WMO Capacity Development Strategy and Implementation Plan

World Meteorological Organization
Weather • Climate • Water

WMO-No. 1133

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2015

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ISBN 978-92-63-11133-3

Cover illustration: Henry Simpson, Liberia Meteorological Service

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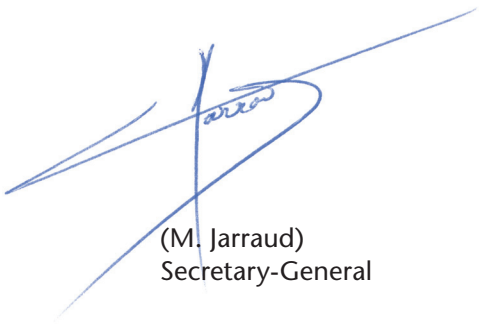
FOREWORD

With the increasing recognition of the essential role of National Meteorological and Hydrological Services (NMHSs) in the provision of weather, water and climate services that contribute to the safety and well-being of society, and in view of the still considerable technological gap between developed and developing countries, the World Meteorological Congress at its sixteenth session emphasized the need to develop efficient and effective ways of strengthening the capacities of WMO Members to provide weather, water and climate services that satisfy the needs of all users. Congress requested the Executive Council to establish a Capacity Development Strategy to ensure, in a holistic way, that all actors in meteorology, hydrology and climatology work towards the same overall objective: facilitating sustainable development of NMHSs.

The resulting Strategy, intended to guide WMO capacity development activities starting in the sixteenth financial period (2012–2015), was born of a systematic study of the processes that had been successfully employed to strengthen NMHSs and of the support provided by WMO, through its Members, Programmes and constituent bodies. The Capacity Development Strategy of WMO and its Implementation Plan was designed to assist all Members, especially least developed countries and small island developing States.

Sustainable growth requires that the Strategy captured in this publication continue in future periods and that the principles be applied more broadly. The specific activities will evolve to fit national, regional and global priorities; however, the Objectives of the Strategy will likely serve as the basis of action for years to come.

On behalf of WMO, I therefore wish to thank all those who made this publication possible.



(M. Jarraud)
Secretary-General

EXECUTIVE SUMMARY

The Capacity Development Strategy (CDS), as approved by the Executive Council at its sixty-fourth session, manifests the holistic nature of capacity development. On the basis of the criteria laid down by the Sixteenth Congress and the sixty-third and sixty-fourth sessions of the Executive Council, a strategic framework was developed to ensure that a range of relevant considerations was factored in the CDS and, subsequently, the Capacity Development Strategy Implementation Plan (CDSIP). An analysis of how the World Meteorological Organization (WMO) can best help National Meteorological and Hydrological Services (NMHSs) develop and sustain their activities led to the formulation of the six strategic objectives of the CDS:

Strategic Objective 1: Define required capacities and identify deficiencies
Strategic Objective 2: Increase visibility and national ownership
Strategic Objective 3: Optimize knowledge management
Strategic Objective 4: Reinforce resource mobilization and project management
Strategic Objective 5: Strengthen global, regional and subregional mechanisms
Strategic Objective 6: Increase education and research opportunities

The CDS is expected to serve as a basis for action beyond the sixteenth financial period, while the CDSIP for 2012–2015 seeks to identify activities that during this period contribute to the accomplishment of the CDS strategic objectives.

As a standard-setting organization, WMO provides the framework for international cooperation in weather, water and climate. By promoting the establishment of standards for the measurement of geophysical observations and the processing and standardization of related data, WMO helps NMHSs to build their services, cooperate with their neighbours and contribute to global efforts.

The CDS lays emphasis on communicating WMO technical requirements and on assisting Members in translating them into national, regional and global priorities and actions. Over the last two decades, this emphasis has been somewhat muted as new technologies and rapidly changing methods of data collection and exchange have rendered many WMO requirements obsolete or incomplete. During the 2012–2015 financial period, those standards and requirements should be brought up to date and promulgated, and relevant manuals amended. Emphasis must be placed on the need for compliance to create what has been called a "culture of compliance". In parallel, reports by NMHSs on their conformance to those requirements should be collected and used to establish baselines and identify gaps at national, regional and global levels. This information should be used in the formulation of WMO assistance to Members in the development of their NMHS.

This focus on compliance will further collaboration between NMHSs and advance the application of meteorology to public weather services, agriculture, aviation, shipping, the environment, water issues and mitigation of the impacts of natural disasters.

Foundational activities for future action are paramount for this financial period. For example, tools to communicate both what NMHSs need and what WMO has to assist them should be improved. Baseline information on national capabilities should be gathered and the role of WMO bodies that contribute to those capabilities should be clarified. Once the required mechanisms in these areas have been established, they should serve to further elucidate priorities for future plans and contribute to the development of future WMO Strategic and Operating Plans.

Section 2.4.1 of the CDSIP identifies CDS key activities and priority areas for 2012–2015 relating to each of the six strategic objectives.

The CDS lays emphasis on assisting NMHSs in engaging with national stakeholders. This engagement should foster mutual understanding and yield prioritized requirements that justify investment in capacity while building national ownership, strengthening the NMHS service orientation and emphasizing the socioeconomic contributions of NMHSs.

1. WMO CAPACITY DEVELOPMENT STRATEGY

1.1 INTRODUCTION

The need for WMO capacity development assistance is grounded in the Convention of the World Meteorological Organization (WMO), which recognizes that Members need to work with each other and with other organizations to coordinate, standardize, improve and encourage efficiencies in the exchange of information to further its application to the needs of society. The Convention further notes the vital mission of National Meteorological and Hydrological Services (NMHSs) in the provision of weather, climate and water observations and services, and their contributions in addressing societal needs. The World Meteorological Organization implements its Programmes through the NMHSs of its Members and utilizes the capabilities of NMHSs to provide effective services for the safety and well-being of society. The scope of the services provided by NMHSs has increased as the need for environmental information has grown. The increasing vulnerability of many societies to natural hazards and extreme weather events, and the sensitivity of national economies to climate variability and change have exposed gaps in the capabilities of NMHSs, particularly those of developing countries, least developed countries (LDCs) and small island developing States (SIDSs). The Sixteenth World Meteorological Congress considered that the collaborative work of WMO depends on observations and technical contributions from the NMHSs of developing and developed countries alike. Therefore, assisting the NMHSs in developing countries to fill these gaps is necessary to the work of WMO and benefits all WMO Members.

The World Meteorological Congress at its sixteenth session adopted the WMO Strategic Plan 2012–2015, which recognizes capacity-building for the developing and least developed countries as one of the five strategic priority areas expected to make a significant contribution to the achievement of the expected results. To further elaborate on how capacity-building as a cross-cutting priority will be addressed and in light of the factors discussed above, the Sixteenth Congress adopted Resolution 49 (Cg-XVI) – WMO Strategy for Capacity Development.

The purpose of the Capacity Development Strategy (CDS) is to provide WMO with a coordinated and cohesive approach to capacity development activities to help Members fulfil their mandates and contribute to the goals of the Organization. The overall objective of the CDS is to foster effective capacity development assistance to WMO Members and facilitate sustainable development of their National Meteorological and Hydrological Services (NMHSs), particularly in developing countries, LDCs and SIDS. The CDS seeks to build upon existing capacities in NMHSs, reduce duplication and utilize opportunities to leverage investments in strategic partnerships and synergies. It also aims to integrate the roles and requirements of regional associations, technical commissions, WMO co-sponsored programmes and WMO Programmes within the strategic priority areas in the provision of development assistance to Members.

The CDS requires a collaborative approach to what is a common goal. However, particular emphasis is laid on the role of national governments, especially in planning and sustaining the capabilities of NMHSs, in partnership with the regional and global community. The importance of NMHSs for public safety, security, national development and general socioeconomic benefits flowing from weather, climate and hydrological services is also emphasized. Correspondingly, the CDS is designed to have its greatest impact at country level. The Organization's facilitative role will focus on strengthening NMHSs, enhancing subregional, regional and global cooperation while providing a framework for NMHSs to advocate services that further national policies, strategies and plans.

A distinction is made between "capacity-building" and "capacity development". The former implies that no capacity exists, while the latter considers existing capacities with an emphasis on a more holistic approach and national ownership of the development process. By using the term "capacity development", WMO acknowledges that its assistance to NMHSs must be informed by existing and planned capacities. For detailed information, see Annex 1: Definitions.

The CDS recognizes that there are four types of capacity: institutional, infrastructural, procedural and human resources. These four dimensions are distinct yet interrelated and must be considered holistically to achieve sustainable capacity development. The CDS also recognizes that WMO capacity development activities should be monitored and results evaluated for sustainability over time.

1.2 STRATEGY

1.2.1 Vision and mission

Capacity development vision
Stronger NMHSs to meet society's need for information on weather, climate and water for the safety and well-being of people throughout the world.

Capacity development mission
To facilitate a holistic and integrated approach to sustainable capacity development of NMHSs, especially in developing countries, LDCs and SIDSs, through advocacy, education and training, outreach, partnerships and resource mobilization, demonstration and pilot projects, service delivery and research.

1.2.2 Strategic objectives and strategic approaches

Objective 1:
Define required capacities and identify deficiencies

An accurate understanding of the required capacities will help formulate appropriate capacity development responses, prioritize investments and mobilize resources. Baseline information is vital for the monitoring and evaluation of capacity development activities and for continuous improvement of operations. Requirements and deficiencies will be inferred from information relating to the compliance of NMHSs with WMO standards and the service needs of different stakeholders, end users and society as a whole. In Objective 1, emphasis will be placed on guidance for defining requirements, training in service delivery/stakeholder relations, compliance with WMO standards, clarification of institutional relationships and identification of deficiencies in the delivery, use and impact of weather, climate and hydrological services.

Strategic approaches:

1.A: Emphasize compliance with WMO technical requirements to address priorities
1.B: Assist countries in identifying deficiencies of NMHSs
1.C: Encourage development of services to address specific user needs
1.D: Establish modalities for engaging partners and stakeholders

Objective 2:
Increase visibility and national ownership

The enabling environment needed to ensure sustainable development of NMHSs depends on national ownership. The CDS will foster closer cooperation between government ministries and departments in charge of NMHSs and those sections of government responsible for setting national priorities, in order to secure political buy-in and goodwill towards NMHSs. Through these efforts, Members will recognize the national and international significance of investing in NMHSs, as part of the development priorities reflected in their National Development Plans (NDPs) and Poverty Reduction Strategy Papers, and, in essence, demonstrate the ownership and commitment needed for sustainable development of the NMHSs.

Socioeconomic benefits will be emphasized so that NMHSs engage in a strong and long-term partnership with their governments thus securing national ownership based on requirements, benefits and deficiencies. This is particularly important given current trends in development financing, which lay emphasis on alignment with the priorities of governments as reflected in NDPs or National Poverty Reduction Strategy Papers, to attract domestic and external funding.

Coordination amongst partners will be strengthened to avoid duplication and foster the sharing of resources. This coordination is needed to develop, mobilize and harmonize investments for the capacity development of NMHSs of Members. In-country engagement of NMHSs with stakeholders will be seen as part of a wider process of strategic management and an integral part of developing capacity through clear institutional arrangements, roles and responsibilities, and national ownership.

Strategic approaches:

- 2.A: Explain to decisionmakers the socioeconomic benefits of services provided by NMHSs
- 2.B: Assist NMHSs in incorporating national and international requirements into national policy, legislative frameworks and national development plans
- 2.C: Enhance outreach to end users and decisionmakers
- 2.D: Develop leadership and management capacities
- 2.E: Reinforce national support to meet societal needs for weather, climate and hydrology services

Objective 3:
Optimize knowledge management

Knowledge management serves to improve activities across the CDS and is essential for defining requirements, needs, gaps and priorities. Knowledge management will ensure the continuous renewal of information, best practices and shared skills across WMO. This Objective will involve the creation of supportive organizational structures through information and communication technologies (ICTs), with emphasis on teamwork and dissemination of knowledge that can assist in capacity development. Strategic Objective 3 will optimize knowledge management and foster sharing of the experiences and resources of NMHSs through regional associations, in partnership with regional bodies and entities. The use of ICTs will enable effective collaborative approaches, real-time information sharing, monitoring and feedback. Encouraging communities of practice will complement ICTs, as human interaction is essential for knowledge management. The sharing of needed skills and information will include the use of volunteers and third-party contributions.

Strategic approaches:

- 3.A: Enhance mechanisms for collecting and sharing up-to-date information relating to the development of NMHSs
- 3.B: Share best practices and success stories relating to the development of NMHSs
- 3.C: Enhance communities of practice dealing with the development of NMHSs

Objective 4:
Reinforce resource mobilization and project management

Weather, climate and hydrological services are becoming core issues of development in many developing countries and funding mechanisms are showing an increased interest in investing in those services. Resource mobilization and project management assistance will be provided to developing countries to build their NMHSs. The development of a stronger regional approach will facilitate the implementation of capacity development activities. The institutional arrangements that enable the implementation of capacity development projects and programmes will also be strengthened. Human resources will be enhanced to better interact with development agencies. Voluntary cooperation and bilateral assistance will also be facilitated and encouraged.

Strategic approaches:

- 4.A: Enhance coordination, actively explore new funding opportunities and develop proposals through dialogue with stakeholders and development partners
- 4.B: Enhance capacity to develop, implement, monitor and evaluate projects
- 4.C: Encourage innovative voluntary and bilateral cooperation

Objective 5:
Strengthen global, regional and subregional mechanisms

Global, regional and subregional mechanisms are critical to the work of NMHSs. The global and regional centres of WMO, which already provide assistance and guidance in technical areas, operational data exchange and training, need to be strengthened to better support NMHSs in line with the Organization's priorities. In addition, WMO engagement through political and scientific mechanisms and initiatives will draw attention to the capacities needed to deliver the required services.

Strategic approaches:

- 5.A: Strengthen the work of global and regional centres
- 5.B: Strengthen global, regional and subregional mechanisms to provide support for weather, climate and hydrological services

Objective 6:
Increase education and research opportunities

Skilled individuals with competencies relevant to service delivery are essential to the operation of NMHSs. Education and research are long-term activities that build the foundation for products and services. The WMO Fellowship Programme provides important basic education for current and future employees of NMHSs in developing countries, LDCs and SIDSs, based on the most recent developments in science and technology of relevance to NMHSs.

Strategic approaches:

- 6.A: Improve access to and provision of fellowships
- 6.B: Strengthen application of research findings

2. CAPACITY DEVELOPMENT STRATEGY IMPLEMENTATION PLAN

2.1 INTRODUCTION

The purpose of this document is to provide the World Meteorological Organization (WMO), through its Congress and Executive Council, with an Implementation Plan to support its Capacity Development Strategy (CDS). The Plan defines a coordinated and cohesive approach to capacity development activities, which WMO should adopt in helping Members to fulfil their mandates.

The roles of WMO constituent bodies as well as those of WMO Members in implementing the CDS are discussed here to further cultivate a collaborative approach to what is a common goal, unattainable without the efforts of all. The CDS aims to ensure that WMO capacity development activities are scalable, that capacity development investments are monitored and results evaluated for sustainability over time. This Implementation Plan is bound to the WMO Strategic and Operating Plans 2012–2015 and is thus developed for a four-year period, whereas the Capacity Development Strategy itself could eventually span several planning periods.

In most cases, capacities do exist. In exceptional circumstances, however, such as in countries emerging from conflict or major natural disasters, capacity building is a more appropriate approach. For concrete examples of how WMO assists in capacity development, see Annex 2: Case studies.

2.2 STRATEGIC FRAMEWORK

An analysis of WMO assistance to NMHSs resulted in the identification of a number of issues, which led to the formulation of the strategic objectives and strategic approaches described above.

The strategic objectives and strategic approaches, together with the identified activities and associated implementation plans, are expected to create an enabling environment, which will ensure that capacities are sustainable and retained over time.

Each of the strategic objectives corresponds to one or more of the eight steps of the capacity development process and deals with the identified issues (see Annex 3: The capacity development process and dimensions, and the quality management approach, for more information).

The strategic approaches will show how the capacity development objectives described above can be achieved. The strategic mechanism builds upon the following aspects of capacity development (see Figure 1 below):

- The eight-step capacity development process**,** adapted from the five-step approach of the United Nations Development Programme and others, to better reflect the steps required for development of NMHSs;

- The four dimensions of capacity development: human, institutional, infrastructural and procedural;

- The WMO Strategic and Operating Plans 2012–2015 (SOPs);

- The WMO Programmes;

- The complementing roles of WMO constituent bodies, Secretariat, Members and partners in capacity development;

- The quality management system (QMS) – a set of interrelated or interacting elements that organizations use to direct and control how quality policies are implemented and quality objectives are achieved;

- The WMO Strategy for Service Delivery, which seeks to build and institutionalize practices to strengthen service delivery by describing key strategy elements and activities.

Figure 1. The CDS strategic framework

2.3 CAPACITY BUILDING IN THE WMO STRATEGIC AND OPERATING PLANS 2012–2015

Capacity building is one of the strategic thrusts of the WMO Strategic and Operating Plans for 2012–2015. It is recognized as a cross-cutting activity that relates in many ways to the other thrusts and is found in all of the expected results of the WMO Strategic Plan. In addition, Expected Result 6: Enhanced capacities of NMHSs, in particular in developing and least developed countries, to fulfil their mandates, acknowledges that special attention must be paid to improving the capabilities of NMHSs in developing and least developed countries.

The Strategic Plan includes capacity building for the developing and least developed countries as one of the five strategic priority areas expected to make a significant contribution to the achievement of the expected results. For further information on this issue, see Annex 4: The Capacity Development Strategy and WMO priority areas.

2.4 IMPLEMENTATION PLAN

The implementation of the WMO Capacity Development Strategy features key activities supporting the 16 strategic approaches under the strategic objectives mentioned above. Section 2.4.1 describes the general implementation framework with key activities and summarizes the priorities for each strategic objective. Section 2.4.2 focuses on the role of WMO and its Members and section 2.4.3 describes the financing mechanisms available.

2.4.1 Key activities and priorities for 2012–2015

Capacity Development Strategy		
Strategic objectives	**Strategic approaches**	**Key activities**
Objective 1: Define required capacities and identify deficiencies	Priorities for 2012–2015	• Cultivate a culture of compliance – Update and clarify standards – Communicate updated standards and technical requirements, and NMHS responsibility to comply – Assist Members in reporting on their compliance (assessments, reporting tools, etc.) • Focus assistance to address the deficiencies of NMHSs in priority areas such as aviation, Global Framework for Climate Services (GFCS), WMO Integrated Global Observing System (WIGOS) and disaster risk reduction (DRR), especially for least developed countries (LDCs) and small island developing States (SIDSs) – Continue to assist NMHSs in completing their quality management system (QMS) so that they can become ISO certifiable, with the recommendation to become fully ISO certified – Support the implementation of competency assessments through provision of guidance, assessor training and, where necessary, targeted assistance through twinning and Secretariat support • Continue to assist NMHSs in building stakeholder confidence and service delivery vision
	1A: Emphasize compliance with WMO technical requirements to address priorities	• Clarify WMO standards, technical requirements, practices and priorities • Compile compliance reports • Organize training activities

Capacity Development Strategy		
Strategic objectives	**Strategic approaches**	**Key activities**
	1B: Assist countries in identifying deficiencies of NMHSs	• Organize stakeholder forums to guide national and regional requirement processes and show global interdependence • Organize national and regional events for users • Develop guidance material on the role and operation of NMHSs • Conduct country assessments and independent analyses and prepare reports of country assessments to establish baselines for monitoring and evaluation purposes • Promote transparency through information sharing leading to the development of requirement-driven strategies
	1C: Encourage development of services to address specific user needs	• Develop communication plans • Define new services and products to be delivered by NMHSs in accordance with the WMO Strategy for Service Delivery
	1D: Establish modalities for engaging partners and stakeholders	• Work with national partners and government entities to build a common vision for the use of environmental information to address societal needs • Organize meetings of national development partners and stakeholders • Share projects and requirements
Objective 2: Increase visibility and national ownership	Priorities for 2012–2015	• Emphasize NMHS responsibility to comply with WMO standards and technical requirements concerning the use of WMO guidance material to build national support • Use information gathered from the categorization of NMHS services, country profile databases and surveys to seek national support based on need – Fill gaps in observing system, institutional, human and procedural capacities • Continue and expand direct country assistance (advocacy, assessments, project formulation and strategic planning) • Continue assistance in the establishment of appropriate national legal and policy frameworks • Continue focus on services, risk mitigation and socioeconomic benefits to build national and partner support

Capacity Development Strategy		
Strategic objectives	**Strategic approaches**	**Key activities**
	2A: Explain to decisionmakers the socioeconomic benefits of services provided by NMHSs	• Develop an advocacy, outreach and communication strategy to approach government • Advocate inclusion of NMHSs in the national development planning process to secure buy-in and national funds for the development of NMHSs
	2B: Assist NMHSs in incorporating national and international requirements into national policy, legislative frameworks and national development plans	• Collect and disseminate examples of clear legislative and policy frameworks, best practices and case studies • Assist developing countries in clarifying national laws and procedures through consultation and training • Research and collect information on socioeconomic benefits • Assist NMHSs in the elaboration of their strategic plans to include the four dimensions of NMHS capacity development • Clarify national mandates and legislation concerning NMHSs for improved service delivery
	2C: Enhance outreach to end users and decisionmakers	Assist NMHSs, through workshops, training events and consultancies, in the development of services designed to meet user needs, with particular emphasis on public weather services, for increased visibility of NMHSs
	2D: Develop leadership and management capacities	• Enhance training to nurture leaders at various organizational levels of NMHSs • Develop a network of experts to assist NMHSs with management skills and strategic planning • Facilitate twinning arrangements
	2E: Reinforce national support to meet societal needs for weather, climate and hydrology services	• Categorize NMHSs according to the level of services provided and use these categories to guide assistance • Link the categories to the human, institutional, infrastructural and procedural capacities needed to provide the required levels of service (for information on NMHS categories, see Annex 5: Categorization of National Meteorological and Hydrological Services) • Tailor fellowships and training activities as well as technical assistance to tackle identified deficiencies and WMO priority areas
Objective 3: Optimize knowledge management	Priorities for 2012–2015	• Establish mechanisms for monitoring and gathering data on NMHS development (categories, country profile databases, surveys and national assessment missions) • Improve web-based tools to help Members access WMO requirements and guidelines, and to report/monitor progress

Capacity Development Strategy		
Strategic objectives	**Strategic approaches**	**Key activities**
	3A: Enhance mechanisms for collecting and sharing up-to-date information relating to the development of NMHSs	• Complete the development of a Country Profile Database • Develop coordinated information collection mechanisms, including surveys and online submissions from Members • Relevant monitoring and evaluation data on capacity development of NMHSs will be made available to stakeholders including partners and investors
	3B: Share best practices and success stories relating to the development of NMHSs	• Establish web-based and other mechanisms • Encourage Members to prepare specific examples of successes and challenges in developing the capacities of their NMHSs • Highlight lessons learned and principles that could be applied in other countries
	3C: Enhance communities of practice dealing with the development of NMHSs	Coordinate the work of informal groupings through communities of practice to provide assistance and insight, experience and knowledge with regard to global and regional initiatives for the development of NMHSs
Objective 4: Reinforce resource mobilization and project management	Priorities for 2012–2015	• Build a strong project oversight system within the Secretariat by setting up a Project Coordination Unit and a Project Oversight Board • Continue and increase resource mobilization and partnerships through a variety of activities • Use the need for NMHSs to comply with WMO requirements and technical standards to target assistance in advocacy, resource mobilization, technology transfer, training and research
	4A: Enhance coordination, actively explore new funding opportunities and develop proposals through dialogue with stakeholders and development partners	Develop mechanisms for sharing information on funding opportunities and facilitating access to donors
	4B: Enhance capacity to develop, implement, monitor and evaluate projects	• Create a project coordination system within the Secretariat to assist NMHSs in the development and coordination of large-scale projects • Develop a monitoring and evaluation toolkit and provide assistance and guidance in gathering data and information • Organize workshops and courses on project management

Capacity Development Strategy		
Strategic objectives	**Strategic approaches**	**Key activities**
	4C: Encourage innovative voluntary and bilateral cooperation	• Organize seminars and workshops to facilitate South-South cooperation • Promote cooperation between NMHSs and their official development assistance (ODA) agencies • Strengthen and expand the Voluntary Cooperation Programme • Encourage communities of interest such as informal planning meetings
Objective 5: Strengthen global, regional and subregional mechanisms	Priorities for 2012–2015	• Clarify roles of WMO bodies and regional centres in capacity development • Continue and expand direct country assistance (advocacy, assessments, project formulation and strategic planning) • Strengthen regional offices: increase the number of staff in Regions, with emphasis on building partnerships with regional economic groupings and regional organizations • Continue engagement at regional level with ministers responsible for meteorology and climate services
	5A: Strengthen the work of global and regional centres	• Deliver regional and subregional pilot projects and demonstrations with emphasis on the services that support regional issues and their link with WMO priorities and global systems • Assist NMHSs in reducing the high cost of observing system expendables and maintenance
	5B: Strengthen global, regional and subregional mechanisms to provide support for weather, climate and hydrological services	• Work with regional associations to build political support in the regions for the services provided by NMHSs • Build partnerships with subregional bodies and economic groupings • Strengthen the Regional Climate Outlook Forums (RCOFs) by providing training and workshops • Build on the successful African Ministerial Conference on Meteorology and other region-wide conferences for ministerial level officials to draw attention to the socioeconomic benefits of investing in NMHSs and the expanding services required of them • Enhance WMO advocacy of and support for NMHSs through collaborative arrangements with entities in the region whose mandates complement those of WMO

Capacity Development Strategy		
Strategic objectives	**Strategic approaches**	**Key activities**
Objective 6: Increase education and research opportunities	Priorities for 2012–2015	• Expand opportunities for developing countries to participate in research and share new findings for operational use • Maintain and expand education and fellowship opportunities especially in priority areas such as climate services, aviation forecasting and disaster risk reduction
	6A: Improve access to and provision of fellowships	• Provide fellowships and enhance fellowship opportunities by building partnerships with academic institutions and societies • Provide education and training advice to Regional Training Centres (RTCs)
	6B: Strengthen application of research findings	• Organize workshops and seminars to share information and findings • Organize training workshops on the application of new research findings for operational use

2.4.2 Role of WMO and its Members

WMO Secretariat

The role of the WMO Secretariat in the implementation of the CDS includes:

- Developing guidance material
  - Manuals and guides are prepared to assist NMHSs in their work. This material contains standards, technical information and practical advice on data collection and exchange, policies and practices as well as specific guidance on the role of the NMHSs. This guidance material is a reference for the establishment of requirements of NMHSs;
- Assisting with country assessments
  - The assistance of WMO experts, or the facilitation of experts from other NMHSs, in the assessment of capacities often provides the objectivity required by governments and donors in the preparation of strategic plans for the development of NMHSs;
- Collecting and disseminating best practices;
- Providing scientific context and input;
- Organizing education and training activities;
- Organizing forums, meetings and workshops for discussion and exchange;
- Organizing data and/or product exchange;
- Providing advocacy at global, regional and national levels;
- Assisting in resource mobilization;
- Assisting in project development and coordination;
- Implementing demonstration and pilot projects at regional, subregional and national levels;
- Assisting with cross-programme capacity development activities and other capacity development work of WMO constituent bodies;
- Developing tools for collecting and sharing information;
- Monitoring capacity development of weather, climate and hydrology services in the NMHSs of Members.

WMO Programmes

All WMO Programmes contribute to the ultimate aim of the Organization: "…to provide world leadership in expertise and international cooperation in weather, climate, hydrology and water resources and related environmental issues, and thereby contribute to the safety and well-being of people throughout the world and to the economic benefit of all nations". Most of the 20 Programmes have specific responsibilities for the implementation of the CDS. Further information on WMO Programmes can be found at http://www.wmo.int.

WMO constituent bodies

The World Meteorological Congress
Congress is the highest level of decisionmaking regarding CDS activities and will guide the work of the constituent bodies and the Secretariat. It has tasked the Executive Council with preparing a capacity development strategy and reporting back on its implementation at the next session of Congress. This strategy defines how the WMO community can better develop the capacities of NMHSs to deliver weather, climate and hydrology services.

The Executive Council
The Executive Council, following input from Congress, guides the work of WMO. The Executive Council Working Group on Capacity Development (EC WG-CD) oversees the capacity development activities of the Organization. The EC WG-CD consults with the Executive Council Panel of Experts on Education and Training and seeks inputs from WMO technical commissions, regional associations, other Executive Council working groups and the Informal Planning Meeting of the Voluntary Cooperation Programme.

More specifically, the Executive Council approved the CDS and will receive regular reports on its implementation.

Regional associations
Some countries have accepted special responsibility for the provision of basic regional services in areas such as aviation, tropical cyclones, climate services and training (see Annex 6: Global and regional centres in support of capacity development). The six regional associations (RAs) of WMO are at the hub of these activities: they advise and monitor the regional centres, set up regional working groups, and organize pilot and demonstration projects, seminars and workshops to carry out those activities at regional and subregional levels. By defining regional requirements and identifying gaps at the regional level, capacity development priorities are captured so that they can be reflected in global agendas and National Development Plans (NDPs), and addressed through regional and subregional partnerships and funding initiatives. Regional associations draw the attention of Members in their region to urgent issues, such as the International Civil Aviation Organization (ICAO) requirements for aviation weather forecasting, widespread flooding, food security and health issues stemming from climate variability or change. Regional associations can also encourage regional or subregional mitigation activities, such as participation in the Severe Weather Forecasting Demonstration Project, or projects using the information obtained from satellite observations and other tools for disaster risk reduction. More specifically, regional associations can directly contribute to Strategic Objective 5: Strengthen global, regional and subregional mechanisms.

Technical commissions
The technical commissions are composed of experts designated by Members and are responsible for studying meteorological, climatological and hydrological operational systems and also for applications and research. They establish methodology and procedures and make recommendations to the Executive Council and Congress. More specifically, technical commissions identify gaps and needs from an operational perspective for capacity development work and form task teams and working groups to address specific requirements.

Members

Each WMO Member State and territory has the overall responsibility for the development of its NMHS. While Members may have differing arrangements, NMHSs are normally governmental institutions with an important national role to play in support of a wide range of domestic and international responsibilities. Members must, therefore, define the duties of their NMHSs. Once those duties have been defined and agreed upon at the appropriate legislative or governmental level, the type of service to be provided by the NMHSs and the resources needed to fulfil their responsibilities can be determined. While WMO can provide examples of the basic duties of NMHSs, of the resources required and best practices, allocation of responsibilities and levels of service to be sustained are national decisions.

In addition to maintaining a plan reflecting basic duties and special services, exhibiting good management and building scientific and user relationships, NMHSs need to be involved in national planning. Arrangements for development assistance within the United Nations system, as well as funding from external sources, are largely based on country strategies. Moreover, support from other government departments or agencies for special services in agriculture, energy, health, water, land management, transportation and civil aviation, voiced at the national level, increases the likelihood of sustained development.

Global weather and climate models do require global data. The interdependence of NMHSs around the world becomes more evident as their scope expands to provide responses to policy issues such as climate change. Countries must contribute to international efforts, as the benefits of doing so far outweigh the costs. More developed countries serve as global or regional centres, providing guidance to other countries. Some Members, which actively participate in WMO bodies, assist other Members on a bilateral basis.

For further details on the capacities of NMHSs, see Annex 5: Categorization of National Meteorological and Hydrological Services.

2.4.3 Resource mobilization

The World Meteorological Organization receives funding from its Members through assessed contributions to support core budget activities, including the work of the Secretariat, regional associations and technical commissions. In addition to regular budget funding, WMO mobilizes voluntary resources (extrabudgetary) through a range of funding modalities to support specific capacity development activities.

Financing mechanisms available to WMO and its Members

(a) Development banks

Financing provided by the World Bank (WB)[1] and regional development banks, such as the Asian Development Bank (ADB), the African Development Bank (AfDB), the European Bank for Reconstruction and Development (EBRD) and the Inter-American Development Bank (IDB), is generally negotiated by the banks directly with ministries of foreign affairs and/or finance of the recipient countries and takes different forms (grants, soft loans, loans, etc.). Development banks predominantly provide loans with some grant support, generally on a bilateral basis. For this reason WMO should focus on helping NMHSs access and engage in these mechanisms through national level processes.

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[1] WMO and WB programmes have come together in recent years, focusing on the modernization of the hydrometeorological sector through direct grant-loan combinations. There are already strong programmes in south-east Europe and Central Asia, which have both regional and national elements. Similar activities are under consideration in Africa.

(b) Climate funds

The key climate funds that countries can approach, with WMO assistance, to support the Global Framework for Climate Services (GFCS) are:

The **Adaptation Fund:** This fund was established by the Parties to the Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC) to finance "concrete" adaptation projects/programmes in developing countries (Non-Annex I Parties to the Convention). The World Meteorological Organization became accredited with the Adaptation Fund as a multilateral implementing entity in December 2010 and can, therefore, submit projects, in line with National Adaptation Plans, on behalf of eligible Members.

The **Green Climate Fund:** The seventeenth session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCC COP 17) adopted a governing instrument for the Green Climate Fund and a process for its full operationalization by 2014. The Fund's long-term goal is to mobilize US$ 100 billion annually in climate finance by 2020. The Green Climate Fund, which aims to become the main multilateral financing mechanism in support of climate action in developing countries, will be a legally independent institution with its own separate secretariat accountable to the COP. Since the Durban Package did not reach any agreement on long-term sources of climate financing, the biggest challenge for the Green Climate Fund will be to secure adequate and sustained funding.

The **Global Environment Facility:** The Global Environment Facility and two other funds administered by it, the Least Developed Countries Fund and the Special Climate Change Fund, focus on climate change mitigation and adaptation activities. They support projects related to agriculture and food security, health, water resources, and disaster prevention.

The **Climate Investment Funds:** Two funds that provide developing countries with the resources needed to reduce their greenhouse gas emissions and mitigate the impacts of climate change. The Clean Technology Fund and the Strategic Climate Fund channel their financial support through the AfDB, ADB, EBRD, IDB and the World Bank Group. There are three programmes under the Strategic Climate Fund: the Pilot Program for Climate Resilience, the Forest Investment Program and the Program for Scaling up Renewable Energy in Low Income Countries. Additional climate funds (list available at http://www.climatefundsupdate.org/listing) focusing on clean development mechanisms and reduction of carbon emissions may offer peripheral opportunities.

(c) The United Nations system

The initiatives of United Nations agencies[2] involved in direct country assistance and financing, such as the Food and Agriculture Organization of the United Nations (FAO), the International Fund for Agricultural Development (IFAD), the United Nations Development Programme (UNDP), the United Nations Environment Programme (UNEP), the World Food Programme (WFP), the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the World Health Organization (WHO), can support the modernization of NMHSs. These United Nations entities should be part of the GFCS governance mechanisms and should be encouraged to incorporate GFCS into their development initiatives. This would help provide resources for GFCS implementation through direct financing and leveraging of related activities.

(d) Official Development Assistance[3]

There has been an increasing focus on water, the environment, health and, more recently, climate change in the ODA sector, as indicated by the 2011 report of the Development Assistance Committee of the Organization for Economic Co-operation and Development (OECD).

The World Meteorological Organization must draw the attention of the ODA sector to the role that weather and climate can play in stalling or slowing down economic development and

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2 WMO currently chairs UN-Water and the HLCP Working Group on Climate Change, mechanisms to secure the adoption of the GFCS throughout the United Nations system and to raise awareness of WMO priorities and capabilities.

3 As defined by the OECD Development Assistance Committee.

poverty alleviation, hence to the need for improved weather and climate services in support of climate-resilient development.

Encouraging NMHSs in developing and least developed countries to engage with their ministries of foreign affairs and related ODA programmes will be crucial for channelling funds towards the capacity development of National Meteorological or Hydrometeorological Services (NMSs) and NMHSs in those countries.

(e) Regional institutions

Regional institutions such as regional intergovernmental bodies and regional economic groupings exist in all WMO Regions. The regional economic communities in Africa, for example, group individual countries in subregions in order to achieve greater economic integration. They are described as the building blocks of the African Union and are central to the strategy for implementing the New Partnership for Africa's Development.

The World Meteorological Organization has a subregional office located in the headquarters of the Secretariat of the Pacific Regional Environment Programme. Establishing strong partnerships with relevant regional organizations provides a major opportunity to leverage support for the development of weather and climate services.

(f) Private sector

While governments are responsible for driving climate change solutions that address the needs of the poorest and most vulnerable, the private sector is an essential partner in preparing for and responding to the impacts of climate change and in building a global green economy. "The challenges that communities in developing countries face as a result of climate change — such as more frequent and intense storms, water scarcity, declining agricultural productivity and poor health — also pose serious challenges for businesses. Community risks are business risks".[4]

[4] United Nations Global Compact, United Nations Environment Programme, Oxfam and World Resources Institute, 2011: *Adapting for a Green Economy: Companies, Communities, and Climate Change – A Caring for Climate Report.*

ANNEX 1: GLOSSARY

Capacity

"Capacity is the ability of a human system to perform, sustain itself and self-renew." (Ubels et al., 2010)

Capacity building

The process of building capacities, based on the assumption that there are no capacities to start from. This approach can be relevant to crisis or immediate post-conflict situations but it is considered to be less comprehensive than capacity development.

Capacity development

The process of strengthening the abilities or capacities of individuals, organizations and societies to solve their problems and meet their objectives on a sustainable basis.

The essential characteristics of capacity development can be described as follows:

1. It is an ongoing, continuous improvement process with feedback mechanisms rather than a short-term intervention;
2. It aims to augment capacity in a sustainable manner;
3. It includes the activities, approaches, strategies and methodologies that help organizations, groups and individuals improve their performance and generate development benefits;
4. It is an endogenous process driven by national mechanisms and facilitated by external agencies;
5. It should be evaluated in terms of the growth of capacity as a whole and over time.

In the WMO context, capacity development emphasizes a holistic and integrated approach to building the competencies and capabilities of NMHSs. It also stresses the role of NMHSs in all aspects of development to ensure long-term sustainability. This approach implies that NMHSs have strong linkages with national, regional and subregional planning and political processes to ensure coordination and cooperation in capacity development activities.

Community of practice

People in the same profession can be grouped into communities of practice, such as networks of international advisers and informal planning meetings. A community of practice is a way for practitioners to share tips and best practices, ask questions of colleagues and support each other. It could also help build resources and skills for the development of the capacities of NMHSs, which reach beyond a single country or group of countries.

SWOT analysis

The SWOT analysis is a strategic planning method used to analyse strengths, weaknesses, opportunities and threats – hence the name SWOT – in a given situation.

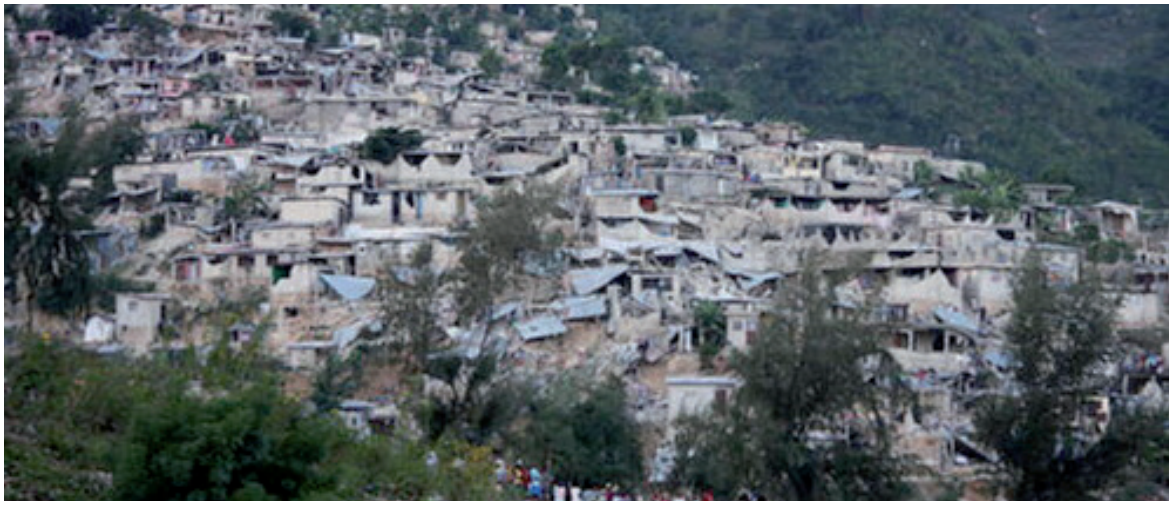
ANNEX 2: CASE STUDIES[5]

1. HAITI: RE-ESTABLISHMENT OF WARNING SERVICES AFTER THE JANUARY 2010 EARTHQUAKE

Aftermath of the January 2010 earthquake in Haiti (photo by the World Food Programme)

This case study	**– Is a good example of the WMO Eight-step Capacity Development Model;** **– Highlights the role of WMO as facilitator and coordinator in restoring early warning services in Haiti after the earthquake of January 2010;** **– Illustrates efforts aimed at making relevant capacities sustainable;** **– Highlights achievements in international and regional cooperation;** **– Shows how the disaster risk reduction (DRR) priorities in Haiti are embedded in the priorities of Regional Association IV (RA IV) and WMO;** **– Highlights the critical issue of national commitment and ownership for long-term sustainability of the National Meteorological Service (Centre National de Météorologie (CNM)) and National Water Resources Service (Service National des Ressources en Eau (SNRE)) in Haiti.**

[5] The case studies can be downloaded from http://www.wmo.int/pages/prog/dra/CDS.html



Haiti: Earthquake devastation, January 2010

1.1 Background

The Sixteenth World Meteorological Congress recommended that the achievements of the coalition of Members that re-established warning services in Haiti in time for the 2010 hurricane season be analysed as a case study for the development of the WMO Capacity Development Strategy (CDS).

The devastation caused by the January 2010 earthquake aggravated the vulnerability of Haiti to natural hazards. In addition to earthquakes, the country experiences recurrent hydrometeorological hazards such as hurricanes, floods, landslides and droughts that impact significantly on the lives and livelihood of the population and on the economy of the country. The already fragile infrastructure of the Haiti National Meteorological Service (CNM) and National Water Resources Service (SNRE) was severely affected by the January 2010 earthquake. Everything was destroyed including office facilities and equipment; one member of staff was killed.

The Organization's response to the earthquake in Haiti was immediate, with support being offered by a coalition of WMO Members (Canada, Cuba, Dominican Republic, France, Japan, United Kingdom and United States of America) and proved to be a success story in international cooperation. The immediate objective of WMO was to restore warning services in time for the anticipated hurricane season just a few months away.

Tropical storm gathering strength to become Hurricane Irene (with projected path) which threatens all the Greater Antilles, Haiti, the Dominican Republic, Cuba and Puerto Rico (warning by the Haiti National Meteorological Centre at Port-au-Prince, 21 August 2011)

This case study examines the activities carried out to restore warning services in Haiti and assesses the sustainability of CNM and SNRE by mapping the activities to the WMO Eight-step Capacity Development Model.

1.2 Activities aimed at restoring warning services

STEP 1 – **The requirements for the restoration of warning services in Haiti were clearly defined by the WMO mission in collaboration with the Haitian Government and in compliance with WMO technical regulations.**

The World Meteorological Organization led the first assessment mission to Haiti between 4 and 10 April 2010. The main purpose of the mission was to assess the situation of the hydrological and meteorological services, in particular regarding the generation of warning advisories and their dissemination to national and international organizations and the Haitian public, with a view to preventing hydrometeorological hazards and mitigating their effects on property and lives.

The capacity requirements for the provision of basic hydrometeorological services are:

- Well-maintained and operational national observatories;
- Systematic recording of observations from national observatories and transmittal to a central collecting platform such as the National Meteorological Centre;
- Connectivity to the WMO Global Telecommunication System (GTS) for real-time hydrometeorological data from other services;
- Sufficient information (data coverage) for systematic processing and generation of forecast products;
- Timely dissemination of products to users;
- Infrastructure and skills for receiving and interpreting critical warning advisories of extreme weather/climate events with lead time for preparedness;
- Skilled personnel to undertake operational tasks.

Prior to the earthquake, CNM and SNRE were not able to provide effective meteorological and hydrological services for the reasons outlined below:

- Lack of adequate government support (political and financial) to the effective functioning of CNM;
- Inadequate operational staff at CNM located at Port-au-Prince airport, operating with 22 staff members most of whom were observers, while only two were weather forecasters, to cover daily operations;
- Inability to produce and issue local forecasts because of lack of connectivity to the GTS, hence no incoming real-time meteorological data for operations;
- Lack of operational equipment, such as computers and specialized tools, severely limiting the ability of CNM to produce forecasts beyond 24 hours;
- Lack of reliable telecommunications and technical expertise, and inability to disseminate data and products to users.

STEP 2 – **The capabilities of Haiti CNM and SNRE were evaluated by the WMO assessment mission team against the requirements for the provision of warning services. A baseline was, therefore, established for human, institutional, infrastructural and procedural capacities in the provision of meteorological early warning services.**

Capacity was lacking in all four areas. Even more serious was the disconnect of CNM and SNRE with the Haitian Government, exposing the lack of national ownership and commitment critical for the sustainability and mandates of CNM and SNRE. The earthquake wiped out everything. As an immediate response to the situation, the WMO mission recommended urgent short-term solutions, outlined in the table below, to restore warning services in time for the upcoming 2010 hurricane season.

Governance	
1.	Prepare a strategic plan that would position CNM and SNRE in the administration of the Haitian Government.
2.	Strengthen cooperation between the two services and get the present (or future) supervisory authority to draw up clear, logical and effective documents on the missions, task sharing and responsibilities of each body, based on a quality management approach. In other words, set up institutional arrangements and a legal framework for the mandates of CNM and SNRE.
3.	Participation of CNM and SNRE in all projects affecting their respective missions.
Infrastructure	
1.	Urgently arrange premises for CNM and SNRE.
2.	Rapid installation of an internet connection for the temporary offices.
3.	Liaise with the French embassy to monitor the political, logistical and financial feasibility of equipping the operational centre of the Ministry of the Interior.
4.	Provide an official vehicle for CNM.
Human resources	
1.	In the first instance, conduct a training programme for the minimum human resources required of a national meteorological service capable of ensuring the safety of persons and property.
2.	Arrange for two forecasters to attend the workshop on cyclone forecasting in French, organized by WMO and the Regional Specialized Meteorological Centre (RSMC) in Miami.
3.	Equip the Haiti meteorological service with a basic synoptic network of automatic weather stations.
4.	Start transmitting information to CNM as soon as possible.
Technical support: observations	
	Start working on the sharing of tasks and missions between CNM and SNRE, especially with regard to the policy on observed data and their storage, database management and archive retrieval. For the SNRE, launch the national inventory of measurement networks to re-establish reliable hydroclimatology, hydrogeology (national inventory of water points) and agrometeorology databases.
Technical support: forecasting	
1.	Set up in Haiti the extranet dedicated to forecasting expertise, decided at the RA IV Hurricane Committee, adding new information as it is made available.
2.	Develop a Flash Flood Guidance System suitable for Haiti.
3.	Make arrangements for a two–three day basic training course on the Flash Flood Guidance System so that forecasters and observers can make use of this tool and the data it contains.
4.	Set up a backup forecasting team to be based in Martinique between 1 June and the end of November.

Technical support: production	
	Ensure that CNM has a semi-automated system, where possible, that can produce graphics and text. The system should be able to work with dissemination tools, especially e-mail and file transfer systems such as FTP.
Dissemination and communication	
	Complete the CNM public website, under construction in Canada.

It was necessary to restore services requiring well-trained professional staff, upgrading of communication facilities for the reception of real-time observations, modelling products and computer workstations, which together would amount to an integrated programme for the modernization of the weather service.

STEP 3 **– Assessment of the deficiencies of CNM and SNRE in meeting the requirements of warning services, which were identified in Step** 2**, and establishment of a baseline.**

The activities carried out by the mission team were coordinated with the Permanent Representative of Haiti, the head of SNRE and the Director of CNM, who arranged meetings with various national agencies and ministries and participated with the team in several of those events. The mission assessed institutional and operational capacities and identified gaps and needs of CNM and SNRE with respect to the provision of hydrometeorological services in support of disaster risk reduction and early warning systems. Sectoral needs were also assessed not only for the 2010 hurricane season, but also for the medium- and long-term reconstruction of the country.

Therefore consideration was given to the gaps in medium- and long-term capabilities. As a result of the WMO assessment mission, the following gaps were identified in personnel, infrastructure, institutional mandates and procedures of CNM and SNRE:

- No premises to house CNM and SNRE, not even on a temporary basis;
- Very limited observing systems and information technology infrastructure;
- Neither CNM nor SNRE had had a budget in the last three years;
- Their respective mandates were not clearly defined. The Government of Haiti did not seem able to acknowledge any responsibility for either SNRE or CNM, questioning their sustainability;
- No 24/7 shifts due to staff limitations;
- Demoralized ageing staff in SNRE which covers climatology, hydrology, hydroclimatology and hydrogeology;
- Limited delivery of products and forecasts.

STEP 4 **– A short-term strategic plan was developed to address the identified gaps. However, the National Adaptation Programme of Action (NAPA), adopted prior to the** 2010 **earthquake, had already pointed to the need for strengthening meteorological observatories to boost early warning capabilities at the national level.**

The assessment team performed an exhaustive gap analysis and the outcomes were used to develop a strategic plan to close the identified gaps and strengthen the capacities of CNM and SNRE to meet the service requirements for 2010–2011.

A project proposal by the Food and Agriculture Organization of the United Nations (FAO) entitled Haiti: Strengthening Climate Resilience and Reducing Disaster Risk in Agriculture to Improve Food Security in Haiti Post-earthquake, [6] to be funded under the Least Developed Countries Fund (LDCF), was listed as a national priority in the 2006 NAPA. Although the project emphasizes increasing resilience to climate variability and change in the agriculture and food security sectors,

[6] http://www.thegef.org/gef/node/3339

there is no mention of building capacities of CNM and SNRE and strengthening climate early warning systems, which are central to increasing resilience. Another project, submitted by the United Nations Development Programme (UNDP) to LDCF in 2008, entitled Strengthening Adaptive Capacities to Address Climate Change Threats on Sustainable Development Strategies for Coastal Communities in Haiti, incorporated the enhancement of capacity of the national environmental observatories including meteorological observatories. The project was intended to build on and complement the activities of a previous project.

The assessment revealed a critical need to build effective National Meteorological and Hydrological Services to support a multi-hazard early warning system, disaster risk management and socioeconomic development in Haiti. Furthermore, given the increasing risks associated with climate change, the development of those services is critical to the support of medium- and long-term planning in sectors such as agriculture, water resources management, health, tourism, infrastructure and the environment.

STEP 5 – The national ownership process was initiated but stalled pending the formation of a new government. The mission, which involved the participation of the Haitian government authorities, facilitated national ownership in the short term. However, long-term national ownership remains elusive.

Government appreciation of the services provided by CNM and SNRE increased significantly following the earthquake. Moreover, the mission highlighted the economic contribution of those services to Haiti. The mission also suggested mandates and estimated a national budget for service operations, but no national resources were allocated to those services. The commitment of the Haitian Government, a critical CDS element for the long-term sustainability of CNM and SNRE, remains as yet unclear.

Institutional issues were identified by the assessment mission as one of the most serious threats to long-term sustainability of CNM and SNRE. The institutions were not firmly established in the national administration and no budget had been allocated to them in the previous three years. This is not conducive to long-term capacity development. Therefore, lack of the necessary enabling policy and legal and institutional frameworks remains a barrier to capacity development goals in Haiti.

STEP 6 – Resources were mobilized mostly from external sources to meet the identified needs of CNM and SNRE.

To mobilize resources to meet the identified needs of CNM and SNRE, WMO participated in the World Summit for the Future of Haiti, hosted by the Dominican Republic on 2 June 2010. At the summit, WMO discussed the needs of CNM and SNRE with donors, aid agencies and members of the Interim Commission established to manage the trust fund that had been set up as a result of the pledging event held in New York on 31 March 2010. At that event, attended by the United Nations Secretary-General Ban Ki-moon and the United Nations Special Envoy for Haiti (former President Clinton), about US$ 10 billion were pledged and subsequently a multi-donor trust fund, the Haiti Reconstruction Fund (HRF) was established. However, funding for CNM through this mechanism did not materialize quickly because of delays related to the election and installation of a new government in 2010–2011. Cooperation with other United Nations agencies and national aid agencies was also held up. The formation of a new government was urgently needed to enable the implementation of plans that had been delayed.

Contribution of WMO Members

To meet the urgent need for assistance in Haiti, a number of Members, as part of a Region IV Haiti Task Team, including Canada, Cuba, Dominican Republic, France, United Kingdom and United States, offered and subsequently provided assistance as summarized in Table 1 below. WMO Members' and RA IV Task Team's contributions totalled over US$ 700 000. In addition, WMO received specific offers of assistance from equipment manufacturers, and Canada was in the process of seeking funding for longer-term assistance.

The CNM office in Haiti (left) consists of two shipping containers behind the civil aviation office, at the airport. Inside (right) are unopened boxes containing automatic weather station equipment sent by WMO after the earthquake (photos from WMO MeteoWorld, *June 2011).*

Table 1. Summary of Members' contributions

Purpose of the contribution	Amount (US$)	Source/Donor
Interim operation facilities for CNM staff and telecommunications (Emergency Managers Weather Information Network (EMWIN), Internet and GTS connections)	60 000	Martinique (France) and United States
Computer equipment	20 000	Canada
Observing network (7 synoptic stations)	215 000	WMO Voluntary Cooperation Programme
Development of extranet and meteorological products	45 000	Météo-France
Development of a public website	35 000	Canada
Team of forecasters based in Martinique	110 000	Canada, France and WMO
Radar data		Cuba
Site survey and installation of an automatic weather station (AWS)	25 000	WMO and Dominican Republic
Flash flood guidance products	90 000	United States and France
One 11-month fellowship for 5 CNM staff members	100 000	WMO

STEP 7 – A capacity development response was implemented to address the short-term needs of the country, with oversight ensured by lead agencies as outlined in Table 2 below.

The immediate response provided the following:

Infrastructure

- Installation of a satellite ground station, linking Haiti to the GTS, and participation in the exchange of real-time meteorological data and products;
- Link to the Emergency Managers Weather Information Network;
- Enhanced network of observatories through the installation of seven automatic weather stations which improve data coverage and increase accuracy and reliability of forecasts;
- An extranet, operated by Météo-France, with specialized numerical-model-based products as well as map-based flash flood guidance to improve the accuracy and lead times of forecasts and warnings;
- Timely reception in Haiti of the advisories of the National Hurricane Center in Miami as a result of the installation of the satellite ground station;
- Pre-paid Internet access for three years and a public website (www.meteo-haiti.gov.ht) courtesy of Canada and Météo-France.

The Météo-France forecast office in Martinique (left). Forecaster from the Meteorological Service of Canada at the Haiti forecast desk (right) (photos from WMO MeteoWorld, *June 2011)*

Human resources

- Establishment of a Visiting Forecaster Programme to increase forecasting staff at the Haiti CNM. Six skilled meteorologists from Canada, the Met Office (UK) and Météo-France went to Haiti during the hurricane season. One forecaster from the Met Office (UK) has remained in Martinique to support forecasting and warnings for Haiti;
- Hands-on training on the operation of the Flash Flood Guidance System provided to Haitian forecasters by the National Weather Service of the National Oceanic and Atmospheric Administration (NOAA/NWS) and the Hydrologic Research Center (United States), and Météo-France;
- Provision of WMO fellowships with funding support from Météo-France to train five Haitian forecasters for one year in Toulouse, France.

Institutional and procedural capacities

- An inter-agency body, which had been set up within the Haitian Government prior to the earthquake, initiated procedures for the coordination of DRR activities and clarified the roles of various agencies. The Director of CNM participated in this group. However, more extensive procedures are needed within the government and the agencies responsible for

an efficient and sustained response to disasters, including CNM, to ensure greater coordination;
- Safe and secure office facilities with a steady power supply, computing equipment and telecommunications for their daily operation;
- A surface observational network for real-time meteorological data;
- Telecommunications for collecting real-time data, accessing forecasting guidance and disseminating forecasts and urgent warnings;
- Specialized forecasting tools and products to support weather and flash-flood guidance;
- Forecasting expertise to train Haitian forecasters and help them to use forecasting tools, including flash-flood guidance products;
- Improved dissemination of forecasts and warnings to communities and numerous humanitarian relief organizations in Haiti;
- Organization of at least a one-year course to train four or five observers as forecasters before the next hurricane season;
- Partnerships with relevant international organizations to share resources as shown in Table 2 below. With support from the WMO Secretariat, links were established with key United Nations organizations and other international and development agencies working in Haiti to explore opportunities for improved support to the country.

Table 2. Capacity development activities coordinated by WMO after the 2010 earthquake in Haiti

Activity	Lead agency overseeing the activity
1. Setting up the headquarters of CNM and SNRE (a) Two temporary buildings donated by a private entity in Martinique (b) Internet access under Canadian contract for three hurricane seasons (c) Furniture (USAID), computers and office support systems (Canada)	UNDP (coordination), United States Agency for International Development (USAID) and Canada
2. Strengthening the observation network and forecasting/warning capabilities (a) Installation of a very small aperture terminal (VSAT) for GTS link and EMWIN (b) Installation of seven AWS and cellular data transmission under Canadian contract (c) Specialized numerical-model-based products and Flash Flood Guidance System (d) Visiting Forecaster Programme providing skilled staff for 24/7 operations	United States, Météo-France, United Kingdom, Canada and France
3. Strengthening of telecommunications and dissemination of products (a) Setting up a public website (www.meteo-haiti.gov.ht) (b) E-mails from CNM and Martinique to over 200 addresses (c) Short Messages System (SMS) and Weather Radio System at CNM (d) Exploring opportunities to include RANET (a radio and Internet network for the communication of hydrometeorological and climate-related information)	Canada (hosting), Météo-France and United States

Haitian children line up to receive aid at a refugee camp in Port-au-Prince (photo by ABC News *USA)*.

STEP 8 **– Efforts were made to have a monitoring and evaluation plan in place to assess the short-term operational capacities for measuring progress. Linking the continuous improvement of CNM and SNRE to medium-term capacity development plans was an essential aspect of this step.**

Operational capacities and medium-term development of CNM and SNRE

During this period efforts were made to ensure that the short-term operational capacities, developed for the 2010 rainy and hurricane season, were evaluated, adjusted, maintained and subsequently linked with medium-term capacity development activities.

The team that carried out the assessment mission to Haiti (April 2010) developed a project proposal to address medium-term capacity development needs at an estimated cost of US$ 9 704 600. The overall objective of the project was to create an operational environment that was institutionally and logistically geared to CNM and SNRE.

The World Meteorological Organization worked with the UNDP Bureau for Crisis Prevention and Recovery, the United Nations country team in Haiti and the World Bank to determine protocols and procedures for the submission of proposals for medium–term reconstruction of CNM and SNRE.

1.3 Ensuring the sustainability of capacity developed at Haiti national meteorological and hydrological services

1. Capacity development initiatives, including training and long-term educational opportunities, are needed to ensure the long-term sustainability of systems. Efforts should be made to increase qualified staff, provide more permanent facilities and establish a modern observing system including, for example, radar technology.

2. Well-targeted cooperation with other organizations and institutions for the use of various systems is valuable, but lack of coordination will further confuse what is now an already fractured network and limit the usefulness of any observing system.

3. Concerted efforts to secure national ownership and institutional positioning of CNM and SNRE within the Haitian Government are urgently needed to ensure sustainability. Both services will require:

   (a) Stable institutional positioning within the Government of Haiti and reflection of the role and mandates of CNM and SNRE in national planning, legislative and legal frameworks;
   (b) National partnerships with ministries and institutions;

(c) Regular national budget and resources;
(d) A clear plan for the development of human and operational capacities;
(e) Strong government support with a clear legal mandate for the roles of CNM and SNRE in the rebuilding of operational capacities for weather, water and climate services.

Haiti's solution for these structural concerns should take account of the needs of all users, be addressed at high levels of government and be included in national development plans.

*Haiti's National Palace before and after the earthquake (*New York Times*: top, Matthew McGregor, Department of National Defence, Canada; bottom, Jorge Cruz, Associated Press)*

4. The development and sustainability of CNM and SNRE also depend on opportunities for leveraging resources, know-how, data exchange and forecasting capacities through a regional cooperation framework. A Caribbean regional cooperation programme on multi-hazard early warning systems with national development components is being developed under the cross-cutting framework of the DRR Programme, in collaboration with NMHSs, disaster risk management agencies, RA IV, regional centres, WMO technical programmes and commissions, international partners and funding agencies.

2. FLOOD MANAGEMENT IN MOZAMBIQUE[7]

Aerial picture showing the impact of Cyclone Jokwe, when the Zambezi river burst its banks at Vilanculos, Mozambique (photo by DFID/UK).

This case study	**– Highlights the key role of Mozambique National Institute of Meteorology in disaster risk management and the capabilities of the early warning system during the 2000 flood;** **– Shows the importance of the National Institute of Meteorology in enhancing skills through its relation with the Southern African Development Community (SADC) Climate Services Centre and the need to strengthen the national early warning system;** **– Exhibits elements of the WMO strategy for service delivery and generation of climate information, which ensures that disseminated information is usable and reaches vulnerable communities. User feedback for product improvement is an essential part of this strategy;** **– Highlights the role played by the National Institute of Meteorology in a multi-disciplinary team to manage an extreme climate event in the national and regional context;** **– Highlights national ownership and commitment to strengthening the early warning system to manage future, more frequent and severe floods effectively.**

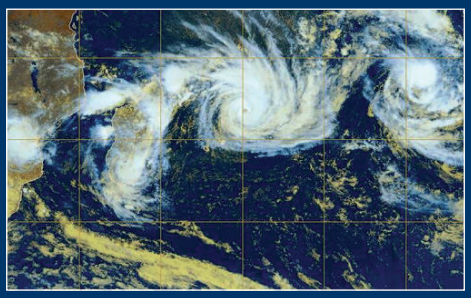
2.1 Background

The country's long-term challenge is to learn to live with floods and droughts. Mozambique is one of the poorest countries in the world, with more than 50% of its 19.7 million people living in extreme poverty. Development has been compromised in recent years by hydrometeorological disasters leading to a marked decline in economic growth rates – from 12% before the 2 000 floods to 7% after the floods.

Two main factors contribute to the high incidence of flooding in Mozambique. First, the tropical cyclones that form in the southwestern Indian Ocean and sweep the country's coast. While

[7] Adapted from *Climate Risk Management in Africa: Learning from Practice*, published in 2007 by the International Research Institute for Climate and Society (IRI).

relatively few of these cyclones actually make landfall, an average of three or four get close enough each year to cause high winds and heavy rain, leading to flooding. Second, Mozambique is a downstream country through which nine major international river systems that drain vast areas of south-east Africa find their way to the ocean (Figure 2). The country must thus manage the downstream effects of rain that falls far beyond its own catchment areas: an estimated 50% of the water in Mozambique's rivers comes from outside the country. Floods in Mozambique occur every two to three years along the major rivers: Incomati, Limpopo, Save, Buzi, Pungwe, Zambezi and Licungo. The severity of the flooding is determined by the rainfall both in the country and in the other catchment areas of these rivers outside Mozambique.



Satellite picture showing tropical cyclones developing south of the Equator and moving towards Madagascar and Mozambique (photo by Météo-France/La Réunion).

This satellite picture from Météo-France/La Réunion shows tropical cyclones developing south of the Equator and intensifying as they move in a west-south-west direction towards Madagascar and the Mozambique Channel, creating havoc along their path. The Tropical Cyclone Centre in La Réunion is a WMO Regional Specialized Meteorological Centre (RSMC) whose primary mission is to provide appropriate guidance to the 13 Members of the RA I Tropical Cyclone Committee (Botswana, Comoros, France, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Seychelles, South Africa, Swaziland, Tanzania, and Zimbabwe) for all tropical disturbances occurring in its area of responsibility.

The floods of 2000 were one of the costliest disasters in the country's history. They were caused by two successive cyclones: Cyclone *Eline* in late February and Cyclone *Hudah* in mid-April 2000. Heavy and persistent rain across southern Africa resulted, for the first recorded time, in the simultaneous flooding of the Limpopo, Incomati, Umbeluzi, Save, Buzi and Pungwe rivers (Figure 3). At least 700 people died, 650 000 were displaced and 4.5 million were affected, totalling a quarter of Mozambique's population.

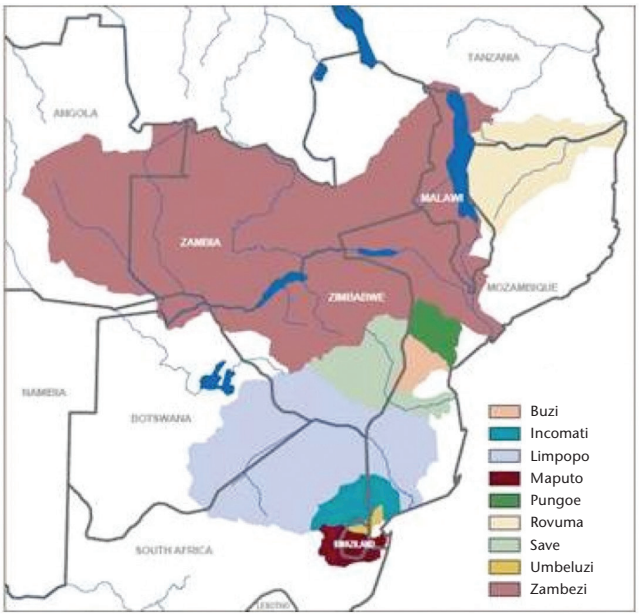


Figure 2. Major river basins of Mozambique
Source: Mozambique National Directorate of Water

Figure 3. Mozambique flooded river basins in 2000

Extreme climate events brought about by the El Niño-Southern Oscillation phenomenon have disrupted the country's development. Since 1980, there have been seven major droughts and seven major floods as shown in Table 3 below.

Table 3. Extreme climate-related events in Mozambique since 1980

Year	Event	Areas affected	Number of people affected
2002–06	Drought	43 districts in southern and central provinces	800 000 people affected
2001	Floods	Zambesi river	500 000 affected; 115 deaths
2000	Floods	Limpopo, Maputo, Umbeluzi, Incomati, Buzi, and Save river basins; floods were caused by record rainfall and three cyclones	More than 2 million people affected; 700 deaths
1999	Floods	Sofala and Inhambane provinces; highest rainfall level in 37 years; EN1 (major road) shut for 2 weeks	70 000 people affected; 100 deaths
1997	Floods	Buzi, Pungue and Zambezi rivers; no road traffic to Zimbabwe for 2 weeks	300 000 people affected; 78 deaths
1996	Floods	All southern rivers of the country	200 000 people affected
1994–95	Drought	Southern and central parts	1.5 million people affected; cholera epidemic
1991–92	Drought	Whole country affected	1.32 million people severely affected; major crop failure
1987	Drought	Inhambane province	8 000 people affected
1985	Floods	9 rivers in the southern provinces; worst flooding in 50 years followed by 4 years of drought	500 000 people affected
1983–84	Drought	Most of the country affected	Many deaths from drought and war; cholera epidemic
1981–83	Drought	Southern and central provinces	2.46 million people affected
1981	Floods	Limpopo river	500 000 people affected
1980	Drought	Southern and central provinces	No data available

2.2 Dealing with the severe floods of 2000

This case study looks at disaster risk reduction (DRR) strategies and, in particular, at the shift from reaction to preparedness adopted by the Government of Mozambique to deal with the flood. It focuses on the flood early warning system based on the advisories provided by the Mozambique National Institute of Meteorology with input from the WMO RSMC/La Réunion and the SADC Climate Services Centre. Experiences are drawn from the 2000 disaster, when the most severe floods in living memory affected large areas of the country. Furthermore, the case study examines the DRR activities carried out by the Government of Mozambique and maps them to the WMO Eight-step Model for Capacity Development. It looks in particular at the best practices in climate risk management, applied during the floods of 2000, in order to identify gaps in the early warning system. Key capacity development elements are singled out to assess the degree of sustainability of the early warning system in the context of the WMO strategy for capacity development.

2.2.1 *Policymaking and planning*

Mozambique post-independence governments, recognizing the risks of climate-related disasters, have sought to put in place structures for managing and mitigating their impacts: the Department for Combating Natural Disasters was established in 1977; in 1999, a new National Policy on Disaster Management was adopted and the Department for Combating Natural Disasters was replaced by the National Disaster Management Institute. This resulted in a new approach to disaster management, from reaction to preparedness, which relied heavily on the SADC Climate Services Centre providing climate information and warning advisories to the National Institute of Meteorology.

Under the new policy, preparedness for floods is facilitated by a flood early warning system. This provides forecasts of flood risk, detects and monitors flooding and issues flood warnings when necessary, paving the way for a coordinated response. The flood early warning system is coordinated by the National Directorate of Water, together with the National Institute of Meteorology and the National Disaster Management Institute. This collaboration reflects the essential integration of hydrological and climate information needed to understand and predict floods and to manage an effective disaster response. The National Disaster Management Institute is responsible for the overall coordination of such a response.

Since 1996, climate forecasts have provided the basis for early warning and contingency planning. The National Institute of Meteorology collects meteorological data and prepares a range of forecasts – seasonal (October to March), 4-day and daily forecasts. It also monitors cyclones thanks to the information received from the WMO RSMC/La Réunion. Seasonal forecasts provided by the Southern African Regional Climate Outlook Forum (SARCOF) ahead of the rainy season, in October, inform a meeting of water resources experts, who assess preparedness for the predicted climate event. If flooding is expected, a flood team is mobilized. When flooding occurs, the team's role is to monitor the situation, receive and analyse information, recommend responses, ensure collaboration between the different bodies involved and coordinate activities at central and local levels.

Regional water administrations monitor water levels in river basins and provide data to the National Institute of Meteorology. The latter collects data from meteorological stations across the country and from radar equipment and satellites; it uses these data to update forecasts periodically.

Regional water administrations issue flood warnings, when necessary, to district governments, local authorities and the media (radio, television and newspapers). District governments and local authorities, in collaboration with the Red Cross and other non-governmental organizations (NGOs), are responsible for the dissemination of information, in particular warnings, at the local level, and for the evacuation of people before the floodwaters rise.

A high-level ministerial committee, chaired by the Prime Minister, became the overall decision-making body in the event of a disaster. This was supported by a technical committee comprising experts from the ministries of public works and housing, transport and communications, health, agriculture, the environment, defense and foreign affairs. The committee met daily while the disaster lasted.

2.3 Best practices in climate risk management

STEP 1 – Requirements for an effective early warning system to efficiently manage floods were defined with plans ranging from the issue of a flood warning to the mobilization of response units set up by the National Disaster Management Institute.

Mozambique thus has policies and structures in place for domestic flood management, but it cannot address its water-related climate challenges alone, since weather events outside the country often determine the internal situation. Regional cooperation is, therefore, critical particularly for flood prediction, and engagement with relevant neighbouring countries is

essential in addressing transboundary issues pertaining to the use and management of the river systems. This cooperation is facilitated by SARCOF[8] which is coordinated by the SADC Climate Services Centre in Gaborone, Botswana.

The role of SARCOF is to facilitate information exchange and interaction among forecasters, decisionmakers and climate information users in the 14 SADC Member States. Seasonal climate outlook forecasts from the SADC Climate Services Centre are downscaled to specific national situations and fed into the flood forecast of the Mozambique National Institute of Meteorology. Highly skilled staff is needed to interpret regional climate forecasts issued by the SADC Climate Services Centre and downscale them to the specific national context of Mozambique. Adequate infrastructure in the NMHS is essential to perform this operation. The water authorities in the region also exchange data on a regular basis. Interestingly, the need for coordinated water management often transcends political disagreement. Figure 4 below is an example of a seasonal climate outlook product from the SADC Climate Services Centre, used during a SARCOF session.

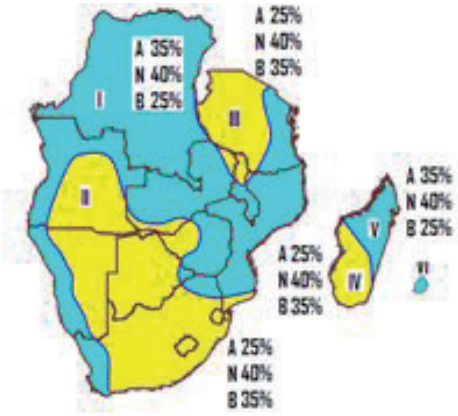


Figure 4. Seasonal outlook forecast indicating a 35% probability of above-normal rainfall in most of Mozambique.

STEP 2 – The capabilities of the NMHS to issue accurate warning advisories with sufficient time for preparedness were evaluated and a baseline was established.

The SARCOF meeting of September 1999 warned that there was a high probability of above-average rainfall between October and December 1999 for most of Mozambique, although there was a 45% probability of normal rainfall in much of the Limpopo river basin. The forecast for January–March 2000 showed a 50% probability of above-average rainfall in the central region (Buzi and Save river basins), while the likelihood of above-average rainfall for southern Mozambique was only 30%. An updated forecast in December 1999 showed that the probability for central Mozambique had decreased to 45%, while for southern Mozambique it had increased to 35%, for the period January–March 2000. This situation caused concern among staff at the National Institute of Meteorology. In the previous year, scientists had noted a correlation between La Niña activity and high rainfall in southern Mozambique, a phenomenon that appeared to be repeating itself more forcefully. In addition, it was noted that 1999–2000 coincided with the cyclic peak of sunspot activity, which over the past 100 years had been correlated with periods of exceptionally heavy rainfall.

The National Institute of Meteorology, therefore, raised the probability of above-average rainfall to 50% in its national forecast and warned that there was also a high probability of floods. This was a brave move since two seasons earlier the Institute had wrongly predicted a severe drought in connection with the 1997/1998 El Niño event. In order to understand what had gone wrong with the forecast, the Institute organized an international conference and invited top scientists to share their knowledge and experience. This was seen as a positive step, since the National

[8] SARCOF is a regional climate outlook prediction and application process adopted by the fourteen countries that make up SADC: Angola, Botswana, Democratic Republic of Congo, Lesotho, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe.

Institute of Meteorology had not acted alone. The scientific community acknowledged its limitations in predicting the impacts of El Niño. This helped the Institute to regain the otherwise damaged credibility.

The Government took the warning advisory issued by the National Institute of Meteorology seriously, as part of the early warning system and disaster risk preparedness, and approved a multi-sectoral contingency plan.

The flood warnings by the National Institute of Meteorology and subsequent preparations coordinated by the National Disaster Management Institute proved to be fully justified when, between January and March, the worst floods in over 100 years affected three major river basins – the Incomati, Limpopo and Save. The flooding was not the result of a single weather event but rather the cumulative effect of a succession of events. While each event was predicted and monitored with some success, the way in which they interacted was complex and not well foreseen – a major limitation in the capabilities of the early warning system.

STEP 3 – **The gaps in the early warning system, identified during the** 2000 **flood, were analysed to determine how to tackle future, more severe floods.**

GAP 1: The river basin authorities and the National Institute of Meteorology lacked the capacity and equipment to carry out short-range real-time modelling and forecasting. These would have helped to predict the extent and severity of flooding and better target flood warnings to specific areas or villages. Modelling, supported by ground and satellite data, is vital for accurate short-term flood prediction. With the exception of the Limpopo, none of the country's river basins had calibrated models in place. Accurate prediction is in turn a prerequisite not only for the credibility of warnings to the public but also for the faith placed in the early warning system, hence for the resources allocated to it by the Government. Communication between the different front-line groups proved, for the most part, good. Information and data were shared by telephone, radio, e-mail and fax. Good relations built prior to the disaster, both within Mozambique and with neighbouring countries, formed the basis of both formal and informal communications.

GAP 2: Conflicting information came from different sources, causing some confusion. The Government relied on information from the National Institute of Meteorology and other governmental institutions, while NGOs and aid organizations received forecasts from the United States and other global sources. The need for a single voice providing information to all stakeholders was a valuable lesson drawn from the disaster. The Public Weather Services Programme of WMO stipulates that the NMHS is the single authoritative voice for issuing warnings at the national level, to avoid confusion.

GAP 3: Communication of flood warnings to the general public and vulnerable communities remained a challenge. The media did not have a defined role and only began reporting about the event when it was already underway. It seems that the risk was not fully understood by many people, who chose not to leave their homes.

GAP 4: Resources, both human and financial, were limited in preparing for the floods and dealing with them. Mozambique was not able to maintain on stand-by a large corps dedicated to disaster management, instead it had to mobilize personnel as and when the situation demanded. Donor agencies did not respond adequately to funding calls for pre-flood preparation, although substantial post-disaster funding was provided. Yet the strategy is to have adequate resources before the disaster rather than after.

STEP 4 – **A crisis management rather than a strategic plan was developed to address the overwhelming magnitude of the floods in coordination with national planning authorities and partner organizations.**

The high-level committee set up to deal with disasters, which normally meets four times a year, started to meet fortnightly. In November, the committee released a national contingency plan for rains and cyclones during the 1999/2000 season. Provincial and local structures developed their

own plans and conducted preparatory exercises. There were attempts at mobilizing resources, but few could be spared, bearing in mind that at that time the disaster was still a mere probability. So, for example, of 20 boats requested, only 1 had been provided when disaster struck. Leave was cancelled for key officials in December and January.

As predicted in the regional forecast, there were heavy rains in southern Mozambique and adjacent countries between October and December. Around the beginning of February, Cyclone *Connie* over the Indian Ocean made landfall and caused further heavy rain in the Maputo area. The Limpopo, Incomati and Umbeluzi rivers were affected, with water levels at their highest since records began. Three weeks later, Cyclone *Eline* made landfall and moved inland, causing serious flooding of the Save and Buzi rivers, in the centre of the country, and aggravating the flooding of the Limpopo river, in the south. At the beginning of March, a third cyclone out at sea, *Gloria*, came into the picture, contributing to further record flooding of the Limpopo, Incomati, Save and Buzi rivers. Finally, Cyclone *Hudah* followed *Eline* and made landfall in April. Flood warnings were issued as the flooding escalated. However, warnings were not always accurate and not always understood or heeded by local communities. The interest of the mass media increased as the disaster unfolded. Both national and international media began to report dramatic stories and heroic rescues. The magnitude of the floods far exceeded anything in living memory. The towns of Xai-Xai and Chokwe, on the Limpopo, and many other small towns and villages in the same region, were completely inundated and remained under water for about 2 months.

STEP 5 – National commitment to the immediate crisis management plan was secured. In addition, national commitment for an effective early warning system was also obtained and reflected in the National Adaptation Programme of Action (NAPA) submitted in 2008 to the United Nations Framework Convention on Climate Change (UNFCCC).

The NAPA[9] has prioritized strengthening of the early warning system which is considered critical for managing floods in Mozambique and building resilience to the impacts of a changing climate on the country's economic sectors. This demonstrates commitment to the enhancement of the national early warning system and associated capacities of the NMHS.

STEP 6 – Resources were mobilized. Both national and international support was provided.

STEP 7 – The crisis management plan was implemented as the Government strove to contain the situation and coordinate rescue efforts.

The Government declared an emergency, mobilized its disaster response mechanisms and made appeals for assistance, supported by extensive coverage in the international media. The first external teams arrived on 11 February from South Africa. Coordinated by the National Disaster Management Institute, a combined national and international effort resulted in about 50 000 people being rescued by boat and aircraft. The displaced, numbering 650 000, were accommodated in temporary centres and public health measures were put in place, successfully preventing measles and cholera outbreaks. At least 700 people died as a direct consequence of the floods. An estimated 350 000 head of livestock also perished and vast areas of agricultural land were devastated, with soils and crops lost. Some 6 000 fishermen lost 50% of their boats and gear. Schools and hospitals were among the many buildings destroyed.

Implications for good practices in climate risk management and disaster risk reduction

An effective flood early warning system depends not only on the technical and institutional capacity to produce a good risk assessment, but also on the ability to communicate that risk to vulnerable groups and the authorities in charge of the response. This points to the development of user-driven services and effective service delivery systems, focusing on vulnerable communities along the river systems of Mozambique. Efforts must, therefore, be made to provide user-focused services to vulnerable communities, who should be able to use and derive benefits from those services.

[9] http://unfccc.int/adaptation/workstreams/national_adaptation_programmes_of_action/items/4585.php

BBC News, Tuesday, 29 February 2000, 21:56 GMT: "Thousands of Mozambique flood victims spent Tuesday sitting in trees, on rooftops and on patches of high ground, surrounded by swiftly flowing muddy water, waiting for over-stretched rescuers to pluck them to safety."

A South African helicopter hovers above flood victims

Chokwe province: Awaiting rescue on a rooftop

"***From above it looks as if a huge tidal wave of brown water has swept through the Save river valley. Trees have been uprooted, houses lie in ruins and debris is floating in the floodwater. Those who survive the flooding have been stranded on rooftops and in trees. Beneath them the bloated corpses of livestock float in the waters***". **(From Greg Barrow in Maputo, *BBC News*, Sunday, 27 February, 2000, 20:58 GMT)**

Experience of previous floods and the sheer magnitude of impacts generated by the recent flooding and other climate-related shocks in the country, have led the Government to set up flood management structures at various levels, from central to local, and to facilitate active collaboration between these structures. Figure 5 below shows the sheer rise in the number of hydrometeorological disasters[10] in Mozambique starting from 1994.

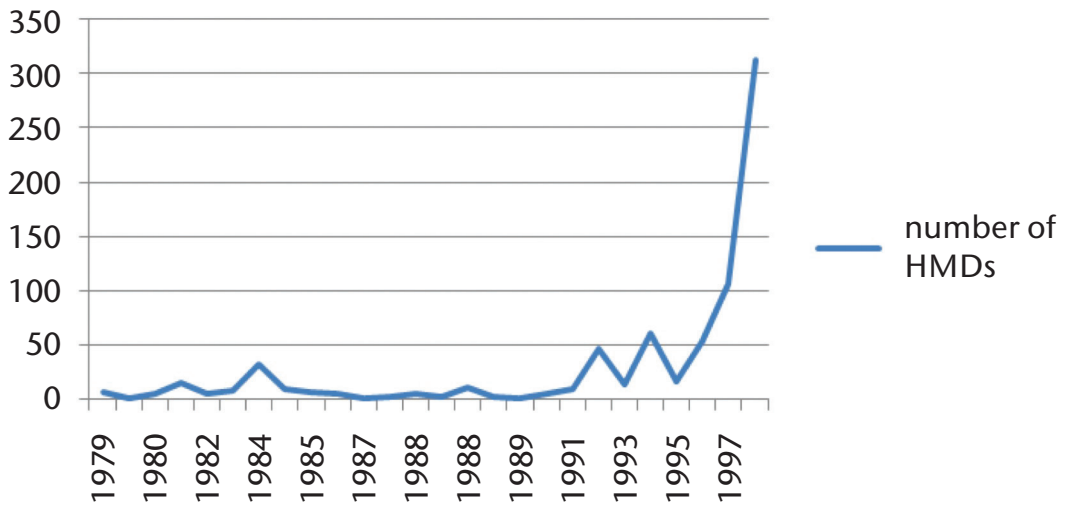


Figure 5. Hydrometeorological disasters affecting Mozambique in the period 1979–1997

Source: Arame Tall (DesInventar Mozambique/GRID-Arendal data).

[10] Hydrometeorological disasters include cyclones, strong winds, rains and tropical depressions, flooding, drought and heatwaves, as well as disaster-related epidemics.

STEP 8 **– A thorough monitoring and evaluation plan was in place and metrics to measure success against the baseline were incorporated in the plan. The process was used to recommend continuous improvement of the National Disaster Management Strategic Plan and the strengthening of the early warning system in the event of future, more severe flood in Mozambique.**

The magnitude of the 2000 flooding was overwhelming, and the poverty of the majority of Mozambicans added to their vulnerability. However, the country's flood planning and preparedness, with climate information provided by the Mozambique National Institute of Meteorology and the SADC Climate Services Centre, laid down the framework for massive international support. The complexities of managing a disaster of such magnitude proved an eye-opener for regional and national authorities. Climate information was available before and during the flooding. Floods were forecast by the National Meteorological Institute with regional climate input from the SADC Climate Services Centre, and tropical cyclone warnings and advisories were received from the WMO RSMC/La Réunion. The magnitude of floods was not anticipated, but this is not surprising, since floods exceeded all those since records began**.**

Much reflection and analysis after the floods of 2000 led to some improvements in the flood early warning system and flood management practices in Mozambique.

2.4 Improvements since 2000

2001

Following the floods of 2000, a Lessons Learned Workshop, funded by the Office for the Coordination of Humanitarian Affairs (OCHA), was held by the Mozambique National Institute for Disaster Management in Beira, on 26 and 27 July 2001, to draw lessons from the rescue and relief operations carried out in the centre of the country between January and May 2001. Some 130 delegates attended the workshop, including the governors of three of the four affected provinces, as well as district administrators and representatives of government departments, United Nations agencies, donors and NGOs.

The workshop had three specific objectives:

1. To review the 2001 flooding and the role of the main players;
2. To draw lessons for prevention, preparedness and response;
3. To propose adjustments to the contingency plan for the next rainy season.

The plenary session of the workshop considered the following areas for improvement:

1. Coordination, data gathering and processing, the press, training and response;
2. Logistics, communication and food security;
3. Health, water supply, sanitation and shelter;
4. Warnings, public awareness, education and resettlement.

After comparing experiences of the response strategies adopted in 2000 and 2001, in the centre and south of Mozambique, the workshop pointed to the following major improvements in 2001:

1. In 2000, needs assessment and implementation of the response strategy were more difficult, costly and time-consuming because the area affected by flooding was very large. Hence, the need for full cooperation and collaboration to serve vulnerable populations and save lives was even greater. In 2001, the assessment was conducted immediately by government agencies and partners using the same tools. The data were fed into a common database that was accessible to all partners. Differing statistics, conflicting assessments and competitive responses were thus avoided.

2. In 2001, many aspects of the rescue and relief operations were improved, particularly national and provincial coordination and contingency plans. The Mozambican Government and the international community improved substantially their management capacity during 2001.

3. The contingency plan for 2001 was based on the accurate forecast of potential floods in the period January–April, between Vilanculos, in Inhambane Province, and Quelimane, in Zambézia Province.

4. The United Nations contingency plan was fully integrated with the national contingency plan and allowed the prepositioning of equipment and goods in areas at risk before the floods struck.

5. The United Nations capacity for coordination was increased with the establishment of the United Nations Disaster Management Team, involving all United Nations agencies, governments, NGOs and other partners.

6. An adequate response is highly dependent on availability of funds. The United Nations joint appeal raised over US$ 10 million or one third of the US$ 30 million sought by the Government to respond to the disaster. The United Nations Office for the Coordination of Humanitarian Affairs was able to secure funding and experts to join the United Nations team to ensure a smooth and effective disaster response using a collaborative team approach.

7. The need to make disaster management an integral part of the planning process in each institution was emphasized since Mozambique is prone to cyclical disasters.

8. Regional efforts within SADC for joint initiatives in disaster management to improve warning systems and response capacity.

2003

The Government of Mozambique signed several key transboundary water agreements concerning the Limpopo, Incomati, Save and Buzi river basins. The Agreement on the Establishment of the Limpopo Watercourse Commission (LIMPOPO Agreement) recognizes the "spirit, value and objectives of the Revised Protocol on Shared Watercourses in the Southern African Development Community". As of 2003, eight SADC countries had ratified the Revised Protocol: Botswana, Lesotho, Mauritius, Mozambique, Namibia, South Africa, Malawi and Swaziland. The Revised Protocol was expected to come into effect once two thirds of the SADC countries had ratified it.

Massingir dam on the Olifants river (left). Macarretane barrage on the main stem of the Limpopo river (right) (Vogel 2010)

2006

A National Disaster Management Strategic Plan was drawn up and adopted in 2006. The plan links the need to reduce the risk of disasters to national priorities for poverty reduction. It has three main objectives: (a) to reduce the loss of life and property during natural disasters; (b) to consolidate the national culture of disaster prevention; and (c) to introduce specific measures to prevent and mitigate disasters. The following improvements were made:

1. In 2006, the Government of Mozambique approved and began the implementation of the Master Plan for Disaster Prevention and Mitigation, as the sole instrument to guide national action to reduce the risk of disasters in the long term. The Government of Mozambique adopted a set of political measures to ensure effective disaster risk reduction, which included:

    - Review and reform of legal and institutional frameworks enhancing the mandate of the National Institute for Disaster Management to coordinate all disaster risk reduction activities, according to the decisions of the Technical Council for Disaster Management;
    - Establishment of National Emergency Operation Centres, at national and regional levels, integrating the National Civil Protection Units for search and rescue activities. This has enhanced the national capacity for coordinating the response to emergencies;
    - Strengthening national capacity for early warning of floods, droughts and cyclones, through wide dissemination to local communities of accurate information on disaster prevention and response;
    - Decentralization of disaster risk management activities through the establishment and training of local committees for risk management in all vulnerable communities throughout the country.

2. A community-based disaster risk management programme was undertaken in the Buzi district of Sofala Province. The project involved raising awareness of risk and building capacity to reduce vulnerability and respond to disasters. Local communities participated in risk assessment and disaster simulation exercises.

    As a result of enhanced capacity, the local communities along the Buzi river are now able to measure water levels and report them, and to understand and heed warning advisories; the death toll during floods has thus been greatly reduced.

The Buzi early warning system

A flood-warning project for Mozambique, initiated by the Munich Re Foundation,[a] includes a simplified early warning system that has been specially tailored to the needs of the local population. The system is based on a remarkably simple structure. A number of villagers have been designated for measuring daily precipitation levels at strategic points in the Buzi river basin. Water levels along the river are also monitored using straightforward gauges. If there is particularly heavy rainfall or the water level becomes critical, this information is passed on by radio. Should reports reaching the central coordination point indicate widespread heavy rainfall, the alarm is raised. The gauges that measure the depth of the river are key elements in the monitoring process. The people living in the area undergo special training to alert them to the dangers. A system of coloured flags is used to signal a flood warning. Pre-designated helpers are sent out equipped with megaphones to raise the alarm, and areas at risk are evacuated.

[a] Flood Warning System Project in Mozambique. http://www.munichre-foundation.org/home/DisasterPrevention/Archive/Mozambique.html

Measuring daily precipitation levels in the Buzi river basin (left). Training local communities living along the Buzi river (right)

The work on the Buzi flood warning system in central Mozambique has been brought to a close. The system was handed over to Mr Landa, the District Governor, in the autumn of 2006. Trials performed before the rainy season, in the autumn of 2005 and 2006, showed that the system had been understood and accepted by the people living along the river.

The second phase entails installing the warning system on the Save River. Evidence of replicability is essential to demonstrate that early warning systems geared to the people at risk will also work successfully in other risk areas.

3. The crucial importance of regional cooperation was acknowledged with the approval, in 2005, of a regional water policy.

4. New agreements on the exchange of data on floods and droughts, and on the coordination of responses across national borders, have also been signed with neighbouring countries (see the Limpopo Agreement above).

5. A regional project began the installation of 50 new gauging stations in the region's main river basins.

6. A flood risk analysis was carried out in the major river basins of Mozambique to identify vulnerable areas and people. It found that 40 out of 126 districts were prone to flooding and that the 5.7 million people in these districts were at risk. This is a valuable starting point for planning and implementing measures to reduce vulnerability. Following the analysis, part of the existing equipment has been upgraded and new equipment installed, including two new radars and 15 new meteorological stations.

7. Between 2004 and 2006, the province hydrometeorological network was expanded from 6 to 14 stations, reducing the time lag between data collection and analysis from one month to one day.

8. Mozambique now has a tropical cyclone warning system, distinct from the flood early warning system. The cyclone warning system informs people of the probable arrival of a tropical cyclone at least 48 hours in advance. Vulnerable populations are advised on the measures to take.

2.5 Future requirements for flood management

- A balance between structural and non-structural measures is necessary for flood mitigation. A good contingency plan is a prerequisite;

- Strong institutional coordination that makes best use of the information and resources available is critical. Effective cooperation at the regional level is also essential, but sharing data in the region is still a challenge;
- Vulnerable communities must be made aware of the risk of flooding and involved in preparedness activities. Appropriate, clear and timely messages during a flood are also vital.

However, inadequate and sporadic government financing cannot ensure the sustainability of flood early warning infrastructure such as weather radars and automatic weather stations. It is essential that the National Institute of Meteorology adopt a more effective strategy to win the support of the Mozambican Government so that adequate national budget allocations complement donor funding. This is crucial to developing the capacities needed to fully deliver the required DRR services for the safety of life and property in the event of future floods.

Nevertheless, it should be noted that as Mozambique continues to improve its DRR contingencplans and policies, adaptive capacity is continuously built into the Mozambique Flood Early Warning System and resilience to droughts and floods has increased.

After Tropical Cyclone *Funso* hit the Mozambican coastline, between 20 and 22 January 2012, severe flooding affected 65 000 people in Zambezia Province. Forty deaths were reported, which is much fewer than in 2000 and 2001.

ANNEX 3: THE CAPACITY DEVELOPMENT PROCESS AND DIMENSIONS

The WMO capacity development process offers a systematic approach to the development of National Meteorological and Hydrological Services (NMHSs). Experience shows that neglecting any aspect of that process may compromise its sustainability.

As shown in the diagram below (Figure 6), the capacity development process consists of eight steps that all capacity development activities need to consider if they are to be effective and sustainable. The steps may be non-linear or iterative, but generally progress from the establishment of requirements to the understanding of existing baseline capacities and the identification of the gaps that need to be filled in order to meet the requirements. These steps can also be used to diagnose the shortcomings of past capacity development activities (see Annex 2: Case studies) and to guide future efforts.

A SWOT analysis was carried out by the Executive Council Working Group on Capacity Development, in December 2011, for each of the eight steps of the CDS described below to identify strengths (internal characteristics of the Organization that give it an advantage), weaknesses or limitations (internal characteristics that place the Organization at a disadvantage compared to others), opportunities (external situations that can be exploited to improve the performance of the Organization) and threats (external elements in the environment that could cause trouble for the Organization) with regard to the assistance that WMO provides to its Members in the area of capacity development.

Care was taken to ensure a holistic analysis of the situation, taking into consideration the different areas recommended by Resolution 49 (Cg-XVI) – WMO Strategy for Capacity Development, including geographical perspectives.

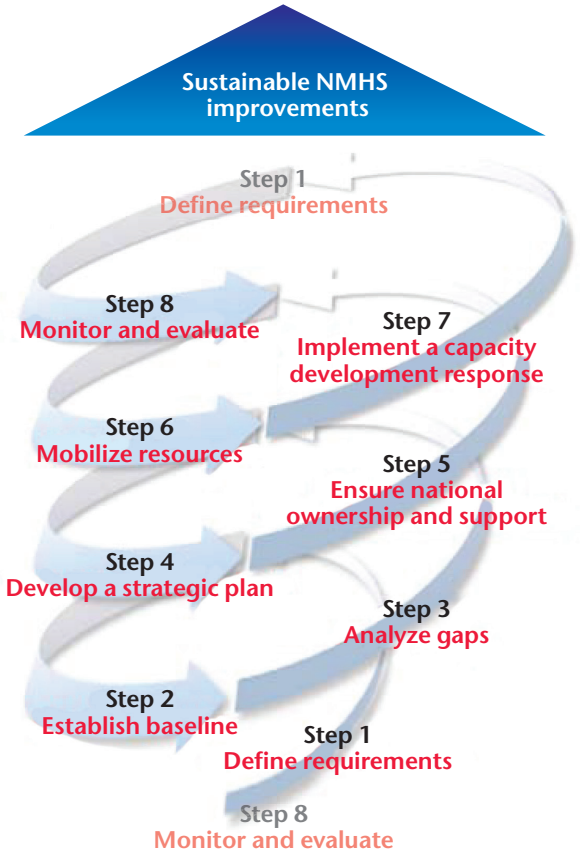


Figure 6. The eight steps of the capacity development process

STEP 1: Define requirements. In this step, the NMHS identifies what services and products are required at the global, regional and national level and what it needs to meet these requirements in terms of its institutional set up and mandate, technical skills, infrastructure, relationship with users and ability to perform its functions. The requirements may vary: they may relate to technical systems, standards or organizational set up, and can be expressed in a number of ways such as type of measurement; coverage, frequency, timeliness and resolution of observations; staffing skills and budget. They all relate to the capacities needed to provide stakeholders with the necessary weather, climate, water and related environmental services such as observations, data management, prediction, communication and data exchange. Requirements can also refer to the quality of services and their usability, availability, reliability, supportability, testability and maintainability. In this step, NMHSs should consider tailoring their products and services to the needs of users and integrating regional requirements – a key element for coordination and advocacy, as recommended by Resolution 49 (Cg-XVI).

STEP 2: Establish a baseline. Assessing existing capacities such as procedures, institutions, human resources and infrastructure is essential. "Capacity Development that is not rooted in a comprehensive study and assessment of the pre-existing conditions will be restricted to training alone, which will not facilitate sustained results" (UNDP Strategic Plan 2008-2013). As recommended by Resolution 49 (Cg-XVI), assessing the capabilities of Members and improving their compliance with WMO standards are two aspects that need to be considered in this step. The national baseline also includes the ability of the NMHS to meet the full range of requirements identified in Step 1.

STEP 3: Analyse gaps. This step aims at comparing what the NMHS has with what it needs to meet national and international requirements. It involves determining what the shortcomings are in terms of institutional, infrastructural, procedural and/or human capacities.

STEP 4: Develop a strategic plan. Strategic planning is the process of identifying an organization's or company's long-term or overall aims and interests and the means of achieving them. A strategic plan, therefore, helps an NMHS to clarify its goals, specify the measures to be taken to fill the gaps in its capacities and make decisions about resource allocation. Generally speaking, a strategic plan deals with the following key questions: *What do we do?* (mission); *Where shall we be in the next three to five years?* (vision); and *How are we going to make it a success?* (strategy). A strategy shall include expected results (ERs) and SMART[11] objectives. To ensure a sustainable approach, the strategic plan should be aligned with the priorities of stakeholders, including national development plans (see Step 5), and linked to resource mobilization (see Step 6). The strategy should lead to a budget for the activities in the plan and should include subprogrammes (observations, communications, staffing and services) with related targets, staff requirements with salaries and training, capital equipment and operating funds (see Step 7).

STEP 5: Ensure national ownership and support. The development of NMHSs must be integrated into national priorities – and linked to regional and global priorities – to ensure its sustainability. This can be achieved through engagement with national governments, regional authorities and related institutions. Multilateral and bilateral assistance is very important, but ownership of the goals, priorities and long-term funding must be evident at the national level. A National Development Plan (NDP), shared funding or some form of government endorsement are sought at this stage to implement the strategy defined in Step 4. Ensuring national ownership and consistency with National Adaptation Programmes of Action (NAPAs) and other national development plans is recommended by Resolution 49 (Cg-XVI).

STEP 6: Mobilize resources. This step stresses the need for NMHSs to mobilize financial and in-kind resources to meet the requirements identified in Step 1 and prioritized in Step 2. National support means, to some extent, national funding. This need not be all from one central government agency. In many cases, funding can be arranged, by agreement or contract, for special services to be provided by the NMHS to another department or to a private entity. In

[11] The acronym SMART – which stands for specific, measurable, achievable, realistic and time-related – summarizes the criteria to be used in setting objectives.

many countries, a portion of funds received for aviation support from airlines is apportioned to the NMHS for aviation services. However, as the cost of developing modern NMHSs can be a challenge for developing countries, external funding is essential. Multilateral and bilateral funding mechanisms exist and should be sought. Resolution 49 (Cg-XVI) emphasizes international, interregional and bilateral cooperation. Volunteerism should also be encouraged to extend the resources available to developing countries. Strong partnerships within United Nations agencies, development banks, NGOs and regional organizations can provide opportunities to leverage resources and build on common interests.

STEP 7: Implement a capacity development response. A capacity development response is needed to align the strategy with national and donor strategic priorities and available resources. The implementation of a capacity development plan requires clear responsibilities, funding sources and mechanisms for coordination and management of the whole process. Goals, expected results and key performance indicators should be incorporated into the implementation plan or national budget so as to enable the monitoring and evaluation phase (Step 8) to adequately reflect progress.

STEP 8: Monitor and evaluate. Evaluation of capacity development promotes institutional arrangements, leadership, knowledge and accountability. This step defines the process of monitoring and evaluating capacity development activities, not only at the end of the implementation phase but throughout the process at defined intervals.

Stakeholders and partners involved in Steps 1–3 will need to take part in the development of the plan when it is put forward for approval and funding. Those involved in national planning and finance must add budget realism to the preparation of a capacity response, which may feed back into the definition of requirements. All players in the process have a role in monitoring and evaluating the implementation of the capacity development response.

Responding to urgent needs in emergencies is a crucial aspect of capacity development in least developed countries (LDCs) and small island developing States (SIDSs). The eight-step process will be applied where possible, but priority is given to a rapid response and to the implementation of a capacity development plan based on previously identified requirements and baseline, and on a gap analysis, with expedited planning, national commitment and resource mobilization.

The four dimensions of capacity development

The WMO Capacity Development Strategy focuses on the following dimensions:

- Human resources: Individuals equipped with the education, skills, knowledge and training that enable them to generate, communicate and use weather, water and climate information for effective decisionmaking, and to manage the process;
- Infrastructural capacity: The capability of NMHSs to access the resources needed to generate, use and archive weather, water and climate data and to access tools relevant to decisionmaking, such as observing networks, data management systems, computer hardware and software, internet, manuals and scientific literature;
- Procedural capacity: The capability of NMHSs to define and advance best practices for generating and using weather, water and climate information. This includes the processes needed to carry out projects, programmes or policies, to monitor their implementation and evaluate results;
- Institutional capacity: The capability of NMHSs to (a) articulate their mandate, elaborate their management structure or envision the desired course of the organization; (b) develop a strategy, translate it into an actionable plan and prepare a budget; (c) engage with stakeholders to identify and create consensus around capacity development issues and related policies, regulations and laws that enable effective provision of services.

These perspectives are distinct and yet interrelated. While highly technical human resources and infrastructural capacities have been relatively well addressed during the long history of WMO technical cooperation, procedural and institutional capacities are also required to implement and

review policies, strategies, programmes and projects. A suite of management and leadership skills need to be added to human resource capacities to enable NMHSs to build stronger national political ownership, develop relevant policies and legal frameworks and enhance sustainability by linking regional, subregional and national planning processes.

Quality management

The World Meteorological Organization encourages NMHSs to implement a quality management system (QMS) and has defined a Quality Management Framework (QMF) to provide advice on development and use of QMSs for meteorological and hydrological organizations. The ultimate goal of a QMS is to encourage and support the continuous improvement of products and services through quality control, quality assurance and quality improvement of the organizational processes.

The CDS process described above may be viewed as a supplement to the WMO QMF. Even if there are no internal or external requirements for an NMHS to apply a QMS, the eight-step process suggests what is needed to build and sustain the capacity of NMHSs and thus to address the requirements of national and international stakeholders.

ANNEX 4: THE CAPACITY DEVELOPMENT STRATEGY AND WMO PRIORITY AREAS

In accordance with the *WMO Strategic Plan 2012-2015*, the main objectives of the capacity building strategic priority area are to:

(a) Focus particular attention on the education and training needs of National Meteorological and Hydrological Services (NMHSs) in developing countries, least developed countries (LDCs) and small island developing States (SIDSs), with a view to addressing specific issues such as forecaster qualifications for aviation meteorology, the Global Framework for Climate Services (GFCS) and disaster risk reduction;
(b) Increase awareness of the socio-economic benefits derived from products and services provided by NMHSs and regional centres, including their contribution to the achievement of the Millennium Development Goals, particularly by promoting gender equality and empowerment of women;
(c) Assist NMHS managers by supplying tools for building effective communication with governments, policy- and decision-makers and development partners, and to enhance their management and leadership qualities to develop, implement and review policies, strategies, programmes and projects;
(d) Continuously assess and address NMHS training needs, including professional training and development, technical training, project development and management training;
(e) Expand the number of strategic partnerships with internal and external stakeholders;
(f) Support the above initiatives through enhanced resource mobilization.

Success in these efforts, especially in developing and least developed countries, will require cooperation with Members and international and regional partners to mobilize resources from multiple extrabudgetary sources.

The Sixteenth World Meteorological Congress called for the preparation of a Capacity Development Strategy (CDS) that would:

(a) Build upon, and contribute to, the implementation of major international initiatives, including the Millennium Development Goals (MDGs), the Fourth United Nations Conference on the Least Developed Countries (UNLDC-IV), the GFCS and regional programmes;
(b) Improve coordination with those programmes and thus better contribute to building the fundamental capacities and capabilities of NMHSs in developing countries, particularly those in transition, LDCs and SIDSs;
(c) Facilitate stronger national political ownership, development of relevant policies and legal frameworks, and enhance sustainability by linking regional, subregional and national planning processes;
(d) Improve collaboration and consistency of the development efforts within the Organization, including regional associations, technical commissions, WMO and WMO co-sponsored programmes, and across all departments within the Secretariat.

Congress also requested that the following issues be considered in the development of the CDS:

(a) How to assess the capabilities of Members to accurately identify gaps and non-compliance with WMO standards, and assist them in the long-term monitoring of the success of the CDS. Congress considered that this could be part of the Country Profile Database;
(b) How to improve compliance with WMO standards and maintain political support for the development of NMHSs. Stronger advocacy by WMO bodies and officers to encourage compliance and support could be an important aspect of the CDS;
(c) How to achieve national ownership, as part of the development process, and ensure that NMHS development plans are consistent with NAPAs, where applicable, and with the respective WMO Regional Association Strategic Plan;

(d) How to ensure that tailored NMHS products and services are relevant for national decisionmakers, development agencies, civil society and the general public. Congress noted that the WMO Strategy for Service Delivery had found that early consultation with stakeholders in the development process was an important aspect of achieving national buy-in of new products and services;
(e) How to evaluate sustainability and impact of project outputs and outcomes;
(f) How to ensure that capacity development activities are scalable, based on the level of voluntary contributions from Members and support from other sources such as aid organizations;
(g) How to include WMO global priority areas in the CDS to help set priorities for the use of resources. For the 2012–2015 financial period, these priority areas are: the development of GFCS, aviation, the WMO Integrated Global Observing System/WMO Information System (WIGOS/WIS) and disaster risk reduction (DRR) activities;
(h) How to recognize the key role played by regional associations, technical commissions, WMO co-sponsored programmes and Regional Offices in integrating the requirements of the Regions, the provision of technical advice and a stronger regional presence through coordination and advocacy;
(i) How to encourage volunteerism and bilateral cooperation in the work of WMO in developing countries.

The CDS was designed to address these issues.

As mentioned under item (g) above, the CDS also focuses on the needs of developing countries in four WMO global priority areas:

The Global Framework for Climate Services

The Global Framework for Climate Services aims to develop the capacity of countries to apply and generate climate information and products relevant to their particular concerns, thus all aspects of GFCS include capacity development. The World Climate Conference-3 recognized that many countries lacked policies, institutions or human resources, with the right skills or practices, enabling them to take advantage of new or existing climate data and products or to create national user interface groups that might facilitate a national dialogue on these issues. The capacity development component of the GFCS Implementation Plan can be seen as the foundation that links and supports four other pillars: Observations and Monitoring, Climate Services Information Systems, User Interface Platform, Research, Modelling and Prediction.

The capacity development component of the GFCS Implementation Plan tackles two separate but related areas: (a) the particular capacity development requirements identified in the other four pillars; and (b) more broadly, the basic requirements (national policies/legislation, institutions, infrastructure and personnel) to carry out any GFCS-related activities. In both areas, capacity development actions under the Framework will facilitate and strengthen, not duplicate, existing activities. The capacity development component of the GFCS Implementation Plan complements the WMO Capacity Development Strategy and its Implementation Plan, and the strategies of GFCS partners and other agencies.

Key questions, identified in the capacity building annex to the GFCS Implementation Plan, that need to be asked in this financial period are:

- Are there national laws or regulations authorizing the generation, collection, communication (nationally and internationally) and archiving of climate information (including data) and products?
- Are there institutions appointed to generate, collect, communicate and archive climate information and products at the national level?
- Do the authorized institutions have the facilities, procedures and sufficient personnel to carry out their tasks in a sustainable manner?
- Do staff have the appropriate skills and qualifications to carry out the required tasks? Do they meet the specific GFCS capacity development requirements?

- How can the Regional Climate Centres and Regional Climate Outlook Forums be improved to best serve the goals of the GFCS?

The first two questions correspond primarily to Strategic Objective 2 of the CDS. The third and fourth questions relate to Objectives 1 and 6. The fifth question relates to Objective 4. The need for information on the capabilities of Members relates to Objective 3. Once the information is gathered and analysed, the institutional, infrastructural, human and procedural resources required to implement GFCS-related project on a sustainable basis can be determined. The information gathered will also help define the collaboration and coordination mechanisms between various players such as the United Nations agencies and programmes, government institutions, non-governmental organizations and the private sector. Incorporating the provision of operational climate services into the development agenda at national, regional and global levels may become more relevant in the long run.

The WMO Aeronautical Meteorology Programme (Aviation)

The capacity development activities of the Aeronautical Meteorology Programme are:

- To continue to assist NMHSs in completing the quality management system (QMS) process and becoming ISO certifiable, with a recommendation to become fully ISO certified;
- To further explore and develop a system of regional "buddy" auditors from within the NMHSs who would help each other prepare and maintain QMS readiness for official external audits, as part of the "twinning & mentoring" framework;
- To support NMHSs and other providers of meteorological services to civil aviation in their efforts to obtain appropriate and adequate resources, through cost recovery and/or national budgets, considering that any QMS implies the availability of such funding (letters and/or joint missions with the International Civil Aviation Organization (ICAO));
- To support the implementation of competency assessments through provision of guidance, assessor training and, where necessary, targeted implementation assistance based on twinning and Secretariat support;
- To ensure that courses in aviation meteorology at Regional Training Centres (RTCs) provide the knowledge that enables all NMHS staff to meet the competency requirements, and that RTCs provide remedial training as necessary to address identified competency gaps;
- To cooperate with ICAO regional offices in monitoring SIGMET compliance by designated centres, and to offer remedial training and targeted implementation support as part of the QMS effort;
- To encourage and help Regional Instrument Centres to become ISO certified as a requirement for the necessary instrument calibration of NMHSs under a QMS;
- To update Members on evolving scientific and technological developments that affect services to civil aviation, such as warnings for volcanic ash, space weather and nuclear and chemical incidents, as well as on new services to air traffic management;
- To provide information and, where necessary, training in new weather data exchange models, based on XML/GML data representation, guided by the Commission for Aeronautical Meteorology and the Commission for Basic Systems;
- To encourage improved collaboration between NMHSs and civil aviation authorities at the national and regional level;
- To promote the increased availability of AMDAR data, provided by airlines to NMHSs, particularly in oceanic and traditionally data-sparse areas.

The WMO Integrated Global Observing System and WMO Information System

A coordinated capacity development effort at global, regional and national levels is of paramount importance to developing countries. This is especially true of NMHSs of least developed countries and small island developing States, to enable them to develop, improve and sustain the national observing components of WIGOS. However, capacity development efforts outside WIGOS but in closely related areas are needed to improve access to and effective utilization of observations, data and products, and related technologies.

The WIGOS capacity development activities at national and regional levels are focused on:

- Helping Members to introduce or improve institutional mandates and policies that enable effective implementation, operation and management of observing systems;
- Filling the existing gaps in the design, operation and maintenance of WIGOS observing systems, focusing on both infrastructural and human capacity development, especially for NMHSs of least developed countries and small island developing States;
- Technological innovation, technology transfer, technical assistance and decision-support tools.

Capacity development in satellite applications for developing countries, LDCs and SIDSs is also addressed in the Implementation Plan for the Evolution of GOS (see *Implementation Plan for Evolution of Space and Surface-based Sub-systems of the GOS* (WMO/TD-No. 1267)). The virtual laboratory will continue to grow and help all WMO Members realize the benefits of satellite data.

The WMO Information System (WIS) capacity development activities are focused on:

- Ensuring that each NMHS is connected to the Global Telecommunication System, so that observation data from the national observing networks for international exchange are available globally;
- Ensuring that each NHMS has basic expertise on metadata management and application, so that each Member will be able to contribute to and benefit from WIS.

Disaster Risk Reduction

The general objective of the programme is to support the development of an end-to-end multi-hazard early warning system. This requires bringing together local and national civil protection organizations and hydrometeorological agencies to discuss and formalize protocols that describe actions to be taken in the event of an extreme weather event. Protocols should include defined courses of action for weather warning and alerts, communication practices, community preparedness and post-emergency response plans. The participation of a wide range of interest groups from the community, government, private and public sector will be required for the development of those protocols.

From a technical point of view, protocols should take advantage of available data to complete hazard and risk assessments, should contain a legislative and policy underpinning, and should include plans for risk financing and transfer.

Such protocols and operating arrangements will inevitably vary in each country. Not only will the hazard profile change with geography, but allocation of services and responsibilities among civil protection agencies, NMHSs and other services will differ from country to country. Similarly, legal and sociocultural factors will affect how information is disseminated within government and to the public. Additionally, countries, due to size, resource constraints or other reasons such as the quest for efficiency through synergies, may choose to draw more limited multinational protocols and develop cooperative (regional or subregional) warning systems.

As decided by the Executive Council at its sixty-fourth session, disaster risk reduction can be advanced through the Programme planned knowledge products and training, as well as through the continuation of the following Expert Advisory Groups:

- Climate Services for Hazard/Risk Analysis
- Multi-hazard Early Warning Systems
- Climate Services for Disaster Risk Financing
- Meteorological and Climate Services for Humanitarian Planning, Preparedness and Response.

ANNEX 5: CATEGORIZATION OF NATIONAL METEOROLOGICAL AND HYDROLOGICAL SERVICES

The role of National Meteorological and Hydrological Services (NMHSs) has changed in the last decades due to the impacts of climate change and the demand for more integrated and multidisciplinary services to meet global societal needs. This demand is expected to grow as severe weather and climate events increase in frequency and intensity. The traditional NMHS is compelled to restructure its business model to meet such demand and requires new partnerships to share resources, keep pace with new technology, create incentives to retain skilled manpower and strive to position its services in the political goodwill of those in charge of allocating resources. The National Meteorological and Hydrological Services of developing countries, least developed countries and small island developing States are the least equipped to cope with this transition. The capacity development activities of WMO will, therefore, focus on these vulnerable countries.

National Meteorological and Hydrological Services can be classified into four categories, according to the level of service they are able to provide and the resources required for ensuring these services. The purpose of this classification system is to help countries better understand the capabilities required to provide weather, climate and hydrology services, and identify what is needed in their own NMHS to ensure the desired service level. The classification can also be a motivating factor by giving an NMHS the elements needed to advance towards a higher level of service. Similarly, the information will facilitate advocacy and inform development partners of a country's capabilities and needs. A better placement of NMHSs in such a scheme can also be used by WMO to understand, support and monitor the development of NMHSs thereby providing a powerful tool to assess the effectiveness of WMO efforts.

The extent to which an NMHS can deliver services will depend on its strengths, capabilities and given mandates. For example, the competence/capability of an NMHS to support and contribute to climate risk management will depend on its capacity to access and process routine and specialized observational data, to manage and analyse climate data, to convert the data into logical and usable information and products, and to contribute to the development of a range of tools to support decisionmaking. Currently, NMHSs are engaged in the delivery of climate services, mostly through making climate observations, managing and analysing the data collected, and distributing climate products, which describe its past, present and possible future states. The engagement diminishes to varying degrees as one moves into the value-added domain of customized climate products and the application of tools.

A hierarchy of national services is given in Table 4, with a brief description of the capabilities expected of an NMHS at each level. The specific services for weather, climate or hydrology will vary to some degree and national situations may differ, especially as the level of service increases. All NMHSs, however, should be able to function at the Category 1 level. For example, in the area of climate services, all NMHSs should be able to perform basic climate services. At present, all but a few NMHSs provide some basic climate services through their observing, archiving, data management and basic analysis capabilities. Optimally, climate service staff should be proficient in climate statistics, including basic homogeneity testing and quality assurance techniques. They should also be capable of interpreting products provided by Regional Climate Centres in order to place national/local conditions within a broader context.

Table 4. Categorization of NMHSs

Level of service	Weather services	Climate services	Hydrology services	Description of capacity needed to achieve service level
Category 1 - Basic	➢ Weather observations ➢ Weather data management ➢ Interaction with users of weather data and products	➢ Climate observations ➢ Climate data management ➢ Interaction with users of climate data and products	➢ Hydrological observations ➢ Hydrological data management ➢ Interaction with users of hydrology data and products	➢ Small network of quality-controlled observations ➢ Basic data-processing, archiving and communication systems ➢ Little or no backup/offsite storage or contingency options ➢ Staff: observers and some meteorologists trained to the standards described in the Basic Instruction Package (BIP) ➢ No 24/7 operation ➢ Rudimentary quality management system ➢ No research and development
Category 2 - Essential	➢ Medium-range (synoptic scale) forecasts and warnings ➢ Established links with media and disaster risk reduction (DRR) communities	➢ Seasonal climate outlooks ➢ Climate monitoring	➢ Hydrological data products for design and operation of water supply structures ➢ Water level and flow monitoring ➢ Short-term flow forecasts (low flows) ➢ Flood forecasting	➢ Able to take and integrate observations from other parties ➢ Well-established protocols for emergencies, backup of data and minimum offsite facilities ➢ Staff: observers and meteorologists trained to BIP standards ➢ 24/7 operation ➢ Well-established quality management system ➢ Able to access most numerical weather prediction data/ products from other centres ➢ Small research and development unit ➢ Some partnerships as junior member
Category 3 - Full	➢ Specialized weather products for a wide range of sectors ➢ Well integrated into DRR communities and having mature links with the media	➢ Specialized climate products ➢ Decadal climate prediction ➢ Long-term climate projections	➢ Seasonal stream flow outlooks ➢ Specialized hydrology products	➢ Advanced observation equipment ➢ Ability to run its own numerical weather prediction suite ➢ Research and development unit ➢ Well-educated/trained staff ➢ Own training group ➢ Developed library and information services ➢ Active partnerships with NMHSs taking a leading role
Category 4 - Advanced	➢ Customized weather products ➢ Weather application tools	➢ Customized climate products ➢ Climate application tools	➢ Customized hydrology products ➢ Hydrology application tools	➢ Advanced observations ➢ Leading research and development team ➢ Well-developed education and training unit

ANNEX 6: GLOBAL AND REGIONAL CENTRES IN SUPPORT OF CAPACITY DEVELOPMENT

There are different types of WMO designated global and regional centres, including Global and Regional Centres for the Global Data-processing and Forecasting System, Regional Telecommunication Hubs, Global Information System Centres, Regional Instrument Centres, Regional Radiation Centres and Regional Training Centres. Currently more than 200 global and regional centres offer specific support to National Meteorological and Hydrological Services (NMHSs) and play a key role in capacity development.

WMO Regional Climate Centres, for example, are centres of excellence that deliver regional products, such as long-range forecasts, which support regional and national climate activities thereby strengthening the capacity of WMO Members in a given region to deliver better climate services to national users.

Regional centres could play a stronger role if they were governed jointly by regional associations, technical commissions, Executive Council bodies and the host Member/organization. In this partnership, regional associations would be expected to play a key role in advising, monitoring and overseeing regional centres.

Further information on WMO global and regional centres can be found at http://www.wmo.int/pages/prog/dra/CDS.html.

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