ No ☐	Rank:
Avalanche	Yes ☐ No ☐	Rank:
Forest or wild land fire	Yes ☐ No ☐	Rank:
Smoke, Dust or Haze	Yes ☐ No ☐	Rank:
Earthquakes	Yes ☐ No ☐	Rank:
Tsunami	Yes ☐ No ☐	Rank:
Volcanic events	Yes ☐ No ☐	Rank:

Data archives of hydrometeorological hazards in your country and the relevant societal data defining their impacts.	
2. Is there a designated national agency responsible for compiling, archiving, and providing official information on the impacts of disasters in your country (i.e., loss of life, number of people affected, or economic losses)?	Yes ☐ No ☐
a. If "Yes", please specify the name of this agency or agencies:	
3. Do you have access to official, reliable information on the <u>impacts</u> of disasters that have affected your Country?	Yes ☐ No ☐

a. If “Yes”, please what the source of your information is:	
4. Does your National Meteorological and Hydrological Service maintain a database of official information on the impacts of disasters that have affected your country?	Yes ☐ No ☐
a. If “Yes”, do you regularly update this database?	Yes ☐ No ☐

b. Please answer the following regarding your hazard database:

Hazards that cause disasters	Indicate for which hazards you keep historical data archives	If you maintain archives of historical hazard data, does this data include information on: Standardized meteorological / hydrological information (e.g. spatial, temporal) to characterize this hazard	Loss of life	Number of people affected	Economic cost
Tornado (rotational high winds)	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
Flash flood	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
Strong winds	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
Hailstorm	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
Thunderstorm or lightning	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
Heavy snow	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
Freezing rain	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
Dense fog	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
Tropical cyclone	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
Storm surge	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
Coastal flooding	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
Heat wave: period of abnormally high temperatures	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
Cold wave: period of abnormally low temperatures	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
Drought	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
River flooding	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
Marine hazards (sea ice, icebergs, etc.)	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
Sandstorm	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
Landslide or mudslide	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
Airborne hazardous substances (i.e., nuclear, biological, chemical, etc.)	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
Waterborne hazards (i.e., nuclear, biological, chemical, oil spills, etc.)	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
Desert locust swarm	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
Hydrometeorological hazards to aviation (i.e., turbulence, icing)	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
Avalanche	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
Forest or wild land fire	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐

b. Please answer the following regarding your hazard database:

Hazards that cause disasters	Indicate for which hazards you keep historical data archives	If you maintain archives of historical hazard data, does this data include information on: Standardized meteorological / hydrological information (e.g. spatial, temporal) to characterize this hazard	Loss of life	Number of people affected	Economic cost
Smoke, Dust or Haze	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
Earthquakes	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
Tsunami	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
Volcanic events	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐

Section II: National legislation, organizational structure and the role of the National Meteorological and Hydrological Service related to disaster risk reduction in your country.

1. Is there legislation that governs the way that disaster risk reduction activities are organized in your country?	Yes ☐ No ☐
2. Is disaster risk reduction coordinated at the national level in your country? If "Yes" please answer questions a through f.	Yes ☐ No ☐
a. Are all disaster risk reduction activities coordinated under the direct line authority of the Head of Government?	Yes ☐ No ☐
b. Are all disaster risk reduction activities coordinated under one ministry?	Yes ☐ No ☐
i. If "Yes", Please specify the ministry:	
c. Is there a **national committee** for disaster risk reduction involving multiple ministries and agencies?	Yes ☐ No ☐
d. Are there other organizational structures for coordination of disaster risk reduction activities (multi-ministry, multi-agency, etc.)?	Yes ☐ No ☐
i. If "Yes", Please specify:	
e. Is there national legislation that clearly defines the roles that each organization or agency plays within this national coordination mechanism for disaster risk reduction?	Yes ☐ No ☐
i. If "Yes", please specify the title and date of the legislation: Title: Date:	
f. Is your National Meteorological and Hydrological Service a participant in the National structure or committee for disaster risk reduction? if "Yes", please answer questions i. – ii.	Yes ☐ No ☐
i. Is your National Meteorological and Hydrological Service a member of this National structure or committee?	Yes ☐ No ☐
ii. Please specify in what capacity:	

3. Has a Disaster Risk Reduction Focal Point been established at your National Meteorological and Hydrological Service to coordinate activities to respond to disaster risk reduction needs? If "Yes", at what level does the Focal Point coordinate activities?	Yes ☐ No ☐
a. National level?	Yes ☐ No ☐
b. International and regional levels?	Yes ☐ No ☐
4. Does your National Meteorological and Hydrological Service provide support (through expertise, products and services) at national level to agencies responsible for disaster risk reduction?	Yes ☐ No ☐
If you answered "Yes", in which capacities?	
a. Activities related to disaster prevention (e.g. hazard mapping, expert advice, and providing historical hazard data for risk assessment projects, etc.)	Yes ☐ No ☐
b. Emergency planning and preparedness (e.g. early warnings of potential disasters, providing educational programmes for the public / decision makers, expert advice for emergency response planning, assisting in the planning and execution of drills)	Yes ☐ No ☐
c. Emergency response operations (e.g. real-time monitoring of weather and hydrological conditions, issuance of updated hydro-meteorological maps, forecasts in support of operational emergency response, and rescue operations, etc.)	Yes ☐ No ☐
d. Reconstruction phase (e.g. hazard data for input to reconstruction decisions)	Yes ☐ No ☐
5. Does the National Meteorological and Hydrological Service provide similar support to the government activities for disaster risk reduction at the following levels:	
a. Provincial or state?	Yes ☐ No ☐
b. Municipal or local level?	Yes ☐ No ☐
6. Does the National Meteorological and Hydrological Service coordinate with emergency management authorities for emergency planning and response activities?	Yes ☐ No ☐
a. At the national level	Yes ☐ No ☐
b. At the provincial and/or municipal levels	Yes ☐ No ☐
7. Does your National Meteorological and Hydrological Service collaborate with the National Red Cross and Red Crescent Societies in your country?	Yes ☐ No ☐
8. Does the National Meteorological and Hydrological Service interact with the office of the United Nations Coordinator in your country?	Yes ☐ No ☐
9. Does your country have a combined National Meteorological and Hydrological Service? If "Yes", please answer questions a – b.	Yes ☐ No ☐
a. Please specify the ministry that oversees the combined National Meteorological and Hydrological service in your country: Ministry name:	
b. Is there national legislation that clearly defines the role that the combined National Meteorological and Hydrological Service plays in disaster risk reduction?	Yes ☐ No ☐

10. If in your country the National Meteorological Service and the National Hydrological Service are separate agencies, please answer questions a through f.	
a. Please specify the Ministry that oversees the National Meteorological Service: Ministry name:	
b. Is there legislation that clearly defines the role that the National Meteorological Service plays in disaster risk reduction?	Yes ☐ No ☐
c. Please specify the Ministry that oversees the National Hydrological Service: Ministry name:	
d. Is there legislation that clearly defines the role that the National Hydrological Services plays in disaster risk reduction?	Yes ☐ No ☐
e. Are there partnership agreements that specify joint mandates between the **National Meteorological Service** and **National Hydrological Service** to develop joint products and issue warnings?	Yes ☐ No ☐
f. Do they coordinate the issuances of warnings for impending hydrometeorological **hazards** in any of the following manners:	
i. Sharing of forecast products and data analysis that could enhance warning quality	Yes ☐ No ☐
ii. Before an official warning is issued that relates to both meteorological hazard(s) and hydrological hazard(s)	Yes ☐ No ☐
iii. Before an official warning is issued by either organization for any hazard	Yes ☐ No ☐
iv. Other coordination is performed (please specify):	
v. Coordination is not performed	Yes ☐ No ☐
11. Does your National Meteorological and Hydrological Service participate in disaster risk reduction activities and initiatives of organizations on the level of a WMO Region or other regional economic grouping? If "Yes", please answer questions a. and b:	Yes ☐ No ☐
a. International organizations	Yes ☐ No ☐
i. International Federation of Red Cross and Red Crescent Societies (IFRC)	Yes ☐ No ☐
ii. Office for the Coordination of Humanitarian Affairs (OCHA)	Yes ☐ No ☐
iii. United Nations Development Programme (UNDP)	Yes ☐ No ☐
iv. Other, please specify (e.g., International funding agencies, United Nations agencies):	
b. Regional organizations, please specify (e.g. Regional development banks, Regional programmes and initiatives for disaster risk reduction, etc.):	

Section III: National Meteorological and Hydrological Service capacity and products and services to support different phases of Disaster Risk Reduction.

1. If your National Meteorological and Hydrological Service has a historical archive of hydro-meteorological hazards, does it provide the following value added services in support of hydrometeorological risk assessment activities of other agencies in your country?	
a. Quality controlled historical databases of hazards	Yes ☐ No ☐
b. Statistical analyses to characterize the hazards	Yes ☐ No ☐
c. Analyses of the potential impacts (e.g. on infrastructures, populations, food security and clean water, etc.)	Yes ☐ No ☐
d. Hazard mapping and high-risk zone analysis	Yes ☐ No ☐
e. Technical advice (in support of emergency plans, emergency response planning, provision of data and expertise to support hydrometeorological risk assessment for development projects, etc.)	Yes ☐ No ☐

2. Does the National Meteorological and Hydrological Service provide the following services based on real-time monitoring of hazards?	
a. Hydrometeorological maps based on observational sources	Yes ☐ No ☐
b. Special Statements	Yes ☐ No ☐
c. Advisories (preparation to take action for impending hydro-metrological hazards)	Yes ☐ No ☐
d. Watches	Yes ☐ No ☐
e. Warnings	Yes ☐ No ☐
f. Technical briefing material	Yes ☐ No ☐
3. Does your National Meteorological and Hydrological Service have an operational observing capacity that issues observations in regular intervals?	Yes ☐ No ☐
a. Is this a dedicated 24 hours a day, every day of the year observing service?	Yes ☐ No ☐
4. Does your National Meteorological and Hydrological Service have an operational forecasting capacity?	Yes ☐ No ☐
a. Is this a dedicated 24 hours a day, every day of the year forecasting service?	Yes ☐ No ☐
i. If "Yes", is a staff meteorologist required to be on site to operate this service?	Yes ☐ No ☐
ii. If "No" please specify the extent of operations (e.g., hours of operation and level of staffing):	
b. Does the forecasting staff have access to real-time hydrometeorological data for development of forecast products?	Yes ☐ No ☐
c. Are communications facilities available 24 hours a day, every day of the year?	Yes ☐ No ☐
d. Please indicate what forecast products you provide:	
i. Nowcast	Yes ☐ No ☐
ii. 24 hour forecast	Yes ☐ No ☐
iii. 3-, 4-, 5- days forecast	Yes ☐ No ☐
iv. 7 day forecast	Yes ☐ No ☐
v. 10 day outlook	Yes ☐ No ☐
vi. Seasonal outlooks of probabilities of potential hazards	Yes ☐ No ☐
e. Is there a dedicated 24 hours a day, every day of the year warning programme that issues watches, alerts, and warnings?	Yes ☐ No ☐
i. If "Yes", is a staff meteorologist required to be onsite during the operational hours of this programme?	Yes ☐ No ☐
5. Which of the following information and sources does your National Meteorological and Hydrological Service use to provide forecasts, advisories and warnings of hydrometeorological hazards?	
a. Observational data collected by your service	Yes ☐ No ☐
b. Regional-scale observational data and predictions, advisories, and forecasts provided by WMO Regional Centre(s) (i.e. Regional Specialized Meteorological Centres)	Yes ☐ No ☐
c. Observational data and/or predictions provided by the National Meteorological and Hydrological Services of Neighbouring or adjacent countries	Yes ☐ No ☐
d. Observational data and/or predictions provided by other organizations in your country	Yes ☐ No ☐
e. Other (please specify):	

If your Country has coastal waters please answer questions 6 – 10.	
6. Does your National Meteorological and Hydrological Service in its observing capacity, have sea level stations (coastal or deep-ocean) to monitor sea level?	Yes ☐ No ☐
a. If "Yes", does your National Meteorological and Hydrological Service send real-time observation data from these sea level stations through the Global Telecommunication System (GTS)?	Yes ☐ No ☐
7. Does your National Meteorological and Hydrological Service receive real-time marine observational data from the GTS?	Yes ☐ No ☐
8. Does your National Meteorological and Hydrological Service have a marine forecast and warning service that provides forecasts and warnings (e.g. storm and gale warnings, weather bulletins) to the mariners and coastal zone users in their region?	Yes ☐ No ☐
a. If "No", does the Port Meteorological Officer have the mandate to provide marine forecasts and warnings to mariners and coastal zone users in their region?	Yes ☐ No ☐
i. If "No", please specify what service has this mandate:	
9. Does your National Meteorological and Hydrological Service receive forecasts and warnings from the marine Metarea coordinator(s)?	Yes ☐ No ☐
10. Does your National Meteorological and Hydrological Service prepare and disseminate forecast or warning products for the Global Maritime Distress Safety System (GMDSS)?	Yes ☐ No ☐
a. If "Yes", does your National Meteorological and Hydrological Service coordinate these products with the appropriate Metarea coordinator(s)?	Yes ☐ No ☐

11. Please specify for what hazards your National Meteorological and Hydrological Service issues warnings, identify who is the issuer, and if the issuing agency is the sole issuer (please note: **NMS** = National Meteorological Service; **NHS** = National Hydrological Service; **Combined service** = National Meteorological and Hydrological Service

Hazards that cause disasters	**Are warnings issued for this hazard**	**Who issues these warnings**	**If warnings are issued for this hazard, is the issuing service mandated by the government as the sole issuer?**	**For the warning services that your country provides, please indicate if further improvements are necessary**	**Does the warning statement include information on the potential risks (impacts) of the hazard?**
Tornado (rotational high winds)	Yes ☐ No ☐	☐ NMS ☐ NHS ☐ Combined service	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
Flash flood	Yes ☐ No ☐	☐ NMS ☐ NHS ☐ Combined service	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
Strong winds	Yes ☐ No ☐	☐ NMS ☐ NHS ☐ Combined service	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
Hailstorm	Yes ☐ No ☐	☐ NMS ☐ NHS ☐ Combined service	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
Thunderstorm or lightning	Yes ☐ No ☐	☐ NMS ☐ NHS ☐ Combined service	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
Heavy snow	Yes ☐ No ☐	☐ NMS ☐ NHS ☐ Combined service	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
Freezing rain	Yes ☐ No ☐	☐ NMS ☐ NHS ☐ Combined service	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
Dense fog	Yes ☐ No ☐	☐ NMS ☐ NHS ☐ Combined service	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
Tropical cyclone	Yes ☐ No ☐	☐ NMS ☐ NHS ☐ Combined service	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
Storm surge	Yes ☐ No ☐	☐ NMS	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐

11. Please specify for what hazards your National Meteorological and Hydrological Service issues warnings, identify who is the issuer, and if the issuing agency is the sole issuer (please note: **NMS** = National Meteorological Service; **NHS** = National Hydrological Service; **Combined service** = National Meteorological and Hydrological Service

Hazards that cause disasters	**Are warnings issued for this hazard**	**Who issues these warnings**	**If warnings are issued for this hazard, is the issuing service mandated by the government as the sole issuer?**	**For the warning services that your country provides, please indicate if further improvements are necessary**	**Does the warning statement include information on the potential risks (impacts) of the hazard?**
		☐ NHS ☐ Combined service			
Coastal flooding	Yes ☐ No ☐	☐ NMS ☐ NHS ☐ Combined service	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
Heat wave: period of abnormally high temperatures	Yes ☐ No ☐	☐ NMS ☐ NHS ☐ Combined service	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
Cold wave: period of abnormally low temperatures	Yes ☐ No ☐	☐ NMS ☐ NHS ☐ Combined service	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
Drought	Yes ☐ No ☐	☐ NMS ☐ NHS ☐ Combined service	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
River flooding	Yes ☐ No ☐	☐ NMS ☐ NHS ☐ Combined service	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
Marine hazards (sea ice, icebergs, etc.)	Yes ☐ No ☐	☐ NMS ☐ NHS ☐ Combined service	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
Sandstorm	Yes ☐ No ☐	☐ NMS ☐ NHS ☐ Combined service	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
Landslide or mudslide	Yes ☐ No ☐	☐ NMS ☐ NHS ☐ Combined service	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
Airborne hazardous substances	Yes ☐ No ☐	☐ NMS	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐

11. Please specify for what hazards your National Meteorological and Hydrological Service issues warnings, identify who is the issuer, and if the issuing agency is the sole issuer (please note: **NMS** = National Meteorological Service; **NHS** = National Hydrological Service; **Combined service** = National Meteorological and Hydrological Service

Hazards that cause disasters	**Are warnings issued for this hazard**	**Who issues these warnings**	**If warnings are issued for this hazard, is the issuing service mandated by the government as the sole issuer?**	**For the warning services that your country provides, please indicate if further improvements are necessary**	**Does the warning statement include information on the potential risks (impacts) of the hazard?**
(i.e., nuclear, biological, chemical, etc.)		☐ NHS ☐ Combined service			
Waterborne hazardous substances (i.e., nuclear, biological, chemical, oil spills, etc.)	Yes ☐ No ☐	☐ NMS ☐ NHS ☐ Combined service	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
Desert locust swarm	Yes ☐ No ☐	☐ NMS ☐ NHS ☐ Combined service	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
Hydrometeorological hazards to aviation (i.e., turbulence, icing)	Yes ☐ No ☐	☐ NMS ☐ NHS ☐ Combined service	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
Avalanche	Yes ☐ No ☐	☐ NMS ☐ NHS ☐ Combined service	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
Forest or wild land fire	Yes ☐ No ☐	☐ NMS ☐ NHS ☐ Combined service	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
Smoke, Dust or Haze	Yes ☐ No ☐	☐ NMS ☐ NHS ☐ Combined service	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
Earthquakes	Yes ☐ No ☐	☐ NMS ☐ NHS ☐ Combined service	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
Tsunami	Yes ☐ No ☐	☐ NMS ☐ NHS ☐ Combined service	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐

11. Please specify for what hazards your National Meteorological and Hydrological Service issues warnings, identify who is the issuer, and if the issuing agency is the sole issuer (please note: **NMS** = National Meteorological Service; **NHS** = National Hydrological Service; **Combined service** = National Meteorological and Hydrological Service

Hazards that cause disasters	**Are warnings issued for this hazard**	**Who issues these warnings**	**If warnings are issued for this hazard, is the issuing service mandated by the government as the sole issuer?**	**For the warning services that your country provides, please indicate if further improvements are necessary**	**Does the warning statement include information on the potential risks (impacts) of the hazard?**
Volcanic events	Yes ☐ No ☐	☐ NMS ☐ NHS ☐ Combined service	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐

12. If you include information on the potential risks (impacts) of the hazard in the warning statements do you collaborate with other agencies (e.g. health, agriculture, etc.) to develop the risk information?	Yes ☐ No ☐
13. Are there any other entities, public or commercial, within your country that provide competing warning services to those listed in question 11 (above)?	Yes ☐ No ☐
a. If "Yes", please specify:	
14. Does your National Meteorological and Hydrological Service have a contingency plan that ensures continuity of warning products and services in case of organizational emergencies (e.g. power failure, communication disruption, etc.)?	Yes ☐ No ☐
a. If "Yes", does this contingency plan involve agreements and protocols with other National Meteorological and Hydrological Services in your region to support each other for delivery of warning products and services in case of catastrophic failure?	Yes ☐ No ☐
15. Does the National Meteorological and Hydrological Service conduct any of the following **internal capacity building and technical training** activities related to disaster risk reduction in your country:	
a. Evaluation of the suitability of communications, workstations, and software to support disaster risk reduction?	Yes ☐ No ☐
i. Implementation of upgrades needed for its communications, workstations, and software to support disaster risk reduction?	Yes ☐ No ☐
b. Providing ongoing technical training on the forecasting of hazards including up-to-date training of new forecasting technologies and products for its staff?	Yes ☐ No ☐
c. Conducting training for its staff on your country's disaster risk reduction processes and related topics?	Yes ☐ No ☐
d. Inviting experts from partner organizations involved in disaster risk reduction as lecturers and/ or trainers?	Yes ☐ No ☐
e. Utilize Fellowships and other training offered through the WMO to enhance the technical capacities of its staff?	Yes ☐ No ☐
16. Does the National Meteorological and Hydrological Service seek external advice for enhancing its capacities related to the support of disaster risk reduction? If "Yes", for which capacities?	Yes ☐ No ☐
a. Monitoring and forecasting	Yes ☐ No ☐
b. Watches and warnings	Yes ☐ No ☐
c. Overall products and services	Yes ☐ No ☐
17. Does the National Meteorological and Hydrological Service conduct internal reviews and seek staff inputs to enhance its capacity building and technical training activities for its staff?	Yes ☐ No ☐
18. Does your country have a "readiness level" system that would result in mandatory actions by National, State or Regional, and/ or local government authorities?	Yes ☐ No ☐
19. Does your National Meteorological and Hydrological Service work in collaboration with other agencies (e.g. agriculture, aviation and/ or maritime meteorological authorities, etc.) in your country, with respect to hydro-meteorological hazard warnings?	Yes ☐ No ☐
a. If "Yes", do you discuss the hydro-meteorological hazard's current and projected characteristics, and possible impacts prior to the issuance of a warning?	Yes ☐ No ☐
20. Does the National Meteorological and Hydrological Service provide specialized alerts, warnings, etc. for decisions and actions in support of **emergency response** in the following civil sectors?	
a. Health	Yes ☐ No ☐
b. Sanitation	Yes ☐ No ☐
c. Housing	Yes ☐ No ☐
d. Food security	Yes ☐ No ☐
e. Fresh water	Yes ☐ No ☐
f. Transportation	Yes ☐ No ☐
g. Land-use planning	Yes ☐ No ☐
h. Safety of Life at Sea	Yes ☐ No ☐
i. Other (please specify):	
21. Does your National Meteorological and Hydrological Service temporarily assign staff to disaster risk management structures in your country in anticipation of a disaster?	Yes ☐ No ☐

22. Dissemination of National Meteorological and Hydrological products and services related to disaster risk reduction activities:

	Hydrometeorological hazard products			
	Historical hazard data archives	**Real-time hazard monitoring**	**Forecasts and outlooks**	**Early Warnings**
a. To whom does the National Meteorological and Hydrological Service provide information:				
i. Head of the Government?	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
ii. Ministry that oversees the National Meteorological and Hydrological Service?	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
iii. Other Ministries?	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
iv. Head of the National Committee for Disaster Risk Reduction	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
v. Emergency response services? (i.e. hospitals, police, fire department)	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
vi. General public?	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
vii. News media?	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
viii. Businesses?	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
ix. WMO Regional Specialized Meteorological Centre(s)?	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
x. The United Nations Country Coordinator (UNDP)?	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
xi. National Red Cross and Red Crescent Societies	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
xii. Other organizations with interest in disaster prevention and mitigation (i.e., development banks, NGOs, academia)?	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
b. Internet based data (e.g. FTP downloads)	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
i. Sent to the recipient on recorded media (i.e. CD, video tape, or DVD)	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
ii. Hard copy mailings	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
iii. Posted on a web page	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
iv. By facsimile	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
v. Mobile phone text messaging (e.g. SMS, MMS)	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
vi. Use of sirens, signal balls, flags, etc?	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
vii. Through meetings or briefings (in person, conference call or teleconference call)	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
viii. Other (please specify):	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐

23. Does your National Meteorological and Hydrological Service have a public weather services programme?	Yes ☐ No ☐
24. Do you have a mechanism for interaction with your country's media during periods of high disaster potential?	Yes ☐ No ☐
a. If "Yes", please specify the mechanism:	
25. Does the National Meteorological and Hydrological Service provide any of the following Education and Public Outreach programmes targeted at increasing awareness of hydro-meteorological hazards?	
a. Education and training targeted at disaster risk reduction managers and authorities and operational emergency response managers on hazards, watches, warnings, etc.	Yes ☐ No ☐
b. Educational modules and training programs targeted at the general public	Yes ☐ No ☐
c. Training of the news media	Yes ☐ No ☐
d. Training targeted at the trainers (i.e., disaster risk authorities, emergency response staff, news media, public, etc.)	Yes ☐ No ☐
e. Collaboration with schools and universities to develop educational programmes and curriculum for hydrometeorological hazards	Yes ☐ No ☐
26. Does your country use standardized hazard response symbols?	Yes ☐ No ☐
a. If "Yes", is there a programme to educate the public on these symbols?	Yes ☐ No ☐
27. Are there joint training activities for the National Meteorological and Hydrological Service staff and emergency response agencies?	Yes ☐ No ☐
28. Does your National Meteorological and Hydrological Service conduct or participate in drills and exercises to ensure disaster preparedness?	Yes ☐ No ☐
29. Which of the following methods and instructional materials are used by the National Meteorological and Hydrological Service to provide education and public outreach programmes?	
a. Pamphlets, brochures, posters	Yes ☐ No ☐
b. Recorded materials (CD's, DVD's, etc.)	Yes ☐ No ☐
c. Web-based training	Yes ☐ No ☐
d. Workbooks to be used in the office or at home	Yes ☐ No ☐
e. E – training modules (e.g. software or network based)	Yes ☐ No ☐
f. Workshops	Yes ☐ No ☐
g. Other (please specify):	
30. Does your National Meteorological and Hydrological Service have a quality control mechanism to enhance your warning capabilities and content? If "Yes", Does this mechanism provide for:	Yes ☐ No ☐
a. Regular interaction with your stakeholders (disaster risk authorities) to enhance your warning capabilities and content?	Yes ☐ No ☐
b. Training for the stakeholders to understand the hazards, warnings and their implications?	Yes ☐ No ☐
c. Training for the general public to understand the hazards, warnings and their implications?	Yes ☐ No ☐
d. Feedback from stakeholders and the general public after an event has occurred?	Yes ☐ No ☐
31. Does the National Meteorological and Hydrological Service seek external reviews and inputs regarding the adequacy of the education and public outreach services it provides?	Yes ☐ No ☐
32. Does the National Meteorological and Hydrological Service seek external evaluations and inputs from stakeholders, regarding the adequacy, relevance, method of access, and availability of its disaster risk reduction products it provides to them?	Yes ☐ No ☐

Section IV: Identify and prioritize areas that are reducing the potential contribution of your agency to disaster risk reduction in your country.

Gaps for disaster risk reduction in your country	Please answer yes or no.
1. Does your National Meteorological and Hydrological service need higher visibility and recognition within the Government as one of the main contributing agencies to disaster risk reduction in your country?	Yes ☐ No ☐
2. In your opinion, if the understanding at the ministerial level of the socio-economic benefits of hydrometeorological products and services were enhanced, would the visibility of the National Meteorological and Hydrological Services at the National level be improved?	Yes ☐ No ☐
3. Does the national disaster risk reduction organizational structures (e.g. involvement of different ministries, decentralized disaster risk management, etc.) limit potential contributions of the National Meteorological and Hydrological Services to disaster risk reduction in your country?	Yes ☐ No ☐
4. Does the lack of understanding by governmental authorities of the value that your National Meteorological and Hydrological Service provides limit your contribution in disaster risk reduction?	Yes ☐ No ☐
5. Does a lack of linkages between the National Meteorological and Hydrological Service with other organizations involved in disaster risk reduction (e.g. emergency planners, emergency response) limit the contributions of your agency to disaster risk reduction in your country?	Yes ☐ No ☐
6. Does a lack of clear legislation or policies regarding the role of the National Meteorological and Hydrological Service (as the sole issuer of warnings, etc) limit the effectiveness of your contribution in disaster risk reduction in your country?	Yes ☐ No ☐
7. If there is a separate National Meteorological Service and Hydrological Service in your country, please answer questions a – c.	
a. Is there need for legislation or partnership agreements to better define the roles each plays in disaster risk reduction?	Yes ☐ No ☐
b. Would better coordination between the two agencies result in enhanced issuances of forecasts and warnings?	Yes ☐ No ☐
c. Would better technical coordination produce enhanced joint products and services?	Yes ☐ No ☐
8. Is the National Meteorological and Hydrological Service limited by resources and infrastructure to deliver critical products and services for disaster risk reduction? If “Yes”, in which of the following areas?	Yes ☐ No ☐
a. Professional staff	Yes ☐ No ☐
b. Computers	Yes ☐ No ☐
c. Network equipment	Yes ☐ No ☐
d. Internet access	Yes ☐ No ☐
e. Communications facilities	Yes ☐ No ☐
f. Financial resources	Yes ☐ No ☐
g. Application software	Yes ☐ No ☐
h. Other, please specify:	
9. Does the lack of appropriate observing networks for hydro-meteorological conditions in your country limit your ability to contribute to disaster risk reduction?	Yes ☐ No ☐

10. Does the lack of resources for the maintenance of the observing networks in your country limit your ability to contribute to disaster risk reduction?	Yes ☐ No ☐
11. What are the major challenges in maintaining your observing networks:	
a. Resources (e.g. replacement parts, personnel, etc.)	Yes ☐ No ☐
b. Hazard related damage	Yes ☐ No ☐
c. Financial resources	Yes ☐ No ☐
d. Other, please specify:	
12. Please indicate if any of the following factors limit your ability for real-time monitoring of hazards:	
a. Professional staff with appropriate training	Yes ☐ No ☐
b. Availability of a dedicated 24 hours a day, every day of the year observing service	Yes ☐ No ☐
c. Financial resources	Yes ☐ No ☐
d. Other, please specify:	
13. Please indicate if any of the following factors limit your ability for providing hazard data products to various stakeholders involved with disaster risk reduction:	
a. Professional staff with appropriate training	Yes ☐ No ☐
b. Ability to archive and update	Yes ☐ No ☐
c. Data rescue	Yes ☐ No ☐
d. Quality assurance	Yes ☐ No ☐
e. Customization of data for stakeholders	Yes ☐ No ☐
f. Others, please specify:	
14. Would enhanced value-added services of the National Meteorological and Hydrological Service in support of hydrometeorological risk assessment in your country strengthen your contributions to disaster risk reduction activities? If “Yes”, please specify which of the following value added services:	Yes ☐ No ☐
a. Analyses of potential impacts of hazards	Yes ☐ No ☐
b. Hazard mapping and high-risk zone analysis	Yes ☐ No ☐
c. Technical advice	Yes ☐ No ☐
d. Others, please specify:	

15. Would upgrading and improving your National Meteorological and Hydrological Services operational forecasting and warning services enhance disaster risk reduction capacities in your country? If "Yes", please specify in what areas:	Yes ☐ No ☐
a. Professional staff	Yes ☐ No ☐
b. Operational infrastructure	Yes ☐ No ☐
c. Access to tools and latest forecasting technologies	Yes ☐ No ☐
d. Technical training of the professional staff	Yes ☐ No ☐
e. Others, please specify:	
16. Does the lack of forecaster training at the National Meteorological and Hydrological Service reduce the effectiveness of your warning services?	Yes ☐ No ☐
17. Does the lack of joint training between staff of the National Meteorological and Hydrological Service and disaster risk managers limit your agency's disaster risk reduction efforts?	Yes ☐ No ☐
18. Does the lack of joint training between staff of the National Meteorological and Hydrological Service and media limit your agency's disaster risk reduction efforts?	Yes ☐ No ☐
19. Does the lack of joint training between staff of the National Meteorological and Hydrological Service and emergency authorities and managers limit your agency's disaster risk reduction efforts?	Yes ☐ No ☐
20. Would educational modules that National Meteorological and Hydrological Service could target at Media, Public, disaster risk reduction authorities enhance your effectiveness in disaster risk reduction?	Yes ☐ No ☐
21. Does the lack of public understanding of the effects of hazards limit public response to your warning services?	Yes ☐ No ☐
22. Does the lack of public understanding of watches and warnings limit the public response to them?	Yes ☐ No ☐
23. Would a "readiness level" system to ensure appropriate response by authorities to the levels of information issued by the Meteorological and Hydrological Service enhance your disaster risk reduction activities?	Yes ☐ No ☐
24. To improve your country's disaster risk reduction activities, does your National Meteorological and Hydrological Service require better collaboration and coordination with the WMO Regional Specialized Meteorological Centres? If "Yes", please specify which activities:	Yes ☐ No ☐
a. Watch and warning coordination	Yes ☐ No ☐
b. Hydrometeorological data exchange	Yes ☐ No ☐
c. Exchange of hydrometeorological information (e.g. analysis, forecasts, bulletins, etc.)	Yes ☐ No ☐
d. Others, please specify:	

25. To improve your country's disaster risk reduction activities, does your National Meteorological and Hydrological Service require better coordination with neighbouring or adjacent countries? If "Yes", please specify which activities:	Yes ☐ No ☐
a. Warning and watch coordination	Yes ☐ No ☐
b. Hydrometeorological data exchange	Yes ☐ No ☐
c. Cross border training activities targeted at common hydro-meteorological hazards	Yes ☐ No ☐
d. Support by neighbouring or adjacent countries in case of disruption of your services due to the impact of a disaster?	Yes ☐ No ☐
e. Others, please specify:	

26. In which of the following areas would WMOs global and regional coordinated efforts could enhance the National Meteorological and Hydrological Services' overall contributions in disaster risk reduction activities?	Please rank the following ten areas in order of importance according to the priorities of your organization (1 being the most important and 10 being the lowest).
i. Advocacy for enhanced visibility of National Meteorological and Hydrological Service' in the area of disaster risk reduction	Rank:
ii. Assist members in the development of the national disaster risk reduction plans	Rank:
iii. Cost benefit analysis of hydro-meteorological services in disaster risk reduction	Rank:
iv. Provision of technical advice and specifications (e.g. to enhance observing networks, operational infrastructures, relevant products and services for disaster risk reduction applications)	Rank:
v. Technology transfer, capacity building, technical guidelines and technical trainings (e.g. forecasting tools and methodologies, hazard mapping, and other inputs to risk assessment tools, etc.)	Rank:
vi. Strengthening strategic partnerships with stakeholders (e.g. disaster risk managers, media, etc.)	Rank:
vii. Strengthening strategic partnerships with other technical organizations and agencies (e.g. meteorology, hydrology, ocean services, etc.)	Rank:
viii. Education, training and public outreach programmes in disaster risk reduction (e.g. targeted at National Meteorological and Hydrological Service and their stakeholders)	Rank:
ix. Establishment of regional emergency protocols for the National Meteorological and Hydrological Services in support of each other in case of disruption of services due to the impact of a disaster	Rank:
x. Resource mobilization	Rank:

Annex 2 – List of WMO Members who Responded to the Survey

WMO Member States (Global)[1] (139/187)

Albania
Algeria
Argentina
Armenia
Australia
Austria
Bahamas
Bahrain
Bangladesh
Barbados
Belarus
Belgium
Belize
Bolivia
Bosnia and Herzegovina
Botswana
Brazil
Burkina Faso
Cambodia
Canada
Chile
China
Colombia
Comoros
Congo
Cook Islands
Costa Rica
Croatia
Cyprus
Czech Republic
Denmark
Dominican Republic
Ecuador
Egypt
El Salvador
Estonia
Ethiopia
Fiji
Finland
France
French Polynesia
Gabon
Georgia
Germany
Ghana
Greece
Guatemala
Guinea Bissau
Haiti
Honduras
Hong Kong, China
Hungary
Iceland
Iran, Islamic Republic of
Ireland
Israel
Italy
Ivory Coast
Jamaica
Japan
Jordan
Kazakhstan
Kenya
Kiribati
Kyrgyz Republic
Lao PDR
Latvia
Libyan Arab Jamahiriya
Lithuania
Luxembourg
Madagascar
Malawi
Malaysia
Maldives
Mali
Malta
Mexico
Micronesia, Federated States of
Monaco
Mongolia
Morocco
Mozambique
Myanmar
Nepal
Netherlands
Netherlands Antilles and Aruba
New Caledonia
New Zealand
Nicaragua
Niger
Nigeria
Norway
Oman
Pakistan
Panama
Paraguay
Peru
Philippines
Poland
Portugal
Qatar
Republic of Korea
Republic of Moldova
Republic of Yemen
Romania
Russian Federation
Rwanda
Saint Lucia
Samoa
Saudi Arabia
Senegal
Serbia and Montenegro
Seychelles
Singapore
Slovakia
Slovenia
South Africa
Spain
Sri Lanka
Sudan
Sweden
Switzerland
Tajikistan
Thailand
The former Yugoslav Republic of Macedonia
Tonga
Trinidad and Tobago
Tunisia
Turkey
Uganda
Ukraine
United Arab Emirates
United Kingdom of Great Britain and Northern Ireland
United Republic of Tanzania
United States of America
Uruguay
Uzbekistan
Vanuatu
Venezuela

NOTE: Numbers in parenthesis (x/y):

- *x refers to the number of responses received*
- *y refers to the number of countries in the mentioned category*

[1] Source: WMO Member Countries

Regional Association I (Africa)[2] (28/52)

Algeria	Egypt	Ivory Coast	Mali	Rwanda	Tunisia
Botswana	Ethiopia	Kenya	Morocco	Senegal	Uganda
Burkina Faso	Gabon	Libyan Arab Jamahiriya	Mozambique	Seychelles	United Republic of Tanzania
Comoros	Ghana	Madagascar	Niger	South Africa	
Congo	Guinea Bissau	Malawi	Nigeria	Sudan	

Regional Association II (Asia)[2] (25/34)

Bahrain	Iran, Islamic Republic of	Lao PDR	Oman	Saudi Arabia	United Arab Emirates
Bangladesh	Japan	Maldives	Pakistan	Sri Lanka	Uzbekistan
Cambodia	Kazakhstan	Mongolia	Qatar	Tajikistan	
China	Kyrgyz Republic	Myanmar	Republic of Korea	Thailand	
Hong Kong, China		Nepal	Republic of Yemen		

Regional Association III (South America)[2] (10/12)

Argentina	Brazil	Colombia	Paraguay	Uruguay
Bolivia	Chile	Ecuador	Peru	Venezuela

Regional Association IV (North and Central America and the Caribbean)[2] (18/22)

Bahamas	Costa Rica	Guatemala	Mexico	Panama	United States of America
Barbados	Dominican Republic	Haiti	Netherlands Antilles and Aruba	Saint Lucia	
Belize	El Salvador	Honduras	Nicaragua	Trinidad and Tobago	
Canada		Jamaica			

Regional Association V (South-West Pacific)[2] (14/19)

Australia	French Polynesia	Micronesia, Federated States of	New Zealand	Singapore
Cook Islands	Kiribati	New Caledonia	Philippines	Tonga
Fiji	Malaysia		Samoa	Vanuatu

Regional Association VI (Europe)[2] (44/48)

Albania	Czech Republic	Iceland	Monaco	Russian Federation	The former Yugoslav Republic of Macedonia
Armenia	Denmark	Ireland	Netherlands	Serbia and Montenegro	Turkey
Austria	Estonia	Israel	Norway	Slovakia	Ukraine
Belarus	Finland	Italy	Poland	Slovenia	United Kingdom of Great Britain and Northern Ireland
Belgium	France	Jordan	Portugal	Spain	
Bosnia and Herzegovina	Georgia	Latvia	Republic of Moldova	Sweden	
Croatia	Germany	Lithuania	Romania	Switzerland	
Cyprus	Greece	Luxembourg			
	Hungary	Malta			

[2] WMO Regional Associations Membership, Basic Documents, WMO 15, 2003, pages 100-105

Developing Countries (excluding Least Developed Countries)[3] (60/87)

Algeria	Colombia	Guatemala	Mexico	Peru	Tonga
Argentina	Congo	Honduras	Micronesia, Federated States of	Philippines	Trinidad and Tobago
Bahamas	Costa Rica	Hong Kong, China	Mongolia	Qatar	Tunisia
Bahrain	Cyprus	Iran, Islamic Republic of	Morocco	Republic of Korea	Turkey
Barbados	Dominican Republic	Ivory Coast	Nicaragua	Saint Lucia	United Arab Emirates
Belize	Ecuador	Jamaica	Nigeria	Saudi Arabia	Uruguay
Bolivia	Egypt	Jordan	Oman	Seychelles	Venezuela
Botswana	El Salvador	Kenya	Pakistan	Singapore	
Brazil	Fiji	Libyan Arab Jamahiriya	Panama	South Africa	
Chile	Gabon	Malaysia	Paraguay	Sri Lanka	
China	Ghana			Thailand	

Small Island Developing States (SIDS)[3] (19/29)

Bahamas	Dominican Republic	Haiti	Micronesia, Federated States of	Seychelles	Trinidad and Tobago
Barbados	Fiji	Jamaica	Saint Lucia	Singapore	Vanuatu
Belize	Guinea Bissau	Kiribati	Samoa	Tonga	
Comoros		Maldives			

Least Developed Countries[3] (25/50)

Bangladesh	Guinea Bissau	Malawi	Nepal	Senegal	Vanuatu
Burkina Faso	Haiti	Maldives	Niger	Sudan	
Cambodia	Kiribati	Mali	Republic of Yemen	Uganda	
Comoros	Lao PDR	Mozambique	Rwanda	United Republic of Tanzania	
Ethiopia	Madagascar	Myanmar	Samoa		

Developed Countries[4] (25/25)

Australia	Finland	Ireland	Monaco	Spain	United States of America
Austria	France	Israel	Netherlands	Sweden	
Belgium	Germany	Italy	New Zealand	Switzerland	
Canada	Greece	Japan	Norway	United Kingdom of Great Britain and Northern Ireland	
Denmark	Iceland	Luxembourg	Portugal		

[3] UN classification based on UN-OHRLLS 2006

[4] Countries described as high-income and advanced economies by the Word Bank and the International Monetary Fund

Sub-group in Regional Association I (Africa): Least Developed Countries (14/33)

Burkina Faso
Comoros
Ethiopia
Guinea Bissau
Madagascar
Malawi
Mali
Mozambique
Niger
Rwanda
Senegal
Sudan
Uganda
United Republic of Tanzania

Sub-groups in Regional Association II (Asia)

Typhoon Committe Members (7/10)

Cambodia
China
Hong Kong, China
Japan
Lao PDR
Republic of Korea
Thailand

Cyclone Panel Members (7/8)

Bangladesh
Maldives
Myanmar
Oman
Pakistan
Sri Lanka
Thailand

Central Asia (4/5)

Kazakhstan
Kyrgyz Republic
Tajikistan
Uzbekistan

Arid Asian Countries (7/8)

Bahrain
Iran, Islamic Republic of
Oman
Qatar
Republic of Yemen
Saudi Arabia
United Arab Emirates

Sub-groups in Regional Association III (South America)

Andean (5/5)

Bolivia
Chile
Colombia
Ecuador
Peru

Non-Andean (5/7)

Argentina
Brazil
Paraguay
Uruguay
Venezuela

Regional Association IV (North and Central America and the Caribbean)

North America (3/3)

Canada
Mexico
United States of America

Carribean (8/12)

Bahamas
Barbados
Dominican Republic
Haiti
Jamaica
Netherlands Antilles and Aruba
Saint Lucia
Trinidad and Tobago

Central America (6/6)

Belize
Costa Rica
El Salvador
Guatemala
Honduras
Nicaragua
Panama

Regional Association V (South-West Pacific)

SIDS (7/9)

Fiji
Kiribati
Micronesia, Federated States of
Samoa
Singapore
Tonga
Vanuatu

Non-SIDS (7/10)

Australia
Cook Islands
French Polynesia
Malaysia
New Caledonia
New Zealand
Philippines

Regional Association VI (Europe)

Northwest (14/14)

Austria
Belgium
Denmark
Finland
France
Germany
Iceland
Ireland
Luxembourg
Netherlands
Norway
Sweden
Switzerland
United Kingdom of Great Britain and Northern Ireland

East (10/11)

Belarus
Czech Republic
Estonia
Georgia
Latvia
Lithuania
Poland
Russian Federation
Slovakia
Ukraine

South (20/23)

Albania
Armenia
Bosnia and Herzegovina
Croatia
Cyprus
Greece
Hungary
Israel
Italy
Jordan
Malta
Monaco
Portugal
Republic of Moldova
Romania
Serbia and Montenegro
Slovenia
Spain
The former Yugoslav Republic of Macedonia
Turkey

The sub-regional groups were identified by the chairpersons of the WMO Regional Associations Working Groups on Disaster Prevention and Mitigation

Annex 3 – Maintenance of Hazard and Impacts Databases

Hazard	Categories	Global 139 /187	Developing Countries 85 / 137	LDC 25 / 50	SIDS 19 / 29	Developed Countries 25 / 25	RA I (Africa) 28 / 52	RA II (Asia) 25 / 34	RA III (South America) 10 / 12	RA IV (North America, Central America and the Caribbean) 18 / 22	RA V (South-West Pacific) 14 / 19	RA VI (Europe) 44 / 48
Airborne hazardous substances	**Status of Archiving data by NMHSs:**	**32**	**8**	**1**	**1**	**9**	**3**	**7**	**1**	**3**	**1**	**17**
	Includes Standardized HydroMet Info	25	6	1	1	6	1	7	1	2	1	13
	Includes Loss Life Info	11	2	1	1	5	1	1	1	2	1	5
	Includes Number Affected Info	8	2	1	1	3	1	1	1	1	1	3
	Includes Cost Info	8	2	1	1	3	1	2	0	2	1	2
Avalanche	**Status of Archiving data by NMHSs:**	**28**	**7**	**1**	**1**	**8**	**0**	**5**	**3**	**4**	**2**	**14**
	Includes Standardized HydroMet Info	23	7	1	1	6	0	5	4	4	1	9
	Includes Loss Life Info	14	4	1	1	6	0	3	2	3	1	5
	Includes Number Affected Info	11	5	1	1	4	0	2	2	3	1	3
	Includes Cost Info	13	3	2	1	6	0	3	0	4	1	5
Aviation hazards	**Status of Archiving data by NMHSs:**	**51**	**20**	**9**	**5**	**9**	**11**	**13**	**2**	**3**	**3**	**19**
	Includes Standardized HydroMet Info	41	16	7	3	8	9	10	3	2	3	14
	Includes Loss Life Info	11	3	4	1	2	3	3	1	2	1	1
	Includes Number Affected Info	14	6	4	1	2	3	5	1	2	1	2
	Includes Cost Info	13	6	2	1	3	1	5	1	3	1	2

Hazard	Categories	Global 139 /187	Developing Countries 85 / 137	LDC 25 / 50	SIDS 19 / 29	Developed Countries 25 / 25	RA I (Africa) 28 / 52	RA II (Asia) 25 / 34	RA III (South America) 10 / 12	RA IV (North America, Central America and the Caribbean) 18 / 22	RA V (South-West Pacific) 14 / 19	RA VI (Europe) 44 / 48
Coastal flooding	**Status of Archiving data by NMHSs:**	**48**	**23**	**7**	**10**	**7**	**4**	**11**	**3**	**10**	**7**	**13**
	Includes Standardized HydroMet Info	36	15	5	6	5	2	10	2	6	6	10
	Includes Loss Life Info	18	7	3	2	5	1	5	1	4	4	3
	Includes Number Affected Info	16	7	4	3	3	1	5	1	3	5	1
	Includes Cost Info	17	8	2	2	4	1	5	0	4	5	2
Cold wave	**Status of Archiving data by NMHSs:**	**69**	**29**	**5**	**0**	**12**	**11**	**14**	**6**	**6**	**1**	**31**
	Includes Standardized HydroMet Info	58	24	4	0	9	9	13	6	5	1	24
	Includes Loss Life Info	17	8	2	0	4	3	6	1	3	0	4
	Includes Number Affected Info	15	9	2	0	2	3	6	2	2	0	2
	Includes Cost Info	15	7	2	0	3	3	6	0	3	0	3
Dense fog	**Status of Archiving data by NMHSs:**	**70**	**32**	**4**	**2**	**12**	**15**	**15**	**6**	**1**	**2**	**31**
	Includes Standardized HydroMet Info	58	27	3	1	10	12	12	6	1	2	25
	Includes Loss Life Info	13	6	0	0	4	2	4	1	1	0	5
	Includes Number Affected Info	11	7	0	0	2	3	4	1	0	0	3
	Includes Cost Info	10	6	0	0	2	3	4	0	1	0	2
Desert locust swarm	**Status of Archiving data by NMHSs:**	**13**	**7**	**5**	**1**	**1**	**10**	**1**	**1**	**0**	**0**	**1**
	Includes Standardized HydroMet Info	11	5	5	1	1	7	1	1	1	0	1
	Includes Loss Life Info	4	1	2	1	1	3	0	0	0	0	1
	Includes Number Affected Info	7	2	4	1	1	5	1	0	0	0	1
	Includes Cost Info	5	2	2	1	1	3	1	0	0	0	1
Drought	**Status of Archiving data by NMHSs:**	**97**	**41**	**18**	**12**	**13**	**21**	**17**	**5**	**12**	**11**	**31**
	Includes Standardized HydroMet Info	88	37	16	11	11	20	15	6	11	10	26
	Includes Loss Life Info	27	10	6	4	7	4	6	0	6	4	7
	Includes Number Affected Info	28	13	7	5	5	6	6	2	5	4	5
	Includes Cost Info	29	15	5	5	5	4	8	2	6	4	5

Hazard	Categories	Global 139 /187	Developing Countries 85 / 137	LDC 25 / 50	SIDS 19 / 29	Developed Countries 25 / 25	RA I (Africa) 28 / 52	RA II (Asia) 25 / 34	RA III (South America) 10 / 12	RA IV (North America, Central America and the Caribbean) 18 / 22	RA V (South-West Pacific) 14 / 19	RA VI (Europe) 44 / 48
Earthquakes	**Status of Archiving data by NMHSs:**	**49**	**23**	**8**	**5**	**9**	**4**	**13**	**3**	**8**	**6**	**15**
	Includes Standardized HydroMet Info	41	19	9	5	8	4	12	3	8	5	9
	Includes Loss Life Info	30	13	5	3	8	2	7	3	7	3	8
	Includes Number Affected Info	30	16	5	3	6	2	8	3	7	4	6
	Includes Cost Info	27	11	5	2	8	2	7	1	6	4	7
Flash flood	**Status of Archiving data by NMHSs:**	**76**	**31**	**14**	**10**	**9**	**12**	**14**	**5**	**12**	**9**	**24**
	Includes Standardized HydroMet Info	65	25	11	9	8	9	10	5	11	9	21
	Includes Loss Life Info	37	18	7	5	5	5	9	2	9	7	5
	Includes Number Affected Info	31	16	7	3	3	5	8	2	8	4	4
	Includes Cost Info	28	13	5	5	4	4	7	0	6	6	5
Forest or wild land fire	**Status of Archiving data by NMHSs:**	**46**	**22**	**8**	**4**	**6**	**10**	**6**	**6**	**8**	**3**	**13**
	Includes Standardized HydroMet Info	36	17	8	4	4	8	5	6	7	2	8
	Includes Loss Life Info	21	11	3	4	5	3	3	2	6	2	5
	Includes Number Affected Info	23	14	3	4	4	3	4	2	7	2	5
	Includes Cost Info	23	12	5	4	4	4	5	1	6	2	5
Freezing rain	**Status of Archiving data by NMHSs:**	**42**	**8**	**1**	**0**	**13**	**3**	**8**	**1**	**2**	**0**	**28**
	Includes Standardized HydroMet Info	36	7	1	0	10	2	7	2	2	0	23
	Includes Loss Life Info	10	2	1	0	5	0	3	1	2	0	4
	Includes Number Affected Info	9	3	1	0	3	0	4	1	1	0	3
	Includes Cost Info	11	5	1	0	3	3	4	0	2	0	2
Hailstorm	**Status of Archiving data by NMHSs:**	**71**	**31**	**3**	**5**	**14**	**7**	**16**	**5**	**7**	**5**	**31**
	Includes Standardized HydroMet Info	60	25	2	5	13	5	12	5	7	5	26
	Includes Loss Life Info	19	9	1	1	5	1	7	2	2	2	5
	Includes Number Affected Info	18	10	2	2	3	1	7	3	2	1	4
	Includes Cost Info	16	8	1	2	3	1	6	1	3	1	4

Hazard	Categories	Global 139 /187	Developing Countries 85 / 137	LDC 25 / 50	SIDS 19 / 29	Developed Countries 25 / 25	RA I (Africa) 28 / 52	RA II (Asia) 25 / 34	RA III (South America) 10 / 12	RA IV (North America, Central America and the Caribbean) 18 / 22	RA V (South-West Pacific) 14 / 19	RA VI (Europe) 44 / 48
Heat wave	**Status of Archiving data by NMHSs:**	**81**	**32**	**10**	**1**	**13**	**18**	**15**	**5**	**7**	**3**	**33**
	Includes Standardized HydroMet Info	68	28	8	1	9	17	13	5	6	2	25
	Includes Loss Life Info	14	6	1	1	4	2	5	0	3	0	4
	Includes Number Affected Info	15	9	1	1	3	3	6	1	2	0	3
	Includes Cost Info	14	7	1	1	3	3	5	0	3	0	3
Heavy snow	**Status of Archiving data by NMHSs:**	**58**	**18**	**0**	**0**	**18**	**4**	**10**	**4**	**3**	**2**	**35**
	Includes Standardized HydroMet Info	46	12	0	0	14	2	8	4	2	2	28
	Includes Loss Life Info	13	5	0	0	5	0	4	2	2	0	5
	Includes Number Affected Info	11	6	0	0	3	0	5	2	1	0	3
	Includes Cost Info	11	4	0	0	4	0	5	0	2	0	4
Landslide or mudslide	**Status of Archiving data by NMHSs:**	**45**	**20**	**7**	**4**	**6**	**4**	**12**	**4**	**9**	**5**	**11**
	Includes Standardized HydroMet Info	37	15	7	4	6	3	10	4	8	5	7
	Includes Loss Life Info	29	14	5	4	5	2	8	2	8	5	4
	Includes Number Affected Info	23	12	5	3	3	2	6	2	6	5	2
	Includes Cost Info	23	9	5	3	5	2	7	0	5	5	4
Marine hazards	**Status of Archiving data by NMHSs:**	**31**	**12**	**1**	**0**	**7**	**4**	**6**	**2**	**1**	**3**	**15**
	Includes Standardized HydroMet Info	24	8	1	0	6	2	5	2	1	3	11
	Includes Loss Life Info	11	4	2	1	3	1	4	0	1	3	2
	Includes Number Affected Info	8	4	2	1	1	1	4	0	0	3	0
	Includes Cost Info	9	4	2	1	2	1	4	0	1	2	1
River flooding	**Status of Archiving data by NMHSs:**	**73**	**28**	**11**	**6**	**12**	**13**	**13**	**4**	**11**	**5**	**27**
	Includes Standardized HydroMet Info	64	24	10	6	9	10	12	5	10	4	23
	Includes Loss Life Info	38	16	8	4	8	4	10	2	9	5	8
	Includes Number Affected Info	35	16	8	4	7	4	9	2	9	4	7
	Includes Cost Info	33	13	7	4	8	4	8	1	7	4	9

Hazard	Categories	Global 139 /187	Developing Countries 85 / 137	LDC 25 / 50	SIDS 19 / 29	Developed Countries 25 / 25	RA I (Africa) 28 / 52	RA II (Asia) 25 / 34	RA III (South America) 10 / 12	RA IV (North America, Central America and the Caribbean) 18 / 22	RA V (South-West Pacific) 14 / 19	RA VI (Europe) 44 / 48
Sandstorm	**Status of Archiving data by NMHSs:**	**30**	**18**	**4**	**0**	**2**	**10**	**11**	**1**	**1**	**0**	**7**
	Includes Standardized HydroMet Info	25	14	3	0	2	8	9	1	1	0	6
	Includes Loss Life Info	6	3	0	0	2	1	2	0	1	0	2
	Includes Number Affected Info	5	4	0	0	0	1	3	0	0	0	1
	Includes Cost Info	6	4	0	0	1	1	3	0	1	0	1
Smoke, Dust or Haze	**Status of Archiving data by NMHSs:**	**54**	**29**	**9**	**5**	**4**	**13**	**17**	**2**	**4**	**3**	**15**
	Includes Standardized HydroMet Info	42	21	8	5	4	11	12	2	4	3	10
	Includes Loss Life Info	9	2	1	1	4	2	2	0	1	0	4
	Includes Number Affected Info	11	6	1	1	2	2	4	1	0	1	3
	Includes Cost Info	9	4	2	1	1	2	4	0	0	1	2
Storm surge	**Status of Archiving data by NMHSs:**	**41**	**14**	**6**	**8**	**11**	**2**	**8**	**2**	**9**	**6**	**14**
	Includes Standardized HydroMet Info	35	10	5	4	10	2	7	3	4	6	13
	Includes Loss Life Info	23	8	5	7	7	1	6	0	5	7	4
	Includes Number Affected Info	15	6	4	4	3	1	6	0	4	3	1
	Includes Cost Info	16	6	3	4	4	1	5	0	4	3	3
Strong winds	**Status of Archiving data by NMHSs:**	**110**	**46**	**17**	**15**	**20**	**21**	**18**	**7**	**12**	**13**	**39**
	Includes Standardized HydroMet Info	92	40	14	12	15	18	16	7	10	11	30
	Includes Loss Life Info	34	17	6	6	6	4	9	2	5	9	5
	Includes Number Affected Info	27	15	5	3	3	4	9	2	4	5	3
	Includes Cost Info	26	13	4	3	5	4	8	1	4	4	5
Thunderstorm or lightning	**Status of Archiving data by NMHSs:**	**103**	**47**	**15**	**13**	**17**	**20**	**20**	**7**	**11**	**11**	**34**
	Includes Standardized HydroMet Info	85	41	11	10	14	17	16	7	10	10	25
	Includes Loss Life Info	35	19	4	3	7	5	10	3	5	6	6
	Includes Number Affected Info	27	15	5	3	2	4	9	2	3	5	4
	Includes Cost Info	21	11	3	2	3	3	7	1	3	4	3

Hazard	Categories	Global 139 /187	Developing Countries 85 / 137	LDC 25 / 50	SIDS 19 / 29	Developed Countries 25 / 25	RA I (Africa) 28 / 52	RA II (Asia) 25 / 34	RA III (South America) 10 / 12	RA IV (North America, Central America and the Caribbean) 18 / 22	RA V (South-West Pacific) 14 / 19	RA VI (Europe) 44 / 48
Tornado	**Status of Archiving data by NMHSs:**	**40**	**16**	**4**	**3**	**11**	**4**	**8**	**3**	**5**	**5**	**15**
	Includes Standardized HydroMet Info	32	10	4	3	10	3	6	2	4	5	12
	Includes Loss Life Info	21	9	3	2	8	2	7	1	3	4	4
	Includes Number Affected Info	16	7	3	1	5	1	7	1	3	2	2
	Includes Cost Info	13	6	2	1	5	1	5	1	3	1	2
Tropical cyclone	**Status of Archiving data by NMHSs:**	**47**	**26**	**11**	**13**	**6**	**6**	**11**	**2**	**14**	**11**	**3**
	Includes Standardized HydroMet Info	43	23	11	12	5	6	10	2	12	11	2
	Includes Loss Life Info	29	18	5	8	4	2	8	1	9	8	1
	Includes Number Affected Info	27	16	6	8	3	1	8	1	9	7	1
	Includes Cost Info	25	14	6	8	3	1	7	0	8	8	1
Tsunami	**Status of Archiving data by NMHSs:**	**27**	**14**	**5**	**3**	**5**	**2**	**9**	**2**	**6**	**6**	**2**
	Includes Standardized HydroMet Info	23	11	5	3	5	2	9	1	4	5	2
	Includes Loss Life Info	17	9	3	2	4	0	7	1	4	4	1
	Includes Number Affected Info	16	8	3	1	4	0	7	1	3	4	1
	Includes Cost Info	13	6	2	2	4	0	5	0	3	4	1
Volcanic events	**Status of Archiving data by NMHSs:**	**16**	**7**	**3**	**1**	**4**	**2**	**2**	**2**	**5**	**3**	**2**
	Includes Standardized HydroMet Info	15	7	3	1	4	3	1	2	5	3	1
	Includes Loss Life Info	12	5	2	1	4	2	1	1	4	3	1
	Includes Number Affected Info	12	6	2	1	3	2	1	1	4	3	1
	Includes Cost Info	12	4	2	1	5	2	1	0	4	3	2
Waterborne hazards	**Status of Archiving data by NMHSs:**	**33**	**9**	**3**	**2**	**8**	**3**	**8**	**2**	**3**	**2**	**15**
	Includes Standardized HydroMet Info	25	7	3	2	5	2	6	2	2	2	11
	Includes Loss Life Info	10	1	2	1	4	2	1	0	2	2	3
	Includes Number Affected Info	9	2	2	1	3	2	1	1	1	2	2
	Includes Cost Info	10	1	3	1	4	2	2	0	2	1	3

[redacted]

Annex 4 – Status of Issuance of Warnings for Different Hazards

[redacted]

Table 2. Status of Issuance of Warnings for Different Hazards Globally

Hazards	Warnings issued	Issued By			Sole issuer of warning	Are further improvements necessary?	Is information included about the potential impacts?
		NMS	NHS	Combined Service			
Strong winds	130	88	0	37	112	111	71
Thunderstorm or lightning	114	74	0	30	95	103	55
Avation hazards	102	66	0	21	86	86	47
Flash flood	99	35	22	38	82	91	59
River flooding	94	16	34	40	70	86	59
Heat wave	94	61	0	32	78	82	47
Drought	92	47	2	36	69	82	57
Dense fog	79	51	0	21	67	70	44
Cold wave	74	44	0	28	62	63	37
Hailstorm	65	40	0	23	55	55	26
Smoke, Dust or Haze	64	43	0	16	55	57	41
Coastal flooding	63	26	11	23	48	58	43
Storm surge	62	32	1	21	51	55	43
Tropical cyclone	61	45	0	14	56	53	52
Forest or wild land fire	59	27	0	23	28	43	27
Heavy snow	58	31	1	24	51	50	29
Landslide or mudslide	43	14	1	21	26	40	31
Freezing rain	42	22	1	16	33	37	22
Marine hazards	37	18	2	13	29	30	22
Sandstorm	34	25	0	7	29	31	18
Waterborne hazards	33	7	3	14	19	23	13
Avalanche	30	11	0	15	19	24	19
Earthquakes	28	11	1	7	19	20	15
Airborne hazardous substances	28	8	1	15	18	21	14
Tsunami	28	18	0	4	21	25	24
Tornado	25	17	0	7	21	22	14
Volcanic events	23	12	0	6	16	19	15
Desert locust swarm	16	11	0	3	10	12	10

Table 3. Status of Issuance of Warnings for Different Hazards in Africa.

Hazards	Warnings issued	Issued By			Sole issuer of warning	Are further improvements necessary?	Is information included about the potential impacts?
		NMS	NHS	Combined Service			
Strong winds	26	25	0	0	24	24	13
Thunderstorm or lightning	23	22	0	0	21	22	11
Flash flood	21	9	9	2	18	18	10
Heat wave	21	20	0	0	20	20	14
Drought	20	17	1	1	13	17	13
Aviation hazards	20	17	0	0	18	19	11
River flooding	19	4	13	1	15	16	11
Dense fog	17	16	0	0	16	16	11
Smoke, Dust or Haze	17	14	0	1	16	16	9
Sandstorm	12	12	0	0	12	11	6
Coastal flooding	11	7	3	1	8	9	7
Cold wave	11	10	0	0	11	10	7
Desert locust swarm	11	8	0	2	7	9	7
Forest or wild land fire	10	6	0	3	4	8	5
Hailstorm	9	9	0	0	8	8	2
Tropical cyclone	9	9	0	0	9	9	8
Earthquakes	5	2	1	1	4	4	2
Landslide or mudslide	5	3	0	2	2	4	4
Waterborne hazards	5	0	1	2	4	4	2
Marine hazards	5	3	1	1	4	4	3
Tsunami	5	4	0	0	4	5	4
Heavy snow	4	4	0	0	4	4	1
Storm surge	4	2	1	1	3	2	3
Volcanic events	3	1	0	1	2	2	2
Tornado	2	2	0	0	2	2	1
Airborne hazardous substances	2	0	1	1	1	1	0
Freezing rain	1	1	0	0	1	1	0
Avalanche	0	0	0	0	0	0	0

Table 4. Status of Issuance of Warnings for Different Hazards in Asia.

Hazards	Warnings issued	Issued By			Sole issuer of warning	Are further improvements necessary?	Is information included about the potential impacts?
		NMS	NHS	Combined Service			
Strong winds	22	14	0	6	20	20	15
Aviation hazards	20	12	0	3	14	16	10
Thunderstorm or lightning	19	12	0	4	16	16	12
Heat wave	18	13	0	5	14	16	9
Flash flood	17	8	1	7	12	17	15
Cold wave	17	11	0	5	15	16	11
Drought	14	4	0	7	11	13	10
River flooding	14	1	3	8	10	13	12
Dense fog	14	9	0	3	13	13	9
Tropical cyclone	14	12	0	1	13	14	13
Smoke, Dust or Haze	13	9	0	4	13	13	11
Hailstorm	11	8	0	3	10	9	6
Sandstorm	11	6	0	3	10	11	7
Landslide or mudslide	11	4	0	6	8	11	9
Heavy snow	10	4	0	5	10	10	7
Coastal flooding	10	4	2	4	8	9	7
Storm surge	10	7	0	3	8	9	8
Tsunami	9	7	0	1	7	8	8
Forest or wild land fire	8	3	0	3	4	5	6
Earthquakes	6	5	0	1	6	6	4
Waterborne hazards	6	3	0	3	6	6	3
Freezing rain	6	3	1	2	6	6	4
Tornado	5	4	0	0	4	4	4
Avalanche	5	1	0	4	5	5	3
Marine hazards	4	3	0	0	3	3	3
Desert locust swarm	3	2	0	1	2	2	2
Airborne hazardous substances	3	1	0	2	3	3	2
Volcanic events	2	2	0	0	2	2	2

Table 5. Status of Issuance of Warnings for Different Hazards in South America.

Hazards	Warnings issued	Issued By			Sole issuer of warning	Are further improvements necessary?	Is information included about the potential impacts?
		NMS	NHS	Combined Service			
Strong winds	9	5	0	3	7	7	1
Drought	9	5	0	3	8	9	1
Thunderstorm or lightning	8	4	0	3	6	8	1
Cold wave	8	5	0	3	7	8	1
Heat wave	8	5	0	3	7	8	1
River flooding	7	0	3	4	6	7	1
Hailstorm	6	4	0	2	5	6	1
Flash flood	5	1	1	3	5	5	0
Dense fog	5	4	0	1	4	4	1
Forest or wild land fire	4	3	0	1	3	3	0
Aviation hazards	4	2	0	1	4	4	1
Heavy snow	4	3	0	1	4	4	1
Landslide or mudslide	3	0	0	3	2	3	1
Avalanche	3	1	0	1	2	2	1
Tropical cyclone	3	2	0	1	3	3	2
Tornado	2	2	0	0	1	2	0
Volcanic events	2	2	0	0	2	2	0
Smoke, Dust or Haze	2	2	0	0	2	2	1
Storm surge	2	2	0	0	2	2	1
Sandstorm	2	1	0	1	2	2	0
Coastal flooding	1	1	0	0	1	1	0
Waterborne hazards	1	1	0	0	1	1	0
Marine hazards	1	0	1	0	1	1	0
Freezing rain	1	1	0	0	1	1	0
Airborne hazardous substances	1	1	0	0	1	1	0
Earthquakes	0	0	0	0	0	0	0
Tsunami	0	0	0	0	0	0	0
Desert locust swarm	0	0	0	0	0	0	0

Table 6. Status of Issuance of Warnings for Different Hazards in North and Central America and the Caribbean

Hazards	Warnings issued	Issued By			Sole issuer of warning	Are further improvements necessary?	Is information included about the potential impacts?
		NMS	NHS	Combined Service			
Tropical cyclone	18	8	0	9	16	15	16
Strong winds	18	9	0	9	15	17	16
Drought	15	5	0	9	11	15	11
Thunderstorm or lightning	15	7	0	6	13	15	12
Storm surge	15	6	0	7	13	15	13
Flash flood	14	7	1	6	11	13	14
Coastal flooding	14	5	1	7	12	14	12
Aviation hazards	14	7	0	6	11	12	9
River flooding	12	4	1	7	10	12	11
Heat wave	12	3	0	9	9	12	7
Smoke, Dust or Haze	11	5	0	5	7	10	7
Landslide or mudslide	9	5	0	4	6	9	9
Forest or wild land fire	6	2	0	4	4	6	4
Cold wave	6	1	0	5	4	6	4
Dense fog	6	2	0	4	6	5	4
Tornado	5	2	0	3	4	5	5
Hailstorm	5	1	0	4	4	4	3
Earthquakes	4	0	0	3	2	4	4
Volcanic events	4	0	0	3	1	3	3
Avalanche	4	1	0	3	2	4	4
Waterborne hazards	4	0	0	3	0	3	3
Marine hazards	4	0	0	3	3	4	4
Tsunami	3	0	0	2	2	3	3
Airborne hazardous substances	3	1	0	2	2	3	3
Heavy snow	2	0	0	2	2	2	2
Freezing rain	2	0	0	2	2	2	2
Desert locust swarm	1	1	0	0	1	1	1
Sandstorm	1	0	0	1	0	1	1

Table 7. Status of Issuance of Warnings for Different Hazards in the South-West Pacific.

Hazards	Warnings issued	Issued By			Sole issuer of warning	Are further improvements necessary?	Is information included about the potential impacts?
		NMS	NHS	Combined Service			
Strong winds	14	12	0	2	12	11	10
Tropical cyclone	13	11	0	2	11	10	10
Storm surge	12	9	0	2	10	11	10
Drought	11	7	0	4	8	9	7
Aviation hazards	11	10	0	1	10	8	4
Thunderstorm or lightning	10	8	0	2	9	9	5
Coastal flooding	10	6	1	2	6	10	8
Flash flood	9	4	2	2	7	8	6
Tsunami	9	6	0	1	7	8	7
River flooding	8	2	3	2	5	8	7
Volcanic events	7	4	0	1	5	6	7
Earthquakes	6	3	0	1	4	4	4
Marine hazards	6	6	0	0	5	5	4
Smoke, Dust or Haze	6	6	0	0	5	5	3
Forest or wild land fire	5	3	0	1	1	3	3
Landslide or mudslide	4	0	1	1	3	4	3
Dense fog	4	3	0	1	3	4	3
Hailstorm	3	2	0	0	3	3	3
Waterborne hazards	3	1	0	0	2	1	1
Heat wave	2	2	0	0	1	1	1
Airborne hazardous substances	2	1	0	0	1	1	1
Tornado	1	1	0	0	1	0	1
Heavy snow	1	1	0	0	1	1	0
Sandstorm	1	1	0	0	1	1	1
Avalanche	0	0	0	0	0	0	0
Desert locust swarm	0	0	0	0	0	0	0
Cold wave	0	0	0	0	0	0	0
Freezing rain	0	0	0	0	0	0	0

Table 8. Status of Issuance of Warnings for Different Hazards in Europe.

Hazards	Warnings issued	Issued By			Sole issuer of warning	Are further improvements necessary?	Is information included about the potential impacts?
		NMS	NHS	Combined Service			
Strong winds	41	23	0	17	34	32	16
Thunderstorm or lightning	39	21	0	15	30	33	14
Heavy snow	37	19	1	16	30	29	18
River flooding	34	5	11	18	24	30	17
Flash flood	33	6	8	18	29	30	14
Heat wave	33	18	0	15	27	25	15
Dense fog	33	17	0	12	25	28	16
Aviation hazards	33	18	0	10	29	27	12
Freezing rain	32	17	0	12	23	27	16
Cold wave	32	17	0	15	25	23	14
Hailstorm	31	16	0	14	25	25	11
Forest or wild land fire	26	10	0	11	12	18	9
Drought	23	9	1	12	18	19	15
Storm surge	19	6	0	8	15	16	8
Avalanche	18	8	0	7	10	13	11
Airborne hazardous substances	17	4	0	10	10	12	8
Marine hazards	17	6	0	9	13	13	8
Coastal flooding	17	3	4	9	13	15	9
Smoke, Dust or Haze	15	7	0	6	12	11	10
Waterborne hazards	14	2	2	6	6	8	4
Landslide or mudslide	11	2	0	5	5	9	5
Tornado	10	6	0	4	9	9	3
Earthquakes	7	1	0	1	3	2	1
Sandstorm	7	5	0	2	4	5	3
Volcanic events	5	3	0	1	4	4	1
Tropical cyclone	4	3	0	1	4	2	3
Tsunami	2	1	0	0	1	1	2
Desert locust swarm	1	0	0	0	0	0	0

Table 9. Status of Issuance of Warnings for Different Hazards in Developing Countries

Hazards	Warnings issued	Issued By			Sole issuer of warning	Are further improvements necessary?	Is information included about the potential impacts?
		NMS	NHS	Combined Service			
Strong winds	79	61	0	14	68	71	48
Thunderstorm or lightning	70	53	0	11	60	66	40
Drought	64	36	1	21	47	59	39
Aviation hazards	61	45	0	7	50	54	33
Flash flood	60	27	14	16	49	55	41
Heat wave	55	43	0	11	46	52	30
River flooding	54	10	22	19	42	50	37
Tropical cyclone	48	36	0	10	43	44	41
Smoke, Dust or Haze	44	36	0	5	39	42	29
Dense fog	42	34	0	6	38	38	26
Coastal flooding	39	20	7	11	30	36	29
Cold wave	38	28	0	8	33	36	21
Storm surge	33	21	1	9	26	30	26
Forest or wild land fire	30	16	0	10	15	22	16
Hailstorm	30	24	0	5	26	27	12
Landslide or mudslide	27	13	1	12	17	26	21
Sandstorm	25	21	0	2	23	24	13
Tsunami	21	15	0	3	15	20	17
Earthquakes	17	9	1	5	14	16	11
Heavy snow	16	12	0	3	16	16	9
Desert locust swarm	15	11	0	3	10	12	10
Waterborne hazards	13	4	1	4	9	10	5
Marine hazards	13	9	2	2	10	11	8
Volcanic events	13	6	0	4	9	11	9
Tornado	12	11	0	0	9	11	7
Avalanche	9	4	0	4	6	8	6
Freezing rain	7	6	0	1	7	7	4
Airborne hazardous substances	6	3	1	1	4	4	2

Table 10. Status of Issuance of Warnings for Different Hazards in Least Developed Countries.

Hazards	Warnings issued	Issued By			Sole issuer of warning	Are further improvements necessary?	Is information included about the potential impacts?
		NMS	NHS	Combined Service			
Strong winds	21	17	0	3	19	21	14
Drought	19	14	0	5	13	18	12
Thunderstorm or lightning	18	14	0	2	15	18	11
River flooding	18	3	10	3	14	16	12
Flash flood	17	8	6	3	15	17	11
Aviation hazards	16	11	0	3	11	15	10
Heat wave	15	13	0	2	13	15	10
Tropical cyclone	14	12	0	2	14	13	13
Smoke, Dust or Haze	13	11	0	1	12	13	8
Coastal flooding	9	4	2	3	8	9	7
Cold wave	9	8	0	1	8	9	8
Storm surge	8	5	1	2	8	8	8
Dense fog	7	6	0	1	6	7	5
Tsunami	7	4	0	1	6	7	6
Desert locust swarm	7	4	0	2	3	6	5
Forest or wild land fire	6	3	0	2	2	4	3
Sandstorm	5	5	0	0	5	5	3
Landslide or mudslide	4	2	0	2	3	4	4
Volcanic events	4	1	0	1	4	4	4
Earthquakes	3	1	0	1	3	3	2
Hailstorm	3	3	0	0	2	3	1
Waterborne hazards	3	1	0	0	3	3	3
Tornado	2	2	0	0	2	2	2
Marine hazards	2	1	1	0	2	2	2
Avalanche	1	0	0	1	1	1	1
Freezing rain	1	1	0	0	1	1	1
Heavy snow	0	0	0	0	0	0	0
Airborne hazardous substances	0	0	0	0	0	0	0

Table 11. Status of Issuance of Warnings for Different Hazards in Small Island Developing States

Hazards	Warnings issued	Issued By			Sole issuer of warning	Are further improvements necessary?	Is information included about the potential impacts?
		NMS	NHS	Combined Service			
Strong winds	18	15	0	3	15	16	15
Tropical cyclone	17	13	0	3	15	14	15
Thunderstorm or lightning	16	13	0	2	13	15	12
Drought	15	9	0	5	11	14	10
Aviation Hazards	15	12	0	3	13	13	9
Flash flood	14	10	1	3	11	12	12
Storm surge	13	8	0	3	11	13	12
Coastal flooding	13	8	1	3	11	13	12
River flooding	12	6	2	4	11	12	11
Smoke, Dust or Haze	11	8	0	2	8	10	5
Landslide or mudslide	8	4	1	2	5	8	7
Tsunami	6	5	0	1	4	6	4
Forest or wild land fire	5	1	0	4	2	5	4
Dense fog	4	2	0	2	3	4	3
Heat wave	4	2	0	2	3	4	2
Marine hazards	4	3	0	1	3	4	3
Earthquakes	4	3	0	1	3	4	3
Volcanic events	4	2	0	1	3	4	4
Tornado	3	3	0	0	2	3	3
Hailstorm	2	1	0	1	2	2	2
Waterborne hazards	2	0	0	1	0	1	1
Desert locust swarm	1	1	0	0	1	1	1
Avalanche	1	0	0	1	1	1	1

Table 12. Status of Issuance of Warnings for Different Hazards in Developed Countries

Hazards	Warnings issued	Issued By			Sole issuer of warning	Are further improvements necessary?	Is information included about the potential impacts?
		NMS	NHS	Combined Service			
Strong winds	23	19	0	3	17	15	9
Aviation hazards	21	14	0	3	18	16	5
Thunderstorm or lightning	20	15	0	3	13	15	7
Heavy snow	20	15	1	3	13	13	8
River flooding	18	6	9	3	7	15	7
Freezing rain	17	12	0	3	9	13	7
Dense fog	16	13	0	2	10	12	6
Flash flood	15	6	5	4	9	13	6
Hailstorm	15	12	0	2	10	10	5
Storm surge	15	7	0	5	12	12	8
Heat wave	14	12	0	2	8	9	5
Cold wave	14	12	0	2	8	8	4
Forest or wild land fire	14	9	0	1	3	9	4
Coastal flooding	12	5	3	3	7	11	6
Marine hazards	12	6	0	3	7	8	6
Avalanche	10	5	0	3	5	6	4
Drought	9	6	1	2	6	7	5
Tropical cyclone	8	6	0	2	8	6	6
Airborne hazardous substances	8	4	0	2	3	4	4
Smoke, Dust or Haze	8	5	0	2	4	6	5
Waterborne hazards	7	2	1	2	1	3	2
Earthquakes	7	2	0	2	3	3	3
Volcanic events	7	4	0	2	4	6	4
Landslide or mudslide	5	0	0	3	1	4	4
Tornado	4	2	0	2	3	4	3
Sandstorm	4	3	0	1	1	2	2
Tsunami	4	3	0	1	3	3	4
Desert locust swarm	1	0	0	0	0	0	0

Annex 5 – Dissemination Methods and Target Audiences

Table 1. Dissemination Systems and Target Audiences – Global Situation

Hazard	Historical Data Archives	Real-Time Monitoring	Forecasts And Outlooks	Early Warnings
Head of the Government?	48.70%	64.29%	78.81%	79.49%
Ministry that oversees the National Meteorological and Hydrological Service?	64.80%	74.59%	84.50%	85.60%
Other Ministries?	68.85%	73.33%	86.61%	89.60%
Head of the National Committee for Disaster Risk Reduction	58.47%	69.75%	79.34%	78.81%
Emergency response services? (i.e. hospitals, police, fire department)	51.67%	67.50%	80.49%	80.00%
General public?	62.30%	81.30%	97.73%	96.03%
News media?	63.93%	79.20%	97.76%	97.64%
Businesses?	50.00%	56.90%	73.39%	66.95%
WMO Regional Specialized Meteorological Centre(s)?	43.44%	49.58%	48.74%	46.15%
The United Nations Country Coordinator (UNDP)?	19.33%	18.75%	24.14%	23.48%
National Red Cross and Red Crescent Societies	23.28%	28.44%	33.33%	37.17%
Other organizations with interest in disaster prevention and mitigation (i.e., development banks, NGOs, academia)?	41.80%	38.05%	48.72%	46.55%
Internet based data (e.g. FTP downloads)	41.82%	55.56%	69.91%	69.16%
Sent to the recipient on recorded media (i.e. CD, video tape, or DVD)	38.33%	21.43%	27.43%	25.45%
Hard copy mailings	45.38%	39.47%	53.39%	48.72%
Posted on a web page	46.72%	69.35%	87.40%	81.75%
By facsimile	52.89%	62.60%	85.83%	82.17%
Mobile phone text messaging (e.g. SMS, MMS)	13.22%	27.42%	31.97%	31.71%
Use of sirens, signal balls, flags, etc?	4.20%	14.78%	11.40%	14.91%
Through meetings or briefings (in person, conference call or teleconference call)	47.93%	65.85%	76.19%	72.58%
Other (please specify):	32.00%	48.98%	55.10%	58.00%

Table 2. Dissemination Methods and Target Audiences in Africa

Hazard	Historical Data Archives	Real-Time Monitoring	Forecasts And Outlooks	Early Warnings
Head of the Government?	43.48%	47.62%	80.00%	77.78%
Ministry that oversees the National Meteorological and Hydrological Service?	69.23%	79.17%	96.00%	91.67%
Other Ministries?	72.00%	66.67%	96.00%	87.50%
Head of the National Committee for Disaster Risk Reduction	54.17%	62.50%	78.26%	76.19%
Emergency response services? (i.e. hospitals, police, fire department)	28.00%	43.48%	54.17%	54.55%
General public?	57.69%	69.57%	100.00%	95.83%
News media?	62.96%	72.00%	100.00%	96.00%
Businesses?	50.00%	47.62%	79.17%	68.18%
WMO Regional Specialized Meteorological Centre(s)?	36.00%	45.83%	43.48%	42.86%
The United Nations Country Coordinator (UNDP)?	26.09%	21.05%	26.32%	30.00%
National Red Cross and Red Crescent Societies	19.05%	29.41%	33.33%	36.84%
Other organizations with interest in disaster prevention and mitigation (i.e., development banks, NGOs, academia)?	43.48%	40.00%	52.63%	50.00%
Internet based data (e.g. FTP downloads)	21.05%	27.78%	57.89%	52.94%
Sent to the recipient on recorded media (i.e. CD, video tape, or DVD)	13.64%	13.04%	22.73%	22.73%
Hard copy mailings	39.13%	45.45%	58.33%	56.52%
Posted on a web page	26.09%	31.82%	65.22%	50.00%
By facsimile	50.00%	56.52%	75.00%	69.57%
Mobile phone text messaging (e.g. SMS, MMS)	8.70%	17.39%	19.05%	22.73%
Use of sirens, signal balls, flags, etc?	0.00%	9.09%	0.00%	0.00%
Through meetings or briefings (in person, conference call or teleconference call)	45.83%	70.83%	76.00%	75.00%
Other (please specify):	37.50%	37.50%	57.14%	50.00%

Table 3. Dissemination Methods and Target Audiences in Asia.

Hazard	Historical Data Archives	Real-Time Monitoring	Forecasts And Outlooks	Early Warnings
Head of the Government?	57.89%	65.00%	86.36%	86.36%
Ministry that oversees the National Meteorological and Hydrological Service?	63.64%	76.19%	91.67%	95.65%
Other Ministries?	71.43%	71.43%	95.83%	100.00%
Head of the National Committee for Disaster Risk Reduction	66.67%	63.64%	82.61%	82.61%
Emergency response services? (i.e. hospitals, police, fire department)	57.89%	55.00%	86.36%	86.36%
General public?	59.09%	60.00%	91.67%	95.45%
News media?	57.14%	59.09%	91.67%	95.65%
Businesses?	50.00%	40.00%	59.09%	55.00%
WMO Regional Specialized Meteorological Centre(s)?	60.00%	47.37%	61.90%	61.90%
The United Nations Country Coordinator (UNDP)?	30.00%	26.32%	36.36%	33.33%
National Red Cross and Red Crescent Societies	30.00%	21.05%	33.33%	33.33%
Other organizations with interest in disaster prevention and mitigation (i.e., development banks, NGOs, academia)?	23.81%	30.00%	39.13%	36.36%
Internet based data (e.g. FTP downloads)	47.62%	57.89%	80.95%	80.00%
Sent to the recipient on recorded media (i.e. CD, video tape, or DVD)	50.00%	22.22%	26.32%	31.58%
Hard copy mailings	54.55%	33.33%	56.52%	56.52%
Posted on a web page	50.00%	66.67%	91.67%	87.50%
By facsimile	50.00%	73.91%	91.67%	95.83%
Mobile phone text messaging (e.g. SMS, MMS)	14.29%	31.82%	45.45%	40.91%
Use of sirens, signal balls, flags, etc?	14.29%	31.82%	36.36%	27.27%
Through meetings or briefings (in person, conference call or teleconference call)	36.36%	45.45%	72.73%	60.87%
Other (please specify):	18.18%	41.67%	50.00%	54.55%

Table 4. Dissemination Systems and Target Audiences in South America.

Hazard	Historical Data Archives	Real-Time Monitoring	Forecasts And Outlooks	Early Warnings
Head of the Government?	50.00%	80.00%	90.00%	90.00%
Ministry that oversees the National Meteorological and Hydrological Service?	70.00%	80.00%	80.00%	90.00%
Other Ministries?	70.00%	77.78%	80.00%	90.00%
Head of the National Committee for Disaster Risk Reduction	70.00%	90.00%	100.00%	100.00%
Emergency response services? (i.e. hospitals, police, fire department)	70.00%	70.00%	80.00%	88.89%
General public?	70.00%	90.00%	100.00%	100.00%
News media?	60.00%	80.00%	100.00%	100.00%
Businesses?	30.00%	44.44%	50.00%	40.00%
WMO Regional Specialized Meteorological Centre(s)?	30.00%	37.50%	44.44%	44.44%
The United Nations Country Coordinator (UNDP)?	0.00%	11.11%	11.11%	11.11%
National Red Cross and Red Crescent Societies	10.00%	11.11%	22.22%	22.22%
Other organizations with interest in disaster prevention and mitigation (i.e., development banks, NGOs, academia)?	20.00%	22.22%	33.33%	33.33%
Internet based data (e.g. FTP downloads)	55.56%	66.67%	77.78%	77.78%
Sent to the recipient on recorded media (i.e. CD, video tape, or DVD)	40.00%	11.11%	11.11%	11.11%
Hard copy mailings	10.00%	11.11%	11.11%	0.00%
Posted on a web page	55.56%	66.67%	100.00%	100.00%
By facsimile	55.56%	50.00%	100.00%	90.00%
Mobile phone text messaging (e.g. SMS, MMS)	0.00%	10.00%	10.00%	20.00%
Use of sirens, signal balls, flags, etc?	0.00%	0.00%	0.00%	0.00%
Through meetings or briefings (in person, conference call or teleconference call)	30.00%	40.00%	60.00%	55.56%
Other (please specify):	20.00%	40.00%	60.00%	60.00%

Table 5. Dissemination Systems and Target Audiences in North and Central America and the Caribbean.

Hazard	Historical Data Archives	Real-Time Monitoring	Forecasts And Outlooks	Early Warnings
Head of the Government?	62.50%	87.50%	94.12%	94.12%
Ministry that oversees the National Meteorological and Hydrological Service?	71.43%	85.71%	100.00%	93.33%
Other Ministries?	85.71%	80.00%	93.33%	100.00%
Head of the National Committee for Disaster Risk Reduction	87.50%	93.75%	100.00%	94.12%
Emergency response services? (i.e. hospitals, police, fire department)	66.67%	81.25%	88.24%	82.35%
General public?	80.00%	100.00%	100.00%	100.00%
News media?	73.33%	93.33%	100.00%	100.00%
Businesses?	73.33%	73.33%	100.00%	100.00%
WMO Regional Specialized Meteorological Centre(s)?	60.00%	75.00%	60.00%	42.86%
The United Nations Country Coordinator (UNDP)?	35.71%	35.71%	47.06%	40.00%
National Red Cross and Red Crescent Societies	46.67%	64.29%	64.71%	82.35%
Other organizations with interest in disaster prevention and mitigation (i.e., development banks, NGOs, academia)?	81.25%	64.29%	87.50%	93.75%
Internet based data (e.g. FTP downloads)	50.00%	61.54%	78.57%	76.92%
Sent to the recipient on recorded media (i.e. CD, video tape, or DVD)	53.33%	30.77%	35.71%	33.33%
Hard copy mailings	61.54%	42.86%	71.43%	64.29%
Posted on a web page	62.50%	81.25%	94.12%	93.75%
By facsimile	68.75%	73.33%	93.75%	94.12%
Mobile phone text messaging (e.g. SMS, MMS)	0.00%	26.67%	26.67%	26.67%
Use of sirens, signal balls, flags, etc?	0.00%	21.43%	13.33%	35.71%
Through meetings or briefings (in person, conference call or teleconference call)	71.43%	100.00%	100.00%	100.00%
Other (please specify):	25.00%	42.86%	42.86%	55.56%

Table 6. Dissemination Systems and Target Audiences in the South West Pacific.

Hazard	Historical Data Archives	Real-Time Monitoring	Forecasts And Outlooks	Early Warnings
Head of the Government?	69.23%	71.43%	78.57%	78.57%
Ministry that oversees the National Meteorological and Hydrological Service?	71.43%	78.57%	71.43%	71.43%
Other Ministries?	71.43%	78.57%	85.71%	85.71%
Head of the National Committee for Disaster Risk Reduction	71.43%	85.71%	85.71%	85.71%
Emergency response services? (i.e. hospitals, police, fire department)	71.43%	85.71%	100.00%	100.00%
General public?	69.23%	100.00%	100.00%	100.00%
News media?	71.43%	100.00%	100.00%	100.00%
Businesses?	64.29%	92.86%	85.71%	85.71%
WMO Regional Specialized Meteorological Centre(s)?	78.57%	85.71%	71.43%	78.57%
The United Nations Country Coordinator (UNDP)?	28.57%	28.57%	28.57%	35.71%
National Red Cross and Red Crescent Societies	42.86%	50.00%	50.00%	50.00%
Other organizations with interest in disaster prevention and mitigation (i.e., development banks, NGOs, academia)?	57.14%	71.43%	78.57%	71.43%
Internet based data (e.g. FTP downloads)	50.00%	76.92%	78.57%	78.57%
Sent to the recipient on recorded media (i.e. CD, video tape, or DVD)	42.86%	28.57%	42.86%	30.77%
Hard copy mailings	53.85%	46.15%	50.00%	38.46%
Posted on a web page	50.00%	85.71%	85.71%	85.71%
By facsimile	53.85%	78.57%	85.71%	85.71%
Mobile phone text messaging (e.g. SMS, MMS)	14.29%	28.57%	28.57%	35.71%
Use of sirens, signal balls, flags, etc?	0.00%	15.38%	7.69%	23.08%
Through meetings or briefings (in person, conference call or teleconference call)	57.14%	92.86%	85.71%	92.86%
Other (please specify):	50.00%	50.00%	50.00%	50.00%

Table 7. Dissemination Systems and Target Audiences in Europe.

Hazard	Historical Data Archives	Real-Time Monitoring	Forecasts And Outlooks	Early Warnings
Head of the Government?	32.35%	54.84%	62.86%	66.67%
Ministry that oversees the National Meteorological and Hydrological Service?	56.41%	64.10%	72.50%	76.92%
Other Ministries?	57.89%	72.97%	74.36%	82.50%
Head of the National Committee for Disaster Risk Reduction	33.33%	54.55%	57.58%	60.61%
Emergency response services? (i.e. hospitals, police, fire department)	45.95%	75.68%	83.78%	81.08%
General public?	55.56%	82.05%	97.56%	92.50%
News media?	62.86%	82.05%	97.67%	97.50%
Businesses?	40.54%	54.05%	68.42%	59.46%
WMO Regional Specialized Meteorological Centre(s)?	23.68%	31.58%	32.43%	28.95%
The United Nations Country Coordinator (UNDP)?	5.26%	5.41%	5.71%	5.56%
National Red Cross and Red Crescent Societies	8.33%	13.89%	14.29%	15.15%
Other organizations with interest in disaster prevention and mitigation (i.e., development banks, NGOs, academia)?	34.21%	22.22%	27.78%	22.86%
Internet based data (e.g. FTP downloads)	40.00%	55.56%	61.11%	61.76%
Sent to the recipient on recorded media (i.e. CD, video tape, or DVD)	37.84%	22.86%	25.71%	22.86%
Hard copy mailings	44.74%	42.86%	52.78%	47.22%
Posted on a web page	47.37%	82.05%	92.68%	85.37%
By facsimile	48.65%	52.63%	82.50%	73.17%
Mobile phone text messaging (e.g. SMS, MMS)	23.68%	35.00%	40.00%	35.00%
Use of sirens, signal balls, flags, etc?	5.41%	8.82%	6.06%	8.82%
Through meetings or briefings (in person, conference call or teleconference call)	48.65%	57.89%	68.42%	64.10%
Other (please specify):	41.67%	72.73%	66.67%	72.73%

Table 8. Dissemination Systems and Target Audiences in Developing Countries.

Hazard	Historical Data Archives	Real-Time Monitoring	Forecasts And Outlooks	Early Warnings
Head of the Government?	55.56%	75.93%	89.09%	86.79%
Ministry that oversees the National Meteorological and Hydrological Service?	66.67%	83.33%	92.86%	90.91%
Other Ministries?	71.43%	72.22%	92.86%	92.73%
Head of the National Committee for Disaster Risk Reduction	63.16%	78.95%	91.07%	88.89%
Emergency response services? (i.e. hospitals, police, fire department)	50.91%	61.82%	78.95%	77.78%
General public?	66.67%	78.18%	98.28%	96.43%
News media?	64.91%	75.44%	98.28%	96.43%
Businesses?	56.14%	57.41%	77.19%	68.52%
WMO Regional Specialized Meteorological Centre(s)?	46.43%	50.00%	53.85%	50.00%
The United Nations Country Coordinator (UNDP)?	25.45%	26.00%	30.77%	29.41%
National Red Cross and Red Crescent Societies	27.27%	36.00%	38.46%	44.23%
Other organizations with interest in disaster prevention and mitigation (i.e., development banks, NGOs, academia)?	44.64%	40.00%	52.94%	50.98%
Internet based data (e.g. FTP downloads)	43.14%	52.00%	72.00%	69.39%
Sent to the recipient on recorded media (i.e. CD, video tape, or DVD)	39.29%	14.00%	20.41%	18.75%
Hard copy mailings	45.45%	32.69%	50.00%	47.17%
Posted on a web page	53.57%	64.91%	91.07%	83.93%
By facsimile	55.17%	60.34%	89.29%	86.21%
Mobile phone text messaging (e.g. SMS, MMS)	7.41%	25.00%	29.63%	31.48%
Use of sirens, signal balls, flags, etc?	3.70%	18.87%	17.31%	19.23%
Through meetings or briefings (in person, conference call or teleconference call)	50.00%	69.64%	82.46%	76.36%
Other (please specify):	22.22%	38.46%	48.00%	51.85%

Table 9. Dissemination Systems and Target Audiences in Least Developed Countries.

Hazard	Historical Data Archives	Real-Time Monitoring	Forecasts And Outlooks	Early Warnings
Head of the Government?	50.00%	50.00%	77.78%	78.95%
Ministry that oversees the National Meteorological and Hydrological Service?	77.27%	80.00%	91.30%	95.45%
Other Ministries?	85.71%	75.00%	95.45%	95.45%
Head of the National Committee for Disaster Risk Reduction	80.95%	75.00%	90.91%	90.91%
Emergency response services? (i.e. hospitals, police, fire department)	47.62%	52.63%	68.42%	70.00%
General public?	63.64%	85.71%	95.65%	100.00%
News media?	65.22%	85.71%	95.65%	100.00%
Businesses?	47.37%	58.82%	73.68%	73.68%
WMO Regional Specialized Meteorological Centre(s)?	66.67%	71.43%	60.00%	60.00%
The United Nations Country Coordinator (UNDP)?	36.84%	35.29%	42.11%	50.00%
National Red Cross and Red Crescent Societies	44.44%	37.50%	50.00%	55.00%
Other organizations with interest in disaster prevention and mitigation (i.e., development banks, NGOs, academia)?	52.38%	57.89%	65.00%	71.43%
Internet based data (e.g. FTP downloads)	44.44%	50.00%	57.89%	58.82%
Sent to the recipient on recorded media (i.e. CD, video tape, or DVD)	26.32%	31.58%	40.00%	40.00%
Hard copy mailings	52.63%	55.00%	61.90%	60.00%
Posted on a web page	38.10%	45.00%	61.90%	57.14%
By facsimile	68.42%	75.00%	68.18%	72.73%
Mobile phone text messaging (e.g. SMS, MMS)	19.05%	25.00%	30.00%	28.57%
Use of sirens, signal balls, flags, etc?	5.00%	15.00%	10.00%	10.00%
Through meetings or briefings (in person, conference call or teleconference call)	50.00%	61.90%	72.73%	72.73%
Other (please specify):	60.00%	63.64%	72.73%	72.73%

Table 10. Dissemination Systems and Target Audiences in Small Island Developing States.

Hazard	Historical Data Archives	Real-Time Monitoring	Forecasts And Outlooks	Early Warnings
Head of the Government?	76.47%	75.00%	94.12%	94.44%
Ministry that oversees the National Meteorological and Hydrological Service?	88.24%	86.67%	94.12%	94.12%
Other Ministries?	93.75%	68.75%	93.75%	88.24%
Head of the National Committee for Disaster Risk Reduction	88.24%	87.50%	94.44%	94.44%
Emergency response services? (i.e. hospitals, police, fire department)	58.82%	56.25%	75.00%	76.47%
General public?	81.25%	100.00%	100.00%	100.00%
News media?	82.35%	100.00%	100.00%	100.00%
Businesses?	70.59%	81.25%	94.12%	94.44%
WMO Regional Specialized Meteorological Centre(s)?	68.75%	70.59%	60.00%	58.82%
The United Nations Country Coordinator (UNDP)?	41.18%	33.33%	44.44%	50.00%
National Red Cross and Red Crescent Societies	41.18%	46.67%	47.06%	66.67%
Other organizations with interest in disaster prevention and mitigation (i.e., development banks, NGOs, academia)?	76.47%	62.50%	75.00%	83.33%
Internet based data (e.g. FTP downloads)	50.00%	53.33%	68.75%	68.75%
Sent to the recipient on recorded media (i.e. CD, video tape, or DVD)	37.50%	20.00%	43.75%	40.00%
Hard copy mailings	75.00%	56.25%	75.00%	68.75%
Posted on a web page	41.18%	58.82%	76.47%	76.47%
By facsimile	75.00%	64.71%	76.47%	83.33%
Mobile phone text messaging (e.g. SMS, MMS)	5.88%	18.75%	11.76%	17.65%
Use of sirens, signal balls, flags, etc?	0.00%	6.25%	0.00%	12.50%
Through meetings or briefings (in person, conference call or teleconference call)	70.59%	82.35%	88.24%	88.24%
Other (please specify):	40.00%	40.00%	40.00%	40.00%

Table 11. Dissemination Systems and Target Audiences in Developed Countries.

Hazard	Historical Data Archives	Real-Time Monitoring	Forecasts And Outlooks	Early Warnings
Head of the Government?	40.00%	47.37%	47.62%	45.00%
Ministry that oversees the National Meteorological and Hydrological Service?	54.55%	52.38%	56.52%	61.90%
Other Ministries?	66.67%	75.00%	73.91%	81.82%
Head of the National Committee for Disaster Risk Reduction	42.11%	47.37%	50.00%	52.63%
Emergency response services? (i.e. hospitals, police, fire department)	52.38%	85.00%	85.71%	85.00%
General public?	65.00%	86.36%	95.83%	90.91%
News media?	68.42%	85.71%	96.00%	95.24%
Businesses?	42.86%	61.90%	66.67%	60.00%
WMO Regional Specialized Meteorological Centre(s)?	28.57%	40.00%	45.00%	30.00%
The United Nations Country Coordinator (UNDP)?	4.76%	5.26%	10.00%	5.26%
National Red Cross and Red Crescent Societies	10.00%	21.05%	20.00%	16.67%
Other organizations with interest in disaster prevention and mitigation (i.e., development banks, NGOs, academia)?	28.57%	26.32%	20.00%	16.67%
Internet based data (e.g. FTP downloads)	68.42%	73.68%	73.68%	76.47%
Sent to the recipient on recorded media (i.e. CD, video tape, or DVD)	50.00%	27.78%	31.58%	22.22%
Hard copy mailings	40.00%	27.78%	33.33%	27.78%
Posted on a web page	70.00%	90.00%	90.91%	86.36%
By facsimile	40.00%	60.00%	77.27%	66.67%
Mobile phone text messaging (e.g. SMS, MMS)	25.00%	45.00%	55.00%	50.00%
Use of sirens, signal balls, flags, etc?	10.53%	23.53%	5.88%	18.75%
Through meetings or briefings (in person, conference call or teleconference call)	55.00%	68.42%	75.00%	68.42%
Other (please specify):	37.50%	71.43%	62.50%	71.43%

For more information about this publication, please contact:
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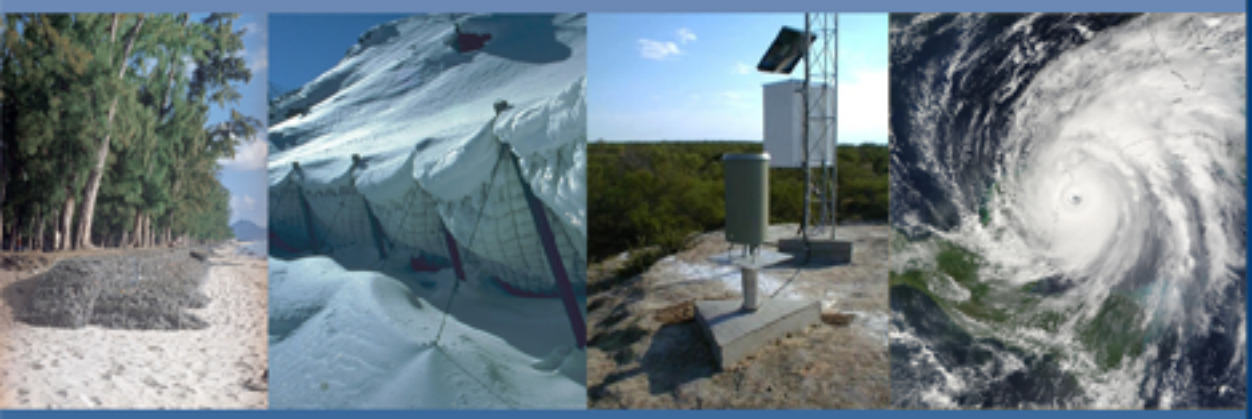

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