

**CONTRIBUTIONS BY THE WORLD
METEOROLOGICAL ORGANIZATION TO THE
MILLENNIUM DEVELOPMENT GOALS**



World
Meteorological
Organization

Weather • Climate • Water

WMO-No. 1080

United Nations Millennium Development Goals

In September 2000, world leaders adopted the United Nations Millennium Declaration, committing their nations to a global partnership for reducing extreme poverty. The Declaration set out eight goals with associated time-bound, measurable and achievable targets that have become known as the Millennium Development Goals (MDGs), with a deadline of 2015 for achieving them.



Goal 1: Eradicate extreme poverty and hunger



Goal 5: Improve maternal health



Goal 2: Achieve universal primary education



Goal 6: Combat HIV/AIDS, malaria and other diseases



Goal 3: Promote gender equality and empowerment of women



Goal 7: Ensure environmental sustainability



Goal 4: Reduce child mortality



Goal 8: Develop a global partnership for development

The goals are interrelated and should be seen as a whole “to create an environment – at the national and global levels alike – that is conducive to development and the elimination of poverty.”

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The first Goal – eradicating extreme poverty and hunger – represents a major challenge. The World Meteorological Organization and its network of National Meteorological and Hydrological Services across the globe play an important role in the drive to eliminate extreme poverty and hunger by supporting agriculture and food security, disaster risk reduction, and key economic growth drivers.

The seventh Goal – ensuring environmental sustainability – corresponds roughly to the areas in which the World Meteorological Organization has been especially successful in projecting its fundamental scientific leadership: authoritative science, disaster risk reduction and climate change adaptation.



The sixth, fourth, fifth and third Goals – combating HIV/AIDS, malaria and other diseases, reducing child mortality, improving maternal health, and promoting gender equality and empowerment of women – have been addressed by National Meteorological and Hydrological Services in developing countries, with assistance from the World Meteorological Organization, by providing tailored weather, climate and water information and services to the health sector for disease prevention and control, and to the population for making decisions on whether to dry laundry, crops, foodstuffs, tie-and-dye batik, and so on, indoors or outdoors.

Foreword

In September 2000, at the dawn of a new millennium and in the midst of the United Nations golden jubilee, an impressive number of Heads of State and Government gathered at the United Nations Headquarters to reaffirm their faith in the Organization and its Charter as indispensable foundations of a safer, more prosperous and equitable world through the Millennium Declaration, a fundamental commitment that was soon translated into a roadmap of eight time-bound and measurable goals to be reached by 2015: the Millennium Development Goals (MDGs).

The first MDG is to *eradicate extreme poverty and hunger*. The next five Goals are related to the consequences of acute paucity. From the beginning, WMO has been highly proactive in contributing to the achievement of these MDGs, often in partnership with other organizations, by providing appropriate weather, climate and water information, as well as services related to health, food security and water quality, especially during the recent food and financial crises. WMO has also supported gender-neutral capacity development.

The seventh Goal – *ensuring environmental sustainability* – relates to the areas most directly related to WMO's fundamental scientific leadership: authoritative science, disaster risk reduction and climate change adaptation.

The eighth Goal – *creating a global partnership for development*, which emphasizes the key role of developed countries in assisting the developing world – is important for WMO in that one of its primary missions is to facilitate worldwide cooperation.

Eleven years after the Millennium Declaration, WMO can demonstrate its significant contributions to the achievement of the MDGs, although, admittedly, this improvement may not always have been as globally uniform as desired. Accordingly, as we

approach 2015, it will become increasingly crucial to hasten the pace and to improve the homogeneity of sustainable development, for which a key element will be the Global Framework for Climate Services (GFCS), recently approved by the Sixteenth World Meteorological Congress (Geneva, May/June 2011).

This publication highlights the significant linkages between WMO weather-, climate- and water-related programmes and activities, and the achievement of the MDGs. More importantly, it aims to illustrate how, under the rising threat of climate change, the production, delivery and effective use of weather and hydrological forecasts, climate predictions and related services can be utilized by communities and socio-economic sectors to achieve most of the MDGs. The given examples of "Ways WMO helps" were compiled from best practices and success stories, especially from developing and least developed countries. These examples are intended as an illustration rather than a comprehensive list of the efforts undertaken by WMO and the National Meteorological and Hydrological Services (NMHSs) of its 189 Members, often with the support of development partners, to increasingly advance the vision of the Millennium Declaration.

Time is running out. Let us continue to live up to our commitment!



(M. Jarraud)
Secretary-General of WMO



Introduction

The Millennium Development Goals (MDGs) are the cornerstone of development policies and activities around the world. Collectively, they constitute a road map for reducing poverty and hunger, saving children and mothers from premature death, providing sustainable, decent livelihoods and preserving the environment for future generations.

Weather-, climate- and water-related environmental conditions, particularly extreme events and disasters, have a significant influence on the cultures, traditions and development paths of societies worldwide, and, consequently, on the achievement of the MDGs. This influence is especially evident in key sectors, such as agriculture and food security, health, disaster risk reduction, water resources management, environmental protection, transport, energy and tourism. In addition, increased frequency and intensity of natural hazards due to climate variability and change pose critical challenges to many countries, in particular developing countries, including the least developed countries (LDCs) and Small Island Developing States (SIDS).

In this context, weather-, climate- and water-related information and services are useful inputs for socio-economic development planning and programme

activities. The potential benefits of enhancing the quality, delivery and use of such information and services in decision-making are enormous, but realizing these benefits requires improvement to the meteorological and hydrological infrastructure, human resources development, and engagement between the providers and users of the information and services.

The World Meteorological Organization (WMO) has a normative and coordinating role in monitoring, forecasting and predicting weather, climate and water events, and in issuing widespread early warnings of extreme weather-related events through National Meteorological and Hydrological Services (NMHSs). In recognition of the increasing relevance of WMO programmes and activities for nearly all socio-economic sectors, the preamble to the WMO Convention emphasizes meteorological, hydrological and related services (see box below) in support of relevant national and international needs. In helping to meet this objective, the WMO Strategic Plan shifts the focus from programmes to expected results that will contribute to resolving major societal issues, including:

- Improving protection of life and property (related to the impacts of hazardous weather, climate, water

Some of the weather, climate and water information products and services provided by the World Meteorological Organization and National Meteorological and Hydrological Services

- Very short-range weather forecasts (2–12 hours)
- Short-range weather forecasts (12–72 hours)
- Medium-range weather forecasts (3–10 days)
- Extended-range weather forecasts (10–30 days)
- Historical climate records and monthly, seasonal, interannual to decadal climate predictions and long-term projections
- Warnings of extreme weather, climate and water events (drought, floods, tropical cyclones, tornadoes, heat-waves, and so forth)
- Specialized weather/climate products for sectoral users such as aviation, agriculture, water resources, energy, health, shipping, insurance and tourism
- Hydrological forecasts
- Atmospheric environmental monitoring and assessments (air quality, ozone, greenhouse gases, acid rain, and so forth).
- Status of the global climate

and other environmental events, and increased safety of transport on land, at sea and in the air);

- Poverty alleviation, sustainable livelihoods and economic growth (in connection with the MDGs), including improved health and social well-being of citizens (related to weather, climate, water and environmental events and influence);
- Sustainable use of natural resources and improved environmental quality.

Thus, WMO contributes directly to eradicating extreme poverty and hunger (MDG 1) and ensuring environmental sustainability (MDG 7), and indirectly to empowering women (MDG 3) and to health-related MDGs (MDGs 4, 5 and 6). Many of the MDGs could not be achieved without the appropriate use of relevant weather-, water- and climate-related information, products and services.

Considering that climate, the environment and sustainable development are inextricably linked, WMO pays particular attention to the achievement of the MDGs in developing countries, especially in LDCs and SIDS. Consequently, in 2003, the World Meteorological Congress established a special programme for LDCs aimed at strengthening and enhancing the capacities of the respective NMHSs to contribute effectively to national development through the provision of relevant information, products and services to weather- and climate-sensitive socio-economic sectors.

The following chapters describe how WMO and NMHSs contribute to and support the relevant MDGs, starting with the higher impact benefit areas. They also illustrate “Ways WMO helps”, based on a selection of good practices. The chapter on the way forward offers guidance for reinforcing the contribution of WMO and NMHSs to the MDG Action Agenda at all levels.

Contributing to the eradication of extreme poverty and hunger (MDG 1)



Agriculture plays a crucial role in developing countries – particularly in LDCs – both in promoting food security and, for much of the population, as the major economic activity with direct linkages to rural development, which results in eradication of poverty and hunger. Agriculture, however, is among those sectors most vulnerable to weather and climate impacts. Food production depends on the efficient use of resources, the most critical of which is water. Variations in weather and climate factors, especially rainfall, are the principal source of fluctuations in global food production, particularly in the semi-arid, tropical countries of the developing world.

Weather-, climate- and water-related hazards (see box below) can result in the

The eradication of poverty has become a major challenge shaping all aspects of socio-economic development, especially in developing countries. The World Meteorological Organization and its network of NMHSs across the globe play an important role in the drive to eliminate extreme poverty and hunger by supporting agriculture and food security, disaster risk reduction and key economic growth drivers.

Supporting agriculture and food security

The number of people suffering from chronic hunger, estimated at 925 million in 2010, is higher today than when the MDGs were launched. Most of the hungry are living in the highly populated regions of South Asia and sub-Saharan Africa, where poverty is widespread and agricultural areas that are extensive but low in productivity are prone to climate-related hazards.

destruction of assets and livelihoods, significant loss of life, and low agricultural production and productivity, particularly in developing countries. Droughts and floods cause crop failure and reduce production, while heavy rainfall washes away fertilizers, and hailstorms damage crops, leading to greater poverty and hunger, especially among rural communities.

Climate change is expected to increase the frequency and intensity of extreme weather, climate and water events, putting stress on crops and livestock. Rising temperatures will also pose a threat to agriculture by encouraging pests and diseases. In some African countries, crop yields from rainfed agriculture could decline by as much as 50 per cent by 2020. Yet, meeting food demand in developing countries, particularly in LDCs, will require cereal yields to rise by 40 per cent.

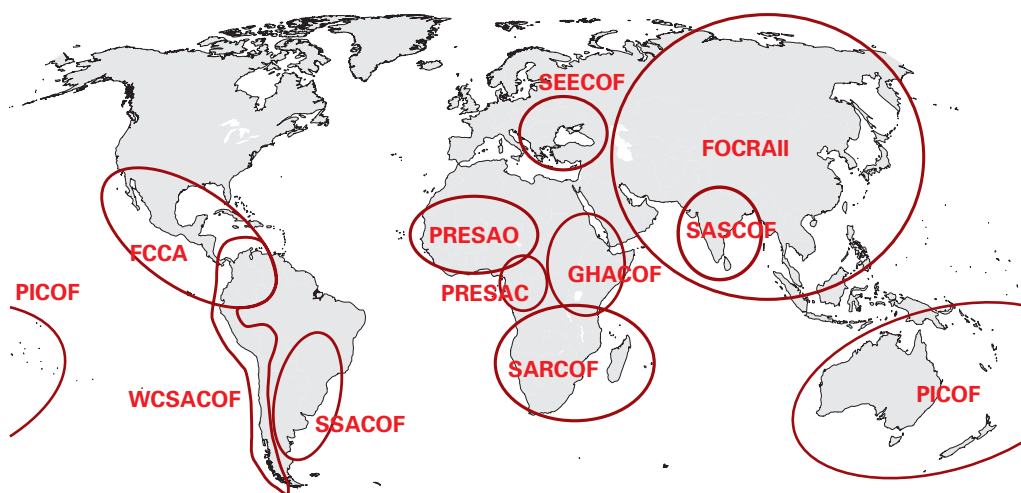
Weather-, climate- and water-related hazards

Droughts	Coastal storms
Flash floods	Smoke, dust or haze
River floods	Storm surges
Severe thunderstorms	Dense fog
High winds	Tropical cyclones
Landslides/mudslides	Tornadoes
Hailstorms	Extreme cold
Heatwaves	Avalanches
Heavy snow	Freezing rain
Sandstorms	Air quality

→ Ways WMO helps

The World Meteorological Organization aims to enhance the capacity of NMHSs in developing countries, thus enabling them to provide weather, climate and water information, and products and services that can be applied to support income-generating activities. Weather and climate information and services allow farming communities to better manage climate risks. The communities are able to make informed decisions, which leads to minimization of crop losses and maximization of production, resulting in better food security and improved livelihoods. The most relevant WMO programmes in this regard are those on Agricultural Meteorology, Disaster Risk

REGIONAL CLIMATE OUTLOOK FORUMS



Reduction, Hydrology and Water Resources, and Public Weather Services.

The World Meteorological Organization has been instrumental in establishing and organizing Regional Climate Outlook Forums (RCOFs) in eleven subregions of the world (see box above). The forums develop and issue regional seasonal climate outlooks, which are downscaled and used at the national level by policymakers and sectoral users, including poor people whose livelihoods depend on climate stability. The RCOF process has facilitated a better understanding of the links between the climate system and socio-economic activities, and has prompted an increasing demand for climate services in many parts of the world.

The following examples show how the effective use of weather, climate and water information and services can contribute to reducing poverty and hunger, and improving livelihoods in the rural communities of developing nations.

- **In Mali**, in collaboration with development partners, WMO has assisted the National Meteorological Service in implementing an agrometeorological project for delivering weather and climate information and services to rural communities. The effective use of these services has reduced the re-sowing rate by 35 per cent and increased crop yields by 20 to 25 per cent, thereby boosting farmers' incomes. As a consequence, farmers are now prepared to invest in new technologies that can raise yields and incomes further. This

project, which is also a climate change adaption mechanism, is being replicated in other West African countries.

- **In Malawi**, smallholder farmers who receive loans for seeds and fertilizer are compensated during times of drought using a weather-index-based insurance scheme that relies on weather and climate information provided by the Malawi Meteorological Service. This insurance scheme is a useful tool for ensuring sustainable incomes for poor farming communities. Similar initiatives are being implemented in Ethiopia, India, Nicaragua, Thailand and Viet Nam.
- **In Niger, Uganda and Zambia**, the respective National Meteorological Services disseminate weather and climate information directly to remote poor populations through the collaborative effort Radio and Internet for the Communication of Hydro-Meteorological Information for Rural Development (RANET). The information is provided in a timely and easily understandable format, enabling users to make informed decisions in their cropping operations.
- **In South America**, WMO, in collaboration with partners, has supported establishment of the International Research Centre on El Niño (CIIFEN) in Guayaquil, Ecuador. The centre monitors El Niño and La Niña events, and issues regional climate outlooks that help Andean communities reduce adverse social and economic impacts of climate on agriculture.

- **In Africa**, WMO and cooperating partners have supported the establishment of regional drought monitoring centres in Nairobi (Kenya), Gaborone (Botswana) and Niamey (Niger). These centres issue seasonal climate outlooks and warnings of impending droughts and floods. The information they provide supports the efforts of governments and regional economic communities to better address food-security issues.

Supporting disaster risk reduction

Globally, 90 per cent of natural disasters are caused by weather-, climate- and water-related hazards, such as droughts, floods, windstorms, tropical cyclones, storm surges, extreme temperatures, landslides and wildfires. In LDCs, the percentage is even higher. Each year, weather-related disasters cause significant loss of life and set back economic and social development by years, if not decades. Between 1980 and 2010, nearly 9 600 disasters caused by natural hazards took the lives of over 2.5 million people and produced economic losses estimated at over US\$ 1.3 trillion. Some extreme weather and climate events are expected to become more frequent and/or more severe due to climate change, as stressed by the Intergovernmental Panel on Climate Change (IPCC, 2007).

The World Meteorological Organization helps to avert disasters by giving vital support to NMHSs in providing timely forecasts and warnings of severe weather and natural hazards, such as drought and floods.

National Meteorological and Hydrological Services contribute to all four phases of an early warning system: prevention, preparedness, response and recovery. The use of weather, climate and water information to assess risks contributes to mitigation, while timely forecasts and warnings of severe weather, and prediction of extreme temperatures and drought or floods aid preparedness. Updated warnings, forecasts, observations and coordination with emergency and relief agencies are a factor in the response phase. Finally, specialized, tailored and targeted forecasts, as well as other advisories, assist post-disaster recovery and reconstruction operations.

→ Ways WMO helps

In Southern Africa, a severe-weather forecasting demonstration project has been implemented in six countries: Botswana, Madagascar, Mozambique, South Africa, the United Republic of Tanzania, and Zimbabwe. The project has improved capabilities for forecasting severe weather, in particular heavy precipitation and strong winds, and is being extended to all 14 Southern African Development Community (SADC) countries and Comoros.

The World Meteorological Organization has initiated or strengthened three systems that contribute to increasing the lead time and accuracy of hydrological forecasts at a global level. These are the Ibero-American network on monitoring and forecasting of hydrometeorological phenomena (PROHIMET), the Global Flood Alert System and the Flash Flood



Guidance System, which has regional pilot projects in nine Southern African countries, six Central American countries and seven South-East Asian countries.

The World Meteorological Organization continues to support NMHSs in improving tropical cyclone and related flood and storm surge forecasts and warnings through regionally coordinated systems. It supports workshops on tropical cyclone/hurricane forecasting and warnings, as well as sessions of the five tropical cyclone regional bodies.

Examples of practical use of weather, climate and water information for disaster risk reduction in developing countries include the following:

- **In Mozambique**, severe floods in 2000 killed 700 people and affected more than 2 million; economic growth was cut from 10 to 2 per cent. The country's Meteorological and Hydrological Services now play a critical role in monitoring tropical cyclones, collecting rainfall and river flow data, and issuing appropriate warnings in formats easily understood by local people. This early warning system has reduced the adverse impacts of subsequent floods.
- **In Bangladesh**, a Tropical Cyclone Preparedness Programme was set up following the devastating Cyclone *Bhola* in 1970. The Bangladesh Meteorological Department issues cyclone warnings, which are transmitted through high-frequency radio transmitting stations operated by 33 000 volunteers throughout the coastal region of the country. These warnings, coupled with other measures, including the provision of shelters, have considerably reduced the socio-economic impacts of floods in recent years. The Cyclone Preparedness Programme now forms part of the Comprehensive Disaster Management Programme for Bangladesh.
- **In Cuba**, a Tropical Cyclone Early Warning System has been established, with which the National Meteorological Service, the media and civil defence forces work in close partnership to educate, warn and prepare the public. The system has been instrumental in reducing the loss of life and damage to property from tropical cyclones in recent years.
- **In China**, the Shanghai Multi-Hazard Emergency Preparedness Programme covers 15 categories of weather hazards, including typhoons, risk of

flooding, dense fog and heatwaves. It sets out the role and responsibilities of all of the relevant agencies in preparing for and responding to hazards, from dissemination of warnings to public education and awareness.

- In South-Eastern Europe, WMO, in coordination with the United Nations Convention to Combat Desertification (UNCCD), has established a Drought Management Centre for Southeastern Europe (DMCSEE) in Slovenia to coordinate and facilitate the development, assessment, and application of drought risk management tools and policies, with the goal of improving drought preparedness and reducing drought impacts.

Through its own Disaster Risk Reduction programme, WMO is contributing to the Hyogo Framework for Action (HFA), which aims to build the resilience of nations and communities to disasters. Through the framework, country-level initiatives are underway to unite scientific and technical agencies, and those responsible for disaster risk management and other relevant sectors (agriculture, health, environment, and so on) in coordinating the development of national disaster risk management strategies. Disaster risk management is also called for by the Bali Action Plan of the United Nations Framework Convention on Climate Change (UNFCCC).

In addition, WMO is helping to develop multi-hazard early warning systems for disaster risk reduction. Through its six Regional Specialized Meteorological Centres, WMO issues tropical cyclone information, bulletins and alerts to all countries at risk. It is also collaborating closely with the Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization (UNESCO IOC) on tsunami early warning systems in various regions, including the Pacific and Indian Oceans. The World Meteorological Organization aims to ensure that all countries, particularly LDCs and SIDS, have the systems, infrastructure, human capacity and organizational structure to develop and utilize early warning systems for reducing the risks and impacts of natural disasters.

Supporting other economic growth drivers

Transport, energy and tourism make vital contributions to economic growth, especially in developing countries. But their sustainability is threatened by the impacts of climate variability and change. The use of weather, climate and water information and services



increases the economic value addition by providing users in these and other commercial sectors with a sound basis for making optimal decisions.



Transport

Industry and trade are the growth engines of economies. But access to goods and services markets, on which trade depends, requires transport infrastructure to move goods and people around. High-

quality transport infrastructure helps boost trade by making it easier and cheaper to supply and distribute goods to domestic, regional and international markets. Poor rural communities also benefit from improved access to local markets.

Transport infrastructure, however, is highly vulnerable to weather-, climate- and water-related extreme events. Disruptions to the supply, transport and distribution chains, upon which trade depends, raise costs and lower economic growth. Since climate change is expected to increase the frequency of some extreme events, the risk of transport and trade disruptions will grow, making weather and climate information and predictions all the more important.

→ Ways WMO helps

Regarding air transport, weather has a major economic and financial impact on the aviation industry. Studies have shown that unexpected weather conditions at aircraft arrival times could result in additional operating costs of up to US\$ 350 000 per day. Of all delays greater than 15 minutes, 80 per cent are reportedly caused by the weather, resulting in an economic loss globally of US\$ 1 billion per year. Approximately one third of all aviation accidents and 40 per cent of fatal accidents are weather related. In

Sweden, assessments have shown winter storms as the main extreme weather events that caused the most adverse impacts on Swedish air traffic over the past decade. Heavy snowfalls result in poor visibility and reduced friction, as well as impede passenger access to airports.

Aeronautical meteorological information on wind, temperature and atmospheric pressure is critical for aircraft take-off, cruising and landing, and contributes to flight efficiency. The provision of timely accurate forecasts and warnings of hazardous weather (thunderstorms, wind-shear, micro-bursts, icing, turbulence, and so forth) at various phases of a flight not only leads to increased flight safety and passenger comfort but can produce huge financial savings by reducing flight delays, creating shorter flight times and lowering fuel consumption. Improved weather forecasts have been estimated to save an average of around US\$ 23 000 per flight at a typical US airport as a result of reductions in the amount of fuel aircraft are required to carry.

Through its Aeronautical Meteorology Programme, WMO assists developing countries in strengthening and modernizing their weather and climate infrastructure and service delivery to the aviation industry, thereby contributing to economic growth through increased safety, regularity and efficiency of air transport.

The International Civil Aviation Organization (ICAO), with which WMO works closely, is responsible for defining aeronautical meteorological requirements, while WMO identifies the most appropriate methods for fulfilling the requirements, including the training of aeronautical personnel. Under the WMO Aircraft Meteorological Data Relay (AMDAR) programme, 3 000 aircraft each day contribute to the collection and relay of worldwide weather data that are essential for aviation safety.

Maritime transport: All types of shipping vessels, from the biggest tankers to the smallest recreational boats, are highly vulnerable to weather and oceanic natural hazards, such as strong winds, heavy seas and poor visibility. Through the Joint WMO/IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM), WMO contributes to marine safety information, including that related to search-and-rescue operations, meteorological forecasts and warnings (provided by NMHSs), and navigational warnings. Under JCOMM, more than 1 000 ships collect and relay daily weather data that are critical for marine safety.

Land transportation in most countries also is affected by weather and climate extremes, such as those related to precipitation, thunderstorms, temperature, winds and visibility. Unusually heavy rainfall can have a major impact on road and rail transportation, causing accidents and leading to the washing away of roads and bridges, blocked transport arteries due to landslides, and so on. Apart from the immediate disruption, damage to transport infrastructure hinders economic growth by making it more difficult to move people and goods around, while repairing the damage may divert funds needed for other development priorities. In terms of safety, a strong correlation has been demonstrated in Kuwait between weather and climate, and unsafe conditions and the occurrence of road accidents. When it rains, the number of reported road accidents soars – statistics reveal an average of not fewer than 90 cases per event (Al-Shulaimi, 2006). In Sweden, rainfall, wind, winter flooding and sea level rise are among the various conditions that affect the road sector. But of these, impacts related to water are the most costly.

The World Meteorological Organization assists NMHSs in developing countries to deliver better weather services for road and rail transport, thereby contributing to increased safety and efficiency.



Energy

Reliable and high-quality electrical energy is central to economic productivity and public welfare. However, electric power systems are sensitive to weather and climate. Strong winds, heavy precipitation and extreme temperatures affect the quality of electricity, leading to reduced voltage, unstable frequency, interruptions in service, downed power lines and abrupt price fluctuations.

Both energy demand and supply are significantly influenced by weather-, climate- and water-related events. On the demand side, temperature changes determine heating or cooling demand while cloudiness determines lighting demand. An increase in temperature of 1°C in summer would increase electricity demand by up to 5 million kilowatts in Japan. On the supply side, heavy rainfall and associated river debris affect hydroelectricity generation, while extreme weather events, like tropical cyclones, disrupt electricity transmission.

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Direct losses to the energy industry in 2005 as a result of Hurricanes *Katrina* and *Rita* have been estimated at US\$ 15 billion. Economic impacts from loss of

hydropower generation in Zimbabwe during the 1991–1992 droughts were estimated at US\$ 102 million. Drought-induced reduction in electricity generation from hydropower has become a consistent feature in Eastern Africa, with far-reaching and devastating impacts on the economies of the countries in the region. In Uganda, between 2004 and 2006, the reduction in water levels at Lake Victoria resulted in the reduction in hydropower generation by 50 MW, which led to the downward adjustment of the GDP growth rate from 6.2 to 4.9 per cent. The country had to turn to costly thermal generators to ease the supply deficit. The United Republic of Tanzania experienced a major power load-shedding that adversely affected the country's industrial and commercial sectors. In Kenya, the drought that occurred between 1999 and 2002 drastically affected hydropower generation, and, in 2000 alone, hydropower generation was reduced by 25 per cent capacity. This resulted in cumulative losses variously estimated at between 1 and 1.5 per cent of total GDP.

Energy managers need reliable weather and climate information and services in order to make informed decisions, in day-to-day operations, as well as when planning long-term energy investments, for example, in estimating future power demand and forecasting market electricity prices.

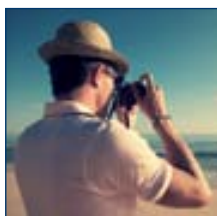
→ Ways WMO helps

The World Meteorological Organization contributes to the assessment and promotion of renewable energy, particularly solar and wind energy, by supporting the provision of high-quality weather and climate information to policymakers, utility companies, energy developers, investors and consumers. WMO assists NMHSs to provide tailored climate information vital for the setting up and maintenance of energy-related infrastructure, such as dams, power plants and electricity distribution systems. Use of renewable energy sources can provide electricity (and with it Internet access) to poor rural communities, helping small-scale businesses and improving livelihoods.

China provides a good example of the use of weather and climate information in the energy sector. The China Meteorological Agency has set up a specialized Wind and Solar Energy Assessment Centre under the National Climate Centre. Under this initiative, wind energy assessments have been carried out to calculate the total potential of wind energy in the country.

In addition, WMO publishes information on the Meteorological Aspects of Utilization of Renewable

Energy Sources, focusing on products and services for weather and climate risk management and adaptation to climate change.



Tourism

Tourism is one of the largest and fastest growing global economic sectors. It is a significant contributor to national and local economies around the world and has an important role in helping to achieve the

MDGs, particularly the alleviation of poverty in LDCs and SIDS. It is a primary source of foreign exchange earnings in 46 out of 48 of the world's LDCs. In 2009, international tourism generated US\$ 852 billion in export earnings, of which about 40 per cent went to developing countries. In Mauritius, for instance, the tourism sector has emerged as the second pillar of the economy. Tourism, thus, offers one of the main sustainable development opportunities for many developing and least developed countries.

Tourism is highly dependent on weather and climate. General travel surveys conducted in Germany, the United Kingdom of Great Britain and Northern Ireland, and Canada showed weather and climate to be a primary travel motivation for most tourists. For instance, a 1°C warmer-than-average summer was found to increase domestic tourism expenditures in Canada by 4 per cent. Surveys by the Scottish Tourist Board revealed that 20 per cent of overseas visitors identify weather as the main cause of dissatisfaction. In Mauritius and the Seychelles, the tourism sector relies heavily on meteorological and hydrological information and products from the NMHSs for better planning, operation and management of the sector.

Climate variability is also a relevant factor. Weather-, climate- and water-related hazards, such as tropical storms, damage beaches and coastal areas, which are the main tourist attractions of SIDS. Since extreme

events are predicted to increase with climate change, they are likely to have an even more profound impact on tourism and tourist destinations in the decades ahead.

Accurate and detailed weather and climate information, including forecasts for extreme weather events, is thus becoming increasingly important to the tourism industry, as well as to travel insurers, whose business is greatly affected by natural hazards.

→ Ways WMO helps

Through its programmes, particularly the Applications of Meteorology Programme, WMO supports NMHSs in developing countries in providing weather and climate services to the tourism industry that will help to make tourism operations more sustainable and minimize their risks. Through its Expert Team on Climate and Tourism, WMO also addresses the impacts of climate variability and change on the tourism industry more generally.

The World Meteorological Organization works closely with the United Nations World Tourism Organization (UNWTO) to enhance national and regional collaboration, particularly in strengthening working relationships between national tourism administrations and NMHSs. In 2003, WMO and UNWTO convened the first International Conference on Climate Change and Tourism. The declaration from this conference provides a basic reference and framework for further action by stakeholders on this issue. In 2008, WMO and the United Nations Environment Programme jointly published a report *Climate Change and Tourism: Responding to the Global Challenges*.

The World Weather Information Service Website of WMO offers online access to the latest weather forecasts and climate information for more than 1 200 of the world's cities, as supplied by meteorological and hydrological services worldwide.



Voices on Climate Change



"Climate change affects us all, but it does not affect us all equally. The poorest and most vulnerable – those who have done the least to contribute to global warming – are bearing the brunt of the impact today."

"Given the nature and magnitude of the challenge, national action alone is insufficient. No nation can address this challenge on its own. No region can insulate itself from these climate changes. That is why we need to confront climate change within a global framework, one that guarantees the highest level of international cooperation."

Ban Ki-moon, Secretary-General of the United Nations

"Today we're seeing that climate change is about more than a few unseasonably mild winters or hot summers. It's about the chain of natural catastrophes and devastating weather patterns that global warming is beginning to set off around the world.. the frequency and intensity of which are breaking records thousands of years old."



Barack Obama, President of the United States of America



"Climate change should be seen as the greatest challenge to face man and treated as a much bigger priority in the United Kingdom."

Prince Charles, HRH The Prince of Wales

"Adaptation to climate change is urgent. It is possible to reduce poverty and at the same time strengthen the capacity of those living in poverty, to adapt to climate change. Therefore, the Bank must intensify existing moves for integrating climate risk management into poverty reduction measures."



Donald Kaberuka, President of the African Development Bank Group



"Previously water would flood mainly at the peak of the rainfall season and mainly along the river banks. These days, floods occur anytime during the rainy season. Previously people would relocate to higher grounds but these days even people settled in areas once considered safe are affected by floods."

Ebbie Mwakasungura, Village Headman, Karonga, Malawi

Contributing to environmental sustainability (MDG 7)



The world's rising population and growing demands on resources are degrading the natural environment at a rapidly increasing rate, threatening its ability to sustain human-induced changes while continuing to function as an ecosystem. The fulfilment of human needs must be balanced with the protection of the natural environment in order for these needs to be met, not only in the present, but also in the indefinite future. Major environmental sustainability issues include climate change, water and sanitation, air quality and urban sprawl.

Addressing climate change adaptation and mitigation

The *Fourth Assessment Report* of the Intergovernmental Panel on Climate Change (IPCC) states that "warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level". Rising sea levels threaten the very existence of some small island states. Another serious impact of climate change will be an increase in extreme weather events, such as drought, floods and strong winds. Developing countries, particularly least developed countries, will be most affected, because of their relatively low capacity to adapt. Changing weather patterns are already hurting rural farmers in poor countries.

→ Ways WMO helps

The World Meteorological Organization, together with the United Nations Environment Programme



(UNEP), established IPCC in 1988 and continues to support its work. The International Panel on Climate Change, which won the Nobel Peace Prize in 2007, makes authoritative scientific assessments of climate change designed to trigger global action, both to mitigate its impact and to adapt to its effects. While governments are trying to reach a global agreement on mitigating climate change, WMO is already helping countries and communities adapt through enhanced access, understanding and use of climate information. WMO also supports the global operational system for monitoring, analysis and modelling of the earth's atmosphere, including its chemical composition, through unique networks of surface, ocean, atmosphere and satellite measurements.

The World Meteorological Organization and its network of NMHSs provide support and critical information for the implementation of multilateral environmental agreements, most notably: UNFCCC; UNCCD; the United Nations Convention on Biological Diversity (UNCBD); Vienna Convention on the Protection of Ozone Layer; IPCC for climate change assessment work; World Climate Research Programme (WCRP) for coordinating research efforts, co-sponsored with the International Council for Science (ICSU) and UNESCO IOC; International Strategy for Disaster Reduction (ISDR); and so forth.

World Meteorological Organization activities include:

- **El Niño and La Niña early warnings:** WMO issues regular updates in several languages on the El Niño and La Niña phenomena, which produce extreme weather events around the world.
- **Nairobi work programme:** This initiative of UNFCCC aims to enhance the understanding and assessment of impacts, vulnerability and adaptation to climate change, and the implementation of practical adaptation actions and measures. Under the programme, WMO is committed to:
 - Collecting, analysing and disseminating relevant climate information;
 - Promoting understanding, development and dissemination of measures, methodologies and tools aimed at increasing economic resilience and reducing reliance on vulnerable economic sectors;
 - Promoting research on adaptation measures and diffusion of know-how and best practices.



- **Global Framework for Climate Services:** The World Climate Conference-3 (WCC-3), organized by WMO in 2009 in Geneva, addressed the issue of climate prediction for decision-making. The Heads of State and Government, Ministers and Heads of Delegations present at WCC-3, through the Conference declaration (see box on page 17), decided unanimously to establish a Global Framework for Climate Services (GFCS) to strengthen the production, availability, delivery and application of science-based climate predictions and services. The Framework is expected to stimulate the development of climate information and services required by decision-makers and the public at global, regional and local levels.
- **Insurance schemes:** Various insurance options are helping developing countries to manage the impacts of climate change. However, high-quality weather and climate data are prerequisites for proper insurance risk management. In many developing countries, lack of appropriate data is the main obstacle to introducing insurance schemes. The World Meteorological Organization is working with NMHSs to improve the collection, quality and dissemination of such data.

Reducing vulnerability and protecting the environment

Weather-, climate- and water-related extreme events can result in hydrometeorological disasters that cause environmental degradation, as well as damage to people and property. For instance, drought can

affect the quantity and quality of water, disrupt water supply, affect biological diversity and contribute to desertification, while floods may cause sanitation problems, especially in poor urban communities.

→ Ways WMO helps

The World Meteorological Organization plays a leading role in research and the provision of information on the status of the world climate, with the aim of sensitizing governments to take the necessary early steps to protect the environment. Each year since 1993, WMO has issued an authoritative statement on the status of the global climate that highlights temperature and precipitation anomalies worldwide and other extreme weather and climate events, such as droughts, floods, heatwaves, El Niño, La Niña, tropical cyclones, hurricanes and typhoons.

The WMO Global Atmosphere Watch (GAW) Urban Research Meteorology and Environment (GURME) project aims to enhance the capabilities of NMHSs in assisting the study and management of urban environments, especially the collection of information on and the forecasting of urban air pollution.

Air quality services are a core component of WMO-supported programmes. The World Meteorological Organization supports NMHSs in monitoring long-term changes in atmospheric composition, including levels of greenhouse gases, ultraviolet radiation, aerosols and ozone. This information helps to assess the effects of these changes on people, climate, regional and urban air quality, and marine and terrestrial

ecosystems. Based on data provided by Members that operate atmospheric monitoring stations, WMO issues annual statements on the state of the ozone layer through the Arctic and Antarctic ozone bulletins.

Strengthening integrated water resource management and sanitation

Increasingly, population growth and climate change are altering the availability and use of water worldwide. Freshwater sources are degrading, while weather extremes pose the threat of more frequent floods in some regions and droughts in others. Water managers everywhere need accurate and timely weather and climate information to make operational decisions and plan for short- and long-term changes in water needs and supplies.

→ Ways WMO helps

World Meteorological Organization programmes, in particular the Hydrology and Water Resources

Programme, assist NMHSs to provide quality data and information on water, including better hydrological forecasts, to all stakeholders involved in water resources management and sanitation. This information is crucial for improving access to safe drinking water and sanitation for rural and urban poor populations, especially in LDCs. Nearly 900 million people worldwide still lack access to safe drinking water, and 2.6 billion – more than one third of the world's population – do not have access to basic sanitation.

In this regard, WMO is implementing specific activities such as the Hydrological Observing Systems (HYCOS) projects and the WMO Associated Programme on Flood Management (APFM). In order to enhance the capacities of countries to develop water information systems for water resources assessments and flood forecasting activities, six Hydrological Cycle Observing System component projects are underway, with the participation of 52 countries, 34 of which are LDCs.

World Climate Conference-3 Declaration

We, Heads of State and Government, Ministers and Heads of Delegation present at the High-level Segment of World Climate Conference-3 (WCC-3) in Geneva, noting the findings of the Expert Segment of the Conference;

Decide to establish a Global Framework for Climate Services (hereafter referred to as “the Framework”) to strengthen production, availability, delivery and application of science-based climate prediction and services;

Request the Secretary-General of WMO to convene within four months of the adoption of the Declaration an intergovernmental meeting of member states of the WMO to approve the terms of reference and to endorse the composition of a task force of high-level, independent advisors to be appointed by the Secretary-General of the WMO with due consideration to expertise, geographical and gender balance;

Decide that the task force will, after wide consultation with governments, partner organizations and relevant stakeholders, prepare a report, including recommendations on proposed elements of the Framework, to the Secretary-General of WMO within 12 months of the task force being set up. The report should contain findings and proposed next steps for developing and implementing a Framework. In the development of their report, the taskforce will take into account the concepts outlined in the annexed Brief Note;

Decide further that the report of the task force shall be circulated by the Secretary-General of WMO to Member States of the WMO for consideration at the next WMO Congress in 2011, with a view to the adoption of a Framework and a plan for its implementation; and

Invite the Secretary-General of WMO to provide the report to relevant organizations, including the UN Secretary-General.

Ensuring the safety of human settlements

Cities and their inhabitants are key drivers of global climatic change. The large and ever increasing fraction of the world's population that lives in cities uses a disproportionate share of resources and produces climate-altering atmospheric pollutants. Cities affect greenhouse gas sources and sinks, both directly and indirectly. They are the main source of anthropogenic carbon dioxide emissions due to the burning of fossil fuel for heating and cooling, industrial processing, transportation of people and goods, and so on.

Cities are also sensitive to climate variability and change. They have the highest population densities, and many urban residents are poor and especially vulnerable to extreme weather-, climate- and water-related events, such as floods and landslides, which affect their access to clean water, safe housing and good sanitation. Climate knowledge could be used more effectively to ensure cities that are more sustainable. Thus, weather and climate information is essential in the planning and design of urban infrastructure, such as buildings, waterworks and sanitation.

→ Ways WMO helps

The World Meteorological Organization is assisting NMHSs to develop expertise in urban climatology that includes education and training. It is drafting a new technical note on *Building Climatology*, replacing the one that was published in 1976. WMO co-sponsored the Seventh International Conference on Urban Climate, in Japan in 2009.

Promoting environmental education and outreach

One of the most compelling outcomes of WCC-3 is the consensus that climate change must be



promoted as an issue of the present. Societies need to improve adaptation to current climate variability and extremes. By doing so, they will improve their adaptive capacity to future climate scenarios. Therefore, efforts should be focused on building the capacity to identify and promote actions that will improve adaptation today and reduce vulnerabilities in the future. Doing so will require institutional strengthening in governance, management and funding, as well as human resources development, in areas such as weather, climate and water. Ideally, climate change should become a mainstream subject in curricula at all educational levels as a priority, in order to enhance interaction between science and communities.

→ Ways WMO helps

The World Meteorological Organization contributes to effective awareness-raising on critical environmental issues, such as climate change, through its publicly available materials directed at audiences ranging from youth to policymakers, as well as through its scholastic and popular meteorological activities. WMO, through three World Climate Conferences and its other activities, has enhanced global awareness of the need to address climate change issues and other environmental concerns.

Contributing to improved health (MDG 6, MDG 4 and MDG 5)



Malaria killed nearly 800 000 people in 2009, of which the vast majority were young children in sub-Saharan Africa. Estimates suggest that a temperature increase due to climate change of 2°C to 3°C, which is at the bottom of the projected range, would increase the number of people at risk of contracting by 3 to 5 per cent, or several hundred million.

Diarrhoea, which is a water-borne disease, is responsible for over 2 million deaths each year. The victims are mostly young children in poor countries.

Weather and climate play a powerful role in the occurrence and spread of diseases worldwide. Weather-, climate- and water-related events trigger seasonal outbreaks of malaria and other diseases, such as bacterial meningitis and tuberculosis. Outbreaks of malaria often follow periods of increased precipitation and/or temperature, and impacts can be severe following prolonged periods of drought and famine.

Millions of children continue to die from preventable causes, such as pneumonia, diarrhoea, malaria and measles, most of them in developing and least developed countries. A child born in a developing country is over 13 times more likely to die within the first five years of life than a child born in an industrialized country. Sub-Saharan Africa accounts for about half the deaths of children under five years of age in the developing world.

Many infectious and chronic diseases affecting children in poor countries, including malnutrition, diarrhoea and malaria, are directly or indirectly related to weather, climate and water events. In addition, extreme events, such as droughts and floods, through their effects on water quality and sanitation, can lead to an increase in water-borne diseases, for example, cholera and diarrhoea. Nearly 1 000 women die every day from complications related to pregnancy and childbirth, almost all of them in developing countries. Every

year, more than a million children are left motherless and vulnerable. Weather-, climate- and water-related disasters, especially drought and floods, reduce food production, which results in low nutrition for pregnant women and their unborn babies. Heavy rainfall provides a breeding environment for malarial mosquitoes. Undernourished pregnant women have a high risk of dying from malaria, a major contributor to maternal death in poor countries.

→ Ways WMO helps

Protecting health from the impact of climate change is a priority for the public health community, as recognized by the annual assembly of the World Health Organization (WHO) in 2008. Closer collaboration between the meteorological and public health sectors provides communities and health and humanitarian agencies with tools to identify elevated risks, take preventive measures and plan effective responses.

The World Meteorological Organization assists NMHSs in developing countries to provide tailored weather, climate and water information and services to the health sector for disease prevention and control, including the distribution of insecticides and medicines.

The World Health Organization Global Malaria Programme in the Southern African countries of Angola, Botswana, Namibia, Madagascar, Mozambique, South Africa, Swaziland, Zambia and Zimbabwe is a good example of the practical use of weather and climate information to combat diseases. Under this Programme, the use of seasonal climate forecasts issued by the Southern Africa Regional Climate Outlook Forum (SARCOF) enables malaria epidemics to be predicted several months ahead, allowing effective control and other preventive measures to be put in place. The climate forecasts have been central to the development of the Malaria Early Warning System (MEWS) with its own Malaria Outlook Forums (MALOFs) for the region.

In order to address seasonal outbreaks of bacterial meningitis in the meningitis belt of Africa, WMO is collaborating with WHO, the International Research Institute for Climate and Society and other leaders within the environmental and public health communities to develop an early warning system for the epidemic through The Observing system Research and Predictability EXperiment (THORPEX). Collaboration between THORPEX Africa and climate and health programmes under the Health Climate Partnership will enable efficient use of resources and add value to weather forecasts from a health-user



perspective. The main objective of the THORPEX programme, which also operates in Asia, Europe and North America, is to reduce and mitigate the impacts of natural disasters and realize the societal and economic benefits of improved high-impact weather forecasts.

The World Meteorological Organization and its partners have also developed the Meningitis Environmental Risk Information Technologies (MERIT) project, aimed at improving public health outcomes in the African meningitis belt by integrating risk indicators of meningitis epidemics into early warning systems and control strategies.

Through programmes co-sponsored by WMO, several projects based on the “Learning through Doing” concept have been launched to help NMHSs collaborate and build partnerships with their health communities. Thus, in Botswana and Madagascar, the health ministries now have longer lead times on the likely occurrence of malaria, plague and Rift Valley Fever epidemics, based on climate predictions provided by the NMHSs. Similar projects have been launched in Ethiopia, Burkina Faso, Chile, Panama and Peru.

The World Meteorological Organization regional centres have also implemented health and climate initiatives, such as the climate and health unit of the African Centre of Meteorological Application for Development (ACMAD), established in 2007. It has launched a project aimed at creating operational linkages between the health sector and the meteorological community, with

a primary focus on malaria and meningitis. Under this project, epidemiologists and climate scientists are working closely with other international organizations, such as the WHO Multi-Disease Surveillance Centre, the Niger-based Centre de Recherche Médicale et Sanitaire (CERMES), United Nations Children’s Fund (UNICEF) and WHO.

At the national level, Ethiopia, Madagascar and Kenya are developing frameworks to improve communication and joint planning between ministries of health and national meteorological services.

The World Meteorological Organization has also collaborated with WHO and UNEP in developing guidelines for assessing human health vulnerability and public health adaptation to climate change and variability. These guidelines provide practical information to governments, health agencies and environmental and meteorological institutions in both developed and developing countries and are applicable at regional, national and local levels. WMO and WHO are also collaborating on a guidance document *Heat Waves and Health: Guidance on Development of Warning Systems* and, with UNWTO, are planning to produce a new joint brochure on the health risks of extreme heat for major outdoor events.

The World Meteorological Organization contributes to increased child health and reduced mortality by assisting NMHSs in providing weather and climate information to the health sector, enabling it to mobilize services, vaccination campaigns and medicines for at-risk communities. In addition, through their services for the agricultural sector, NMHSs assist poor communities to boost food production and food security, helping to ensure that children in these communities receive adequate nourishment.

The World Meteorological Organization assists NMHSs in developing countries, particularly in LDCs, to provide weather and climate information that is crucial for increasing food production, thereby improving nutrition. Weather and climate forecasting also assists governments to anticipate impending drought, giving them more time to avoid famine by preparing and organizing local interventions and raising awareness of the need for international food aid.

Contributing towards the promotion of gender equality and empowerment of women (MDG 3)



In poor communities, where livelihoods are highly dependent on local natural resources, women are disproportionately vulnerable to and affected by climate events and climate change. They have the major responsibility of supplying the household with water and energy for cooking and heating, as well as of producing food.

Women and girls in poor countries often spend one or more hours a day gathering biomass fuel, such as wood, agricultural residues and dung. One study in rural India found that the average time spent collecting wood was 37 hours per month. Women and girls also spend many hours fetching water and carrying supplies and products to and from markets. In addition, they are involved in weather and climate-sensitive household chores, such as drying of laundry, crops and foodstuffs (for example, maize and cassava flour). Performing these tasks reduces the time available for education and income-generating activities.

Calling attention to women, especially those in LDCs, which are most vulnerable to climate change, the Fifty-Second Session of the United Nations Commission on the Status of Women, in 2008, called for women to have equal access to training, credit and skill-development programmes to ensure their full participation in climate change initiatives. The Commission added that technological developments related to climate change should take into account women's specific priorities and needs and make full use of their knowledge and expertise, including traditional practices. It also noted that women's involvement in the development of new

technologies can ensure that they are user-friendly, effective and sustainable.

→ Ways WMO helps

Women's access to and use of weather, climate and water information, particularly weather forecasts, can improve their decisions on housekeeping and income-generating activities. Short- and medium-range weather forecasts provided by NMHSs, with specific mention of the likelihood of sunshine duration, are useful for making decisions on whether to dry laundry, crops, foodstuffs, tie-and-dye batik, and so on, indoors or outdoors.

Use of labour-saving technologies, such as windmills for pumping water and solar boxes for cooking, will go a long way in relieving women and girls of the enormous burden of fetching water and collecting fuel. NMHSs can provide tailored information for the design and sizing of these technologies.

Following the recommendations of the United Nations Commission on the Status of Women, WMO accords high priority to the education and training of women meteorologists and encourages women to take up careers in meteorology and challenging positions in other fields. The World Meteorological Organization has established a network of gender focal points for the NMHSs and organizes regular conferences and workshops for women in meteorology.

Two conferences on the participation of women in meteorology and hydrology were convened by WMO in 1997 and 2003, in Bangkok and Geneva, respectively. Their objectives were to review current participation and develop strategies to increase women's future participation in the activities of WMO and the NMHSs. The Fifteenth World Meteorological Congress in 2007 approved the WMO Policy on Gender Mainstreaming. The WMO Executive Council, at its 59th session in May 2007, established an Advisory Panel of Experts on Gender Mainstreaming. The World Meteorological Organization constituent bodies and many WMO Members designated focal points on gender. These networks, as well as the growing number of women working in the WMO Secretariat, technical commissions and regional associations, are encouraging indicators of practical implementation of the policy.





The way forward

Enhancing the role of the World Meteorological Organization and National Meteorological and Hydrological Services in achieving the Millennium Development Goals

Marked improvements in the production, delivery and use of weather-, climate- and water-related environmental information, products and services have been made during the last decade. Many developing countries, including LDCs and SIDS, however, have not taken full advantage of these advances to upgrade their services, because their infrastructures are inadequate and they have limited human resource capacities. Therefore, special efforts are necessary to develop the capability of NMHSs in the respective countries to provide better products and services to reduce disaster risks and support national development and life supporting activities, thereby contributing to the Millennium Development Goals.

In this regard, WCC-3, held in 2009, established a GFCS to strengthen the production, availability, delivery and application of science-based climate prediction products and services. This new initiative involving a wide array of stakeholders, will help policy-makers and all communities, especially the most vulnerable, to plan ahead and to take informed decisions in order to cope with the impact of climate change, reduce natural disaster risks and contribute to the safeguarding of food production, water supplies and health.

The First Conference of Ministers Responsible for Meteorology in Africa, held in Nairobi, Kenya, in 2010, decided to establish the African Ministerial Conference on Meteorology (AMCOMET) as a high-level mechanism for the development of meteorology and its applications in Africa. They, among others, called for the development of an African Strategy on Meteorology to efficiently meet government and societal needs and requirements for weather and climate information and services. The same approach may be taken in other Regions as appropriate.

In its Strategic Plan for the period from 2012 to 2015, adopted in June 2011 by the World Meteorological Congress, WMO has identified the following priority areas that will make a significant contribution in addressing societal needs:

- Global Framework on Climate Services;
- Disaster risk reduction;
- Observation and information systems;
- Capacity development for developing countries and LDCs;
- Meteorological services for the aviation sector.

Taking the above into account and building upon the work that has already been undertaken, WMO is promoting the following complementary strategies at the global, regional and country level to enhance its contribution, as well as that of the NMHSs, to the Millennium Development Goals.

Global and regional levels

1. Establish and facilitate integration of the results of its scientific and technical programmes with the development orientation of the MDGs, and advocate this integration to Members through enhanced participation in development debates and activities.
2. Highlight the importance of weather-, climate- and water-related information, products and services in achieving the MDGs by citing the outcomes of the international and regional high-level forums that recognized the societal benefits of this information, including WCC-3 in 2009 and the First Conference of Ministers Responsible for Meteorology in Africa, in 2010.
3. Enhance and publicize WMO support given to developing countries, particularly LDCs and SIDS, for building the institutional and operational capacity of their NMHSs to integrate weather, water and climate services into their national development policies and strategies, such as country-specific adaptation plans and programmes, with an emphasis on disaster risk reduction and food security. These activities directly contribute to the attainment of MDG 1 – eradication of extreme poverty and hunger – and will help to gain recognition for the important role played by NMHSs in achieving the MDGs.
4. Enhance and publicize further its activities in atmospheric research, climate, environment, observation and information systems, which can play a key role in achieving MDG 7, which concerns environmental sustainability.
5. Enhance the effectiveness and impact of WMO programmes that directly target the other MDGs, particularly MDGs 6, 5, 4 and 3.
6. Actively promote a collective approach to achieving the MDGs, through strategic partnerships and alliances with relevant organizations and programmes, such as the United Nations Development Programme (UNDP), the Food and Agriculture Organization of the United Nations (FAO), the World Food Programme (WFP), the World Health

Organization, UNEP, the World Trade Organization (WTO), the United Nations Conference on Trade and Development, UNFCCC, ISDR, UNCCD, regional development banks, the World Bank, the International Telecommunication Union (ITU), the United Nations Industrial Development Organization and UNWTO.

7. Seek closer relationships with civil society organizations and other non-governmental organizations that deal with food security, poverty, water resource management and disaster risk management, such as the International Federation of Red Cross and Red Crescent Societies (IFRC).
8. Reinforce the existing involvement and reporting of WMO on the MDGs, sustainable development issues, inter-agency consultation and cooperation, specifically concerning Africa, LDCs and SIDS.
9. Collect, document and distribute examples of best practices to NMHSs and other partners, based on the way in which some NMHSs are contributing to their national development agendas.
10. Sensitize all WMO programme managers and develop their capacity to relate to and cast WMO programmes in the context of the MDGs.
11. Ensure that the GFCS (see box above) plays a major role in addressing the special needs of Africa, LDCs and SIDS through implementation initiatives of regional and national climate centres.
12. Position WMO as a key contributor at the global level to the cross-cutting issues of climate change and climate variability, which affect the attainment of most of the MDGs.
13. Develop communication and advocacy strategies for mainstreaming and factoring weather-, climate- and water-related information and services in development initiatives designed to achieve the MDGs.
14. Organize innovative capacity-building activities for senior staff of NMHSs of LDCs and SIDS in management, strategic planning, communication and resource mobilization.
15. Champion gender equality and assist NMHSs to mainstream gender into climate science, mechanisms and activities, especially in climate institutions at the country level.

Global Framework for Climate Services: Objectives

- Provide a cooperative framework, in which all nations, international organizations, scientists and sectors will work together to operationally provide climate information for meeting the needs of users;
- Enable users to benefit from improved user-driven climate information and prediction;
- Mobilize climate science globally to advance the skills of seasonal-to-interannual and multi-decadal climate predictions to generate and provide future climate information on an operational basis;
- Build a cooperative global infrastructure to foster the sharing of new advances in science and technology.

National level

In order to integrate the achievement of the MDGs into the activities of NMHSs at the national level, NMHSs will endeavour to:

1. Re-orient NMHSs in developing countries, as appropriate, from purely technical and scientific organizations to development-oriented institutions, ensuring that this change starts with senior NMHS staff. Directors of NMHSs will champion this re-orientation and engage decision-makers in the key government ministries (finance, economic planning, environment, foreign affairs, agriculture and transport). National Meteorological and Hydrological Services will initiate demonstration projects to show concrete examples of the services they are providing or can provide in support of national development activities. Decision-makers in developing countries, particularly in LDCs, need to be convinced of the utility of NMHS services.
2. Strive to become more conversant with the MDGs and their achievement rationale by seeking briefings from United Nations Resident Coordinators (RCs) and from the economic planning ministries. NMHSs should also join United Nations country teams as national institutions that also serve as focal points of a United Nations specialized agency (WMO).



3. Participate fully in the MDG framework and contribute actively to national monitoring of the achievement of the MDGs. National Meteorological and Hydrological Services will need to liaise on a continuing basis with the national MDGs and LDC focal points where appropriate, and contribute to UNDP human development reports that focus on the MDGs.
4. Seize the opportunity of various initiatives being undertaken at the national level, such as the Millennium Villages and the Millennium Challenge projects, and factor the relevant weather, climate and water issues into these projects.
5. Act as a relay between WMO programmes and the relevant ministries at the national level, and enhance their capacity and ability to communicate with decision-makers, the general public and specific users.
6. Provide the necessary information for vulnerability assessments of all weather-, climate- and water-sensitive sectors, such as agriculture, energy, water, tourism, transport and health.
7. Participate in the coordinated framework of disaster risk management under the Hyogo Framework for Action, which is crucial for bridging the interface between climate information providers and target users. National Meteorological and Hydrological Services also need to participate in the development and implementation of national disaster risk reduction frameworks and the execution of annual disaster contingency plans.
8. Scale up the adoption and utilization of the best risk management practices, such as weather-derivative crop insurance, which have been piloted in some sectors.
9. Ensure that the benefits derived from the proposed GFCS are used to meet societal needs at the national and sub-national levels, especially in local and national decision-making.
10. Seek assistance and support from WMO in order to enhance the socio-economic applications and benefits of NMHS services.
11. Develop and implement a national strategy targeting all key development stakeholders – governments, politicians, United Nations agencies, non-governmental organizations, the private sector, the media, and so on – with specific advocacy messages. NMHSs should educate the media on weather, climate and water issues as part of their public awareness campaigns at the national level.
12. Urgently address the pressing need for increased investments in their observation networks and data maintenance systems, by mainstreaming weather-, climate- and water-related information and services in the national development frameworks of governments and their development partners, and by making use of WMO resource mobilization initiatives and activities.



Conclusions

Strengthening the role and involvement of WMO in the achievement of the Millennium Development Goals will require concerted efforts from all its Members. National Meteorological and Hydrological Services of developing countries, especially LDCs and SIDS, have a bigger role to play in this endeavour. The World Meteorological Organization will strive to ensure that the development of NMHSs serves their countries and will advise and facilitate, as far as possible, their involvement in MDG-based strategies and programmes at the national and regional levels.

The deadline for achieving the goals is approaching rapidly. Involvement of WMO and NMHSs in the fight against poverty, hunger, natural disasters and environmental degradation will go a long way towards the achievement of the MDGs, particularly Goals 1, 7, 4, 5, 6 and 3.

This publication is expected to contribute to mainstreaming the activities and products of WMO and

NMHSs into development policies and strategies, particularly those dealing with poverty eradication and key socio-economic sectors. It also is intended to stimulate efforts towards demonstrating to governments, cooperating partners and various stakeholders the way in which weather, climate and water-related information and services bring socio-economic benefits to communities, especially in the areas of agriculture and food security, disaster risk reduction, environmental protection, health, transport, tourism, energy and water resources management, and climate change adaptation.

For developing countries, particularly LDCs, this publication provides guidelines on enhancing the contribution of WMO and NMHSs to the achievement of the MDGs. Benefiting from the GFCS, NMHSs should be encouraged to use these guidelines, among others, to mainstream their activities, including generation and effective delivery of relevant weather-, climate- and water-related information and services into national sustainable development strategies.

List of acronyms

ACMAD	African Centre of Meteorological Applications for Development
AMCOMET	African Ministerial Conference on Meteorology
AMDAR	Aircraft Meteorological Data Relay
APFM	Associated Programme on Flood Management
CERMES	Centre de Recherche Médicale et Sanitaire
CIIFEN	Centro Internacional para la Investigación del Fenómeno El Niño
COF	Climate Outlook Forum
FAO	Food and Agriculture Organization of the United Nations
FCCA	Foro Regional del Clima de América Central
FOCRAII	Forum on Regional Climate Monitoring, Assessment and Prediction for Regional Association II (Asia)
GDP	Gross Domestic Product
GFCS	Global Framework for Climate Services
GHACOF	Greater Horn of Africa Climate Outlook Forum
GURME	Global Atmosphere Watch (GAW) Urban Research Meteorology and Environment
HFA	Hyogo Framework for Action
HIV/AIDS	Human Immunodeficiency Virus/Acquired Immunodeficiency Disease
HYCOS	Hydrological Cycle Observing System
ICAO	International Civil Aviation Organization
ICSU	International Council for Science
IPCC	Intergovernmental Panel on Climate Change
ISDR	International Strategy for Disaster Reduction
JCOMM	Joint WMO/IOC Technical Commission for Oceanography and Marine Meteorology
LDCs	Least Developed Countries
MALOF	Malaria Outlook Forum
MDG	Millennium Development Goal
MERIT	Meningitis Environmental Risk Information Technologies
MEWS	Malaria Early Warning System

NMHS	National Meteorological and Hydrological Service
PICOF	Pacific Islands Climate Outlook Forum
PRESAC	Prévision saisonnière en Afrique Centrale
PRESANORD	Prévision saisonnière en Afrique du Nord
PRESAO	Prévision saisonnière en Afrique de l'Ouest
RANET	Radio and Internet for the Communication of Hydro-Meteorological Information for Rural Development
RCOF	Regional Climate Outlook Forum
SADC	Southern African Development Community
SARCOF	Southern Africa Regional Climate Outlook Forum
SEECOF	South-Eastern Europe Climate Outlook Forum
SIDS	Small Island Developing States
SSACOF	South-east South America Climate Outlook Forum
THORPEX	The Observing system Research and Predictability EXperiment
UNCBD	United Nations Convention on Biological Diversity
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO IOC	Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNICEF	United Nations Children's Fund
UNWTO	United Nations World Tourism Organization
WCC-3	World Climate Conference-3
WCRP	World Climate Research Programme
WCSACOF	Western Coast of South America Climate Outlook Forum
WFP	World Food Programme
WIGOS	WMO Integrated Global Observing System
WHO	World Health Organization

WMO	World Meteorological Organization
WTO	World Trade Organization

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