

THEME PAPER

DRAFT v. 18 July 2008

<Information and recommendations to be reviewed and enriched
by countries and stakeholders>

Integrating the Climate Change Dimension into Water Resources Management in the Mediterranean

presented by Morocco, Spain and Greece
with the contribution of the MED EUWI Secretariat

in view of the
Euro-Mediterranean Ministerial Conference on Water
29 October 2008 – Dead Sea, Jordan

TABLE OF CONTENTS

Preface

Introduction: Adapting to climate change, an issue for water resources management

Chapter 1: Climate change impacts in the Mediterranean: one region, multiple challenges

- 1.1. Overall regional
- 1.2. North Africa
- 1.3. Middle East
- 1.4. Southeastern Europe
- 1.5. Mediterranean countries of the EU

Chapter 2: Current processes and recent developments relevant to adaptation and water resources management in the Mediterranean

- 2.1. Multilateral processes
- 2.2. Regional initiatives
- 2.3. Bilateral cooperation

Chapter 3: Main issues with respect to climate change and water resources management

- 3.1. Economic development, food security and poverty
- 3.2. Lack of awareness, integration into policy-making and sound governance
- 3.3. Knowledge development and technology transfer with regard to hydro-meteorological data
- 3.4. Energy
- 3.5. Gender issues
- 3.6. Ecosystems

Chapter 4: The way forward: Exploring water-related adaptation responses for the Mediterranean

- 4.1. Policy formulation, strategic planning and institutional approaches
- 4.2. Technical solutions
- 4.3. Research and innovation
- 4.4. Economic instruments
- 4.5. Cross-cutting measures
- 4.6. Integration with other sectors
- 4.7. International cooperation

Conclusions

References

This paper is presented by Morocco, Spain and Greece, with the contribution of the MED EUWI Secretariat (facilitated by the Global Water Partnership-Mediterranean). The Theme Paper on Integrating the Climate Change Dimension into Water Resources Management in the Mediterranean is a background document of the Euro-Mediterranean Ministerial Conference on Water, Dead Sea, Jordan, 29 October 2008.

Preface

The Steering Committee of the Euro-Mediterranean Ministerial Conference on Water requested the preparation of a Theme Paper on Water and Climate Change in the Mediterranean in view of the forthcoming Conference.

Based on relevant literature, the Paper is aimed at providing an overview of the main issues and challenges with respect to water resources and climate change, current adaptation approaches and on-going initiatives in the Mediterranean and to fuel in-depth reflection on the way forward. It is not intended to be an exhaustive review of all existing policies and mechanisms, but rather a basis for further discussion in view of the Ministerial Conference and a background paper contributing to a future Strategy on Water in the Mediterranean.

The key authors of the Paper are Morocco, Spain and Greece, whereas the Secretariat to the Mediterranean Component of the EU Water Initiative (MED EUWI) has been instrumental in compiling background information and assisting in the drafting of the document.

Introduction: Adapting to climate change, an issue for water resources management

With increasing evidence of changing climatic conditions in the planet, it is now widely recognized that mitigation alone will not be sufficient to address the challenge posed by increased climate variability. Adaptation measures are therefore needed as a complementary coping tool.

Climate change affects the quantitative and qualitative status of water resources by altering hydrological cycles and systems which, in turn, affect variables including the intensity and frequency of floods and droughts; water availability and demand; water quality, including temperature and nutrient content. Changes in these variables lead to impacts on all the socio-economic and environmental goods and services that depend on these variables directly or indirectly.

In this context, the water management will become increasingly difficult because there is general agreement that the supply of and demand for water resources will be substantially affected by climate change.

Hydrological variability and extremes are indeed the main challenge of maintaining water security. This will require significant adaptation, particularly by countries that lack the infrastructure and institutions to store, manage, distribute and deliver their water resources. Water demand will also be affected through the increased flow of migration of people from water scarce regions.

In regions particularly hit by global warming, the sound management of water resources is of utmost importance to ensure equitable access and its integration with adaptation strategies aimed at enhanced communities' resilience.

This is especially true for the Mediterranean, which will be and is already amongst the regions in the world most affected by climate change and where impacts on water resources become immediately visible.

Chapter 1: Climate change impacts in the Mediterranean: one region, multiple challenges

1.1. Overall regional

In the Mediterranean region, the consequences of climate change are forecasted to be particularly severe, increasing the already existing water stress in the region, including in Southern and Southeastern Europe, North Africa and the Middle East.

Phenomena such as recurrent and persistent droughts, high variability in precipitation, serious decrease of soil moisture, river flow decrease, extreme weather events, desertification, etc. are expected to increase significantly in the region and will impact on freshwater availability in terms of quantity and quality. Other serious effects of warming in the Mediterranean could be sea level rise resulting *inter alia* in land erosion and salt water intrusion in coastal areas, thus in the loss of inhabitable and arable land as well as serious alterations of natural habitats and damages in important ecosystems.

Water resources being already scarce throughout the whole region, in combination with increased water demand due to demographic pressure and urbanisation, tourism and development needs in general, climate change is likely to lead to further environmental degradation jeopardising directly or indirectly social cohesion, well being and quality of life as well as security in the immediate future.

1.2. North Africa

In North Africa, as more generally in Africa, vulnerability is very high. Climate change impacts on water are projected to intensify challenges that populations are already facing in overcoming poverty and ensuring their livelihoods and development. The situation is expected to increase competition over water resources for agriculture, domestic use, tourism, etc., to aggravate health issues, thus likely to induce massive migrations and creating important risks of conflicts over water in the region and outside.

The consequences of climate change that North Africa is likely to suffer are: more and more severe droughts, significant reductions in run-off and stream flow (more than 50%) and less soil moisture, due to decreases in rainfall and higher temperatures leading to higher evaporation, aridity and desertification.

Moreover, in the Maghreb, agriculture is dominated by non-irrigated, small-scale farms the modernization of which is not fast enough to feed growing populations. Thus, increasingly frequent droughts in North Africa will force governments to import more food, placing their economies under severe strain unless global warming is checked. North Africa is particularly exposed to water shortages. An additional 155 to 600 million people may suffer an increase in water stress in North Africa with a 3°C rise in temperature.

It is also expected that the already massive extraction of “fossil” water from non-renewable aquifers (notably the Nubian Sandstone Aquifer and the North Sahara Aquifer) will continue giving rise to a wide series of secondary problems. According to four IPCC models, groundwater recharge will decrease dramatically – by more than 70 percent – between now and 2050 along the southern rim of the Mediterranean. Algeria and Tunisia are moreover vulnerable to natural hazards such as floods and, together with Morocco, could also be affected by sea level rise.

1.3. Middle East

The Middle East is also one of the regions most vulnerable to climate change, on account of water scarcity, a significant dependence on climate-sensitive agriculture, population density and economic activity in flood-prone urban coastal zones, and the presence of conflict-ridden areas in which climate-induced resource scarcity could escalate violence and political turmoil.

Most climate scenarios agree that the region will suffer a decrease in water availability (expressed as runoff) of up to 40mm per year with important shifts in precipitation patterns and increased

evapotranspiration. This will highly affect the region's crops, such as rice, citrus fruits, sugar beet, which rely for up to 80 percent on irrigation (e.g. Egypt, Lebanon, Jordan).

A temperature increase of 3-4 degrees Celsius could cause crop yields by 25-35 per cent, according to FAO. Agriculture accounts for 90 percent of the mobilized water resources, which is around 60 percent of the total renewable water resources in the region. Many of the region's irrigation systems are under considerable environmental strain due to salinity, water logging or overexploitation of groundwater (including non-renewable fossil water) the latter being of primary importance in most countries.

Unless adequate and rapid action is taken to reduce vulnerability to climate change, the sub-region will be exposed to large economic and social impacts, some additional 80-100 million people will be exposed, by 2025, to water stress (i.e. access to less than 1,000 m³/ capita/ year) this will exacerbate competition for water across sectors and geographic locations, and will put further pressure on groundwater, which is currently being extracted in most areas beyond the aquifers' recharge potential.

Competition for water within the region and across its borders may grow, carrying the risk of conflict. Some parts of the region, notably the Nile Delta are particularly vulnerable to flooding from rising sea levels.

1.4. Southeastern Europe

In Southeastern Europe, economic activities depending on water availability such as agriculture, tourism, industry, energy will be adversely affected, since increased climate variability will threaten *inter alia* infrastructures, waterways, hydropower, crop yields and timber harvests as well as recreational environments.

River flood hazards, especially flash floods, across much of Southeastern Europe will increase even further, endangering settlements, infrastructures and waterways, hence requiring significantly more investment in flood control and water management in the region, especially at the river basin level. The expenditure for flood protection works, storm water drains etc. will rise significantly

In some countries of the Western Balkans – such as Albania, Bosnia and Herzegovina and Serbia –, which are heavily depending on hydropower for the energy and electricity supply, decrease in precipitation and hence in river flow and run-off will provide further challenges to already stressed national and regional energy security.

In the coastal zones of the Adriatic shoreline, the risk of flooding, erosion, and land loss (due to storminess and sea-level rise) will grow substantially with implications for human settlements and coastal natural habitats. This represents a major threat to important ecosystems (especially wetlands), and natural landscapes vital for biodiversity. In combination with increasing temperatures and heat waves, this could also become a major concern for tourism development in the region.

Social stability and welfare could also be challenged if migratory pressure due to environmental issues from South and possibly East increase.

1.5. Mediterranean countries of the European Union

Southern EU countries will not be spared from climate change. The average run-off in southern European rivers is projected to decrease due to increasing temperature and decreasing precipitation. In particular, some river basins in the Mediterranean, which already face water stress, may see marked decreases of water availability.

Major drought episodes are projected to become more frequent with particularly intense summer droughts. This may be further exacerbated because of an increasing demand for water as a result of elevated temperatures. Worst hit will be Cyprus, Malta, Greece, Italy (South) and Spain with an increase in frequency and severity of droughts and water scarcity. Heat waves will affect tourism activities as well as people' health and enhance energy consumption for cooling purposes.

Mediterranean Europe has been suffering major damaging floods in the recent years. Although the floods cannot be attributed to global climate change alone - since changes in river

management, the increased urbanisation of former floodplains and deforestation of upstream mountainous areas further enhancing local rainfall run-off also affect flood generation -, an increasing risk of flooding in the region is expected under climate change.

In the coastal areas where the pressure on water demand is already very high due to agriculture and tourism, the reduced availability of surface water during dry periods and the reduced groundwater recharge will increase the pressure on groundwater considerably. Many of the groundwater bodies are already heavily abstracted and over-exploited, and some will not be suitable as drinking water because of saline intrusion due to rising sea levels. Even groundwater bodies that are currently managed in a sustainable manner might need a considerable reduction in water abstraction.

Sea-level rise and potential increases in the frequency and/or intensity of extreme weather events, such as storms and associated surges, are additional pressures. The island states of Malta and Cyprus are particularly at risk from sea level rise with a high vulnerability index.

In addition to aforementioned pressures, increased immigration trends from neighbouring countries, especially the southern rim of the Mediterranean, may exacerbate the water supply gap and impact on social peace.

Chapter 2: Current processes and recent developments relevant to adaptation and water resources management in the Mediterranean

2.1. Multilateral processes

The main **Multilateral Environmental Agreements (MEAs)** addressing climate change issues are mentioned below:

- § **The UN Framework Convention on Climate Change (UNFCCC)**, which sets an overall framework for intergovernmental efforts to tackle the challenge posed by climate change. It enjoys near universal membership, with 192 countries having ratified. It entered into force in 1994. Under the Convention, governments gather and share information on greenhouse gas emissions, national policies and best practices; launch national strategies for addressing greenhouse gas emissions and adapting to expected impacts, including the provision of financial and technological support to developing countries; cooperate in preparing for adaptation to the impacts of climate change.
- § **The Kyoto Protocol**, an international and legally binding agreement to reduce greenhouse gases emissions world wide, adopted at the third Conference of the Parties to the UNFCCC (COP 3) in December 1997 and that entered into force in 2005.
- § **The UN Convention to Combat Desertification (UNCCD)**, adopted in Paris in 1994 with the aim to promote effective action against desertification through innovative local programmes and supportive international partnerships.

Two additional MEAs with relevance to climate change and water resources management in the Mediterranean region may be cited:

- § The **Barcelona Convention framework** under which the **Blue Plan**, a Regional Activity Centre of **UNEP's Mediterranean Action Plan**, is currently preparing a regional study on "Energy and climate change in the Mediterranean", with the financial support of the European Investment Bank.
- § The **UN ECE Water Convention**, under which a **Task Force on Water and Climate Change** has been established recently (Bonn, 22-23 November 2007) that aims notably to prepare a Guidance Paper.

Recent developments

Major milestones in the development of international policies and strategies with regard to climate change and water resources are as follows:

§ The **Intergovernmental Panel on Climate Change (IPCC)**, a scientific intergovernmental body was set up by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) in 1988 and obtained the Nobel Prize for Peace in 2007, released the consolidated Synthesis of its **Fourth Assessment Report (AR4)** at its 27th Session in **Valencia (November 2007)**.

§ Conference on **International Solidarity for a Strategy on Climate Change in Africa and in the Mediterranean Region, Tunis, 18-20 November 2007**

The Action Plan adopted at the Tunis Conference lists a number of actions recognized as necessary for the successful management of water resources in the countries of the region: improved data collection and monitoring systems; promotion of technology transfer for analysis, risk assessment and adaptation of the infrastructure needed for managing water resources; development of water saving and re-use programmes. This can only be achieved with the help of developed countries, based on the principle of common but differentiated responsibilities.

§ **EU-Africa Summit, Lisbon, 8-9 December 2007**

The Lisbon Declaration refers to climate change as one of the “key political challenges of our time”.

§ **Euro-Med Water Directors Conference, Bled, Slovenia, 11-12 December 2007**

In the Bled Declaration, the Water Directors of the Euro-Mediterranean countries welcome the initiative to organize a Euro-Mediterranean Ministerial Conference on Water and recommend “Addressing Water and Climate Change through adaptation measures together with mitigation, with emphasis, *inter alia*, on management of droughts and floods and combating desertification” as one of the key themes for the Ministerial Conference.

§ **United Nations Climate Change Conference, Bali, 3-14 December 2007**

The conference culminated in the adoption of the **Bali Road Map**, which consists of a number of forward-looking decisions aiming at reaching a secure climate future the decision on future cooperation under UNFCCC, notably the launch of the Adaptation Fund.

§ **15th Ordinary Meeting of the COP to the Barcelona Convention, Almeria, January 2008**

The Almeria Declaration stresses the importance of taking into account climate change and its adverse effects “on coastal and marine ecosystems and the environment in general and the negative consequences for sustainable development, particularly for developing countries in the Mediterranean basin”.

Funds established under MEAs

The funds that are managed by the GEF (SPA, LDCF and SCCF) available for adaptation projects currently are about US\$ 275 million and include:

- The Strategic Priority on Adaptation (SPA) Trust Fund

The GEF, as an entity entrusted to operate the financial mechanism of the UNFCCC, established the Strategic Priority on Adaptation (SPA) under its Trust Fund. The objective of the SPA is to reduce vulnerability and to increase adaptive capacity to the adverse effects of climate change in the focal areas in which the GEF works. The SPA supports pilot and demonstration projects that address local adaptation.

- The Special Climate Change Fund (SCCF)

The SCCF aims at supporting activities in the following areas: (i) adaptation, (ii) technology transfer, (iii) energy, transport, industry, agriculture, forestry and waste management, and (iv) economic diversification. Adaptation activities to address the adverse effects of climate change have top priority for funding under the SCCF.

- The Least Developed Countries Fund (LDCF)

The LDCF was established to support a work programme to assist Least Developed Country Parties (LDCs) carry out, *inter alia*, the preparation and implementation of national adaptation programmes of action (NAPAs). Mauritania is among the countries having submitted their NAPA.

The Adaptation Fund under the Kyoto Protocol. The Kyoto Protocol Adaptation Fund will be financed from the share of proceeds of the clean development mechanism (CDM) and other sources. It could receive US\$ 80-300 million per year for the period 2008–2012.

Some funding is also available under other Multilateral Environmental Agreements (MEAs) whose areas of work could be synergetic with adaptation, including the **Convention on Biological Diversity (CBD)**, the **UNCCD** and the **Ramsar Convention** on the conservation of wetland resources.

2.2. Regional and sub-regional initiatives

Currently, several adaptation-relevant initiatives and programs are ongoing or proposed for the near future. They have contributed or are expected to contribute to building adaptation capacity in the countries around the Mediterranean, with a special emphasis on the south and east of the region. The list below is not exhaustive but it is meant to shed the light on some of the important adaptation relevant initiatives in the Euro-Mediterranean region.

European Union

The EU Commission has identified Southern Europe and the entire Mediterranean region as being among the most vulnerable areas especially in matters of climate change impacts on water, which will make them even more prone to **water scarcity and drought**. It has presented a **Communication** (July 2007) in the related field that stresses the importance of sustainable water demand management including water-saving policies and water efficiency optimisation throughout Europe.

While the main text of the **Water Framework Directive (WFD)** does not explicitly address climate change, it is well-suited to handle the long-term implications of climate change with its step-wise and cyclical approach. Implementing the Directive requires assessment of the impacts of climate change on the reference conditions of water bodies and on the cost-effectiveness of water management strategies.

There are other relevant EU policy instruments. The proposed **Directive on the Assessment and Management of Floods** complements the WFD by specifically addressing flood risks which are affected by climate change. Similarly, the proposed **Marine Strategy Directive** also provides an overall framework for developing marine strategies that could take into account and enable adaptation to the impacts of climate change. The **Maritime Policy Green Paper** recognises climate change as a major threat, and discusses adaptation to changing coastal risks in Europe.

The EU, as the largest provider of Official Development Assistance (ODA), has also taken a lead role in international development efforts and ambitious commitments. In this context, the EU has highlighted the strong links between climate change and poverty and it has also been suggested that dialogue and partnerships on adaptation should be enhanced with developing countries, which need to face the impacts of climate change in addition to their development burden. This was reiterated at the **G8 Heiligendamm Summit** in June 2007, where adaptation was again recognized as a priority area for cooperation with developing countries.

In this context, the EU has launched the **EU Water Initiative (EUWI)**, the Mediterranean Component (**MED EUWI**) of which is designed to contribute to the achievement of the Millennium Development Goals (MDGs) and WSSD targets for drinking water and sanitation in the Mediterranean, within the framework of an integrated approach to water resources management.

Also as part of the support of the European Union for the development of the water sector in the countries of the south and east Mediterranean under the MEDA Regional Indicative Programming, the **Euro-Mediterranean Regional Programme for Local Water Management (MEDA Water Programme)** has funded 9 projects of which a number address indirectly climate issues, such as i.e. the MEDROPLAN project on Improving drought preparedness, the ADIRA project that explores the introduction of autonomous desalinization programs or the IRWA project on improving irrigation water management.

Moreover, the **EU Common Foreign Policy and Security Policy** could play an important role in reinforcing the EU's capacity to prevent and deal with conflicts arising over access to natural resources, including water, and natural disasters accentuated by climate change, as well as their potential consequences such as forced migration and internal displacements of persons.

In this context, the EU will continue to promote adaptation within the UN Framework Convention on Climate Change (UNFCCC). Inclusion of adaptation measures in geographical programming is therefore to be strengthened in the framework of the **2004 EU Action Plan on Climate Change and Development**, under the Environment and Natural Resources Thematic Programme. At the European Council in June 2008, it was further mentioned that the EU “will work for the effective implementation of the 2007 **Global Climate Change Alliance** (see EU Commission’s Communication of 18 /09/2007) and (that it) will explore ways to mobilise new financial resources to tackle climate change and combat its negative impact”. In this context, the EU would work, *inter alia*, on a global financing mechanism. Close links should also in particular be developed with Africa through an **Africa-EU Partnership on Climate Change**, taking into account major related international instruments such as the UN Framework Convention on Climate Change (UNFCCC) and the UN Convention on Combating Desertification (UNCCD).

In the aftermath of the last year’s **Bali Climate Conference**, the EU is committed to maintaining international leadership on climate change and energy with the ambitious objective to secure a global and comprehensive post-2012 agreement on climate change at Copenhagen in 2009 consistent with the EU’s 2°C objective.

With regard to neighbouring countries, it has been proposed that “climate-proofing” measures/projects be supported by the **European Neighbourhood Partnership Instrument (ENPI)**, in the framework of the European Neighbourhood Policy. The ENPI could also serve as a financing source for initiatives under the Africa-EU Partnership on Climate Change,

North Africa and Middle East

Under the **GEF SPA** and the **SCCF** following concrete planned or ongoing adaptation projects are funded in the broader region:

- **Coping with Drought and Climate Change (regional)** This Strategic Priority on Adaptation funded project, aims to develop and pilot a range of coping mechanisms for reducing vulnerability of farmers and pastoralists to future climate shocks. Components include piloting coping strategies, improving early warning systems, developing drought plans and integrating climate change/drought across sector policies.
- **Community-based Adaptation (CBA) Programme, (global, including Morocco)**. This project is aimed at: (i) developing a framework, including new knowledge and capacity, that spans the local to the intergovernmental levels to respond to community-based adaptation needs; (ii) identifying and financing diverse community-based adaptation projects in selected countries; and (iii) capturing and disseminating lessons learned at the community level to all stakeholders, including governments.

The **World Bank** has also committed to assist developing countries in their efforts to address the climate challenge through a variety of analytical tools and of financial services including the Proposed Climate Investment Fund. To support Middle East and North African (MENA) countries in their adaptation and mitigation efforts, the World Bank Group is currently drafting **MENA Regional Business Strategy to Address Climate Change**, by fully integrating the objectives of reducing climate change induced vulnerability and GHG emissions into the Bank’s development assistance to the region. The proposed business plan is organized around the two following dimensions:

- the World Bank projects (IBRD and IDA) that will serve as “vehicle” to deliver the mitigation or adaptation assistance;
- the additional activities that would help the countries reduce GHG emissions or enhance their resilience to climate change.

The **World Hydrological Cycle Observing System (WHYCOS) project** aims to provide information to improve efficient management of the world’s water resources. It is based on a series of regional projects providing technology and training to monitor hydrological parameters (rainfall, riverflow and evaporation) in the world’s river basins.

There are a number of **regional initiatives for better water resource management** that will facilitate the adoption of appropriate adaptation measures, for example the **Africa Water Vision for 2025**.

Other **projects, initiatives or institutional activities ongoing in the broader region** with regard to climate change include notably:

- the **Consultative Group on Agriculture Research (CGIAR)**'s "**Climate Change Challenge Programme**";
- the **Assessments of Impacts and Adaptations to Climate Change (AIACC)**, conducted in collaboration with the UNEP/WMO and IPCC and funded by the GEF, to advance scientific understanding of climate change vulnerabilities and adaptation options in developing countries;
- the **IDRC Climate Change Adaptation Support Programme for Action-Research and Capacity Development in Africa (CCAA) programme** (five-year, \$65 million) in partnership with DFID, to support African countries in their efforts to address vulnerability, particularly of the poor, to climate change;
- the **Linking Climate Adaptation network (LCA)**, funded by DFID, which is an effort to help communities, policymakers, practitioners and academicians share knowledge on climate change adaptation;
- the **New Partnership for Africa's Development (NEPAD)**, an African-led strategy for sustainable development and poverty reduction in Africa. NEPAD is a long-term agenda for Africa adopted as a programme of the Africa Union;
- the **Sahara and Sahel Observatory (OSS)** work programme in arid, semi arid and sub-humid areas in North, West and East Africa, including long-term observations and networks focusing on land degradation issues and the identification and collection of a number of biophysical indicators to help to assess three sub-regions (North Africa, Sahelian Africa and Eastern Africa) needs and vulnerabilities to climate change and thus identify potential action for adaptation;
- the **Centre Régional Africain des Sciences et Technologies de l'Espace en Langue Française (CRASTE-LF)**, a training and research institute established under United Nations sponsorship to promote the utilization of space science and technology and develop related national and regional capacity.
- the **TICAD4 cooperation scheme between Japan and African countries**, which is dedicated to environmental issues and climate change (coopération entre le Japon et l'Afrique) consacrée aux questions environnementales et changements climatiques dont les principaux points évoqués sont les suivants :
- the **Human Security Network**, an international initiative currently under the chairmanship of Greece, which has chosen to focus its activities on the human security implications of climate change with emphasis on its impact on the vulnerable population groups of children, women and persons fleeing their homes due to climate change as well as to the adaptation opportunities.

2.3. Bilateral cooperation

Following up on the adoption of the ***Declaration on Integrating Climate Change Adaptation into Development Co-operation*** by the OECD Development and Environment Ministers in April 2006, OECD member countries have engaged, jointly with partner countries, into a process to mainstream adaptation into development activities.

Progress has so far been achieved in raising awareness on the importance of integrating climate change into development activities through analytical work, the conduction of training courses and seminars, the development of websites, dialogues with partner country authorities and other initiatives to disseminate relevant knowledge and experiences.

There is now also significant high-level policy endorsement, with initiatives ranging from agreements with broader environmental and development objectives to climate change initiatives mixing mitigation and adaptation approaches and more rarely agreements dealing specifically with adaptation.

The development and implementation by bilateral donor agencies of operational measures aiming at integrating adaptation considerations into development activities however is still at an early stage and considerable efforts need still to be made to advance further the agenda.

Among the bilateral cooperation/assistance initiatives currently underway in the Mediterranean region, the following are worthwhile to be cited:

- The support provided by the **German BMZ/GTZ** to the **Tunisian Government** for the preparation and the implementation of the **National Climate Change Adaptation Strategy**;
- The work undertaken by **Tunisia** to **mainstream climate change into the implementation of the UNCCD** with the support of **BMZ/GTZ**;
- The **Lake Nasser project** for the **development of a planning support system** to analyse management for Nile inflows and releases in the context of climate change, funded by the **Netherlands** through their Embassy in Cairo.

Chapter 3: Main issues with respect to climate change and water resources management

3.1. Economic development, food security and poverty

With water resources becoming even scarcer and population growing fast in most of the region there will be even less water per capita. Serious impacts on the economic development of many Mediterranean countries whose economies and living standards are growing fast are also to be expected.

For some of the countries there will be even issues to the people's livelihoods and food security since food production depends more and more on irrigated agriculture that accounts for up to 90% of water usage. Climate change poses indeed the risk of further depressing the agricultural sector's economic performance through accelerated desertification, yield reductions and increased volatility (especially in cereals), of threatening rural jobs, increasing the fiscal burden of government intervention in support of the sector, and thwarting efforts to improve access to foreign markets for high value crops.

Agriculture yields, especially in rain-fed areas, are expected to fluctuate more widely over time, and to converge to a significantly lower longer-term average: a recent study estimates that for the region as a whole, agricultural output will decrease (in value terms) 21% by 2080, with peaks of almost 40% decrease in countries like Morocco and Algeria.

3.2. Lack of awareness, integration into policy-making and sound governance

Although climate change is getting growing attention throughout the world, including the Mediterranean region, there is still little awareness of the measures to take to cope with the issue among the population but also to a certain extent among policy-makers. There is still some latent scepticism due to the uncertainty of its local and regional impacts leading to certain inertia in the political and decision-making circles.

Such an attitude does not help the development of policies and even less the integration of climate considerations and coping strategies into the existing policy framework and institutional set up.

Furthermore, in many countries of the Mediterranean region, governance issues, such as corruption and lack of transparency, are still affecting public administration, including the sound management of water resources, (i.e. equitable allocation of water and access to sanitation). This problem will be exacerbated by climate change, which will enhance existing water stress. It is therefore crucial that the governance dimension is taken into account and addressed to avoid tensions about water usage and to allow for smooth management of water resources in a context of climate crisis.

3.3. Knowledge development and technology transfer with regard to hydro-meteorological data and climate projections

There is general agreement within countries about the need for enhanced regional and local climate change scenarios. The greatest demand is for climate information for the next 20–50 years, and even the next 5–10 years. Uncertainties need to be reduced and more knowledge is needed to distinguish the consequences of climate change and of natural climate variability. Countries want regional and local data to be merged with hydrological models, and for improvements in the accuracy of hydrological and hydraulic models, including groundwater. There is also a need to improve the coupling of climate and hydrological models. Countries see the need to maintain observation networks to identify climate change trends, and suggested including remote-sensing techniques in hydrological monitoring.

In the countries of the southern Mediterranean, there is furthermore need for capacity building and technology transfer in the field of hydro-meteorological data collection and services. This would enhance disaster preparedness in case of extreme weather events such as flashfloods, storms and even droughts. North-South cooperation in this field of research and science is therefore vital to enhance resilience. Regional cooperation would also be of benefit to MENA countries that face similar problems.

3.4. Energy

Providing additional supplies of water to alleviate droughts can often involve more investment in energy, for example desalination plants and pumped water transfer schemes. Improvements in water quality, which may be needed to combat existing pollution, also often require increased use of energy. Land management schemes for river basin protection, for example the use of land for water storage to alleviate flooding, may have implications for emissions of greenhouse gases.

Considering this climate-water-energy nexus and its implications, it is thus crucial that when dealing with adaptation, proactive, thoroughly planned strategies and structured measures are developed to ensure that coping with climate change does not imply further global warming and in turn disrupt the overall water cycle, affecting further the distribution in time and in space of water resources on our Planet.

3.5. Gender issues

Since women are responsible for water management at the domestic and community level in many countries of the Mediterranean basin, climate change and especially situations of water scarcity and droughts will also impact women more acutely.

Women are also lagging behind in education matters. Lack of education in turn hinders awareness raising processes in environmental issues, including climate change, thus making populations even more vulnerable to forthcoming changes.

3.6. Ecosystems

Already under heavy pressure from manmade activities, ecosystems will be even more severely affected by the climatic changes. Wetlands, which constitute important buffer zones, especially are under immediate threat due to water abstraction and aggravated evaporation due to higher temperatures, while forests are more and more exposed to wild fires, which worsen land degradation/ soil erosion in arid and semi-arid areas of the region and lead to the release of even more greenhouse gases.

Loss of important ecosystems and landscapes implies moreover loss of biodiversity and correlated valuable services and goods.

Chapter 4: The way forward: Exploring water-related adaptation responses for the Mediterranean

Adaptation refers to actual adjustments or changes in decision-making aiming at enhancing resilience/ reducing vulnerability of people and the environment to observed as well as expected changes in climate. There is a wide array of potential adaptive responses/measures: ranging from technological, behavioural/social and managerial to policies. Since adaptation is a cross-cutting issue, IWRM could provide an appropriate framework for streamlining adaptive measures into water management issues.

It is also true that in the meanwhile most of the people of the Mediterranean region are already adapting to climate change, even if they are not always aware of it: e.g. the air conditioning market is booming, with heat waves becoming ever more frequent and severe; the water consumption is rising in the agricultural and domestic sectors as a response to reduced run-off, increased temperature, water evaporation and droughts.

However, spontaneous, individual, responsive adaptation measures, albeit natural to every living being/organism struggling for its survival, results in a vicious circle: leading on the one hand to growing energy consumption, the very cause of global warming, and on the other to increased water-stress, an already “hot” issue in the Mediterranean countries.

Better water management will be essential if communities are to adapt successfully to climate induced changes in their water resources. The strategies adopted will have to use a combination of infrastructural and institutional measures and to go well beyond what is normally considered as “business as usual”. Critically, they will require major changes in the way agriculture, industry and human settlements in general are managed, thus implying Integrated Water Resources Management (IWRM). The future resilience (or vulnerability) of human communities to climate change related impacts will depend, to a large extent on a combination of measures and on the proper success of implementation of these measures.

To a great extent, resilience with regard to climate change impacts on water will depend on the state of water infrastructure. Yet, the armoury of the water manager to address variability and extreme events is not restricted to infrastructural means. As important are the institutional mechanisms that, again more or less formally, help to deal with climate variability and to achieve goals such as water supply for people, industries and farms, to protect communities from flooding while sustaining ecosystems. Integrated water resource management also offers a set of soft tools that are often cheaper, and may be more effective, than its infrastructural tools and can certainly complement infrastructure to ensure that it works effectively.

In the Mediterranean particularly, when addressing potential water shortages, as much attention should be given to managing demand as to increasing supply, by introducing more efficient technologies as well as simply promoting a culture of conservation. This is going to be particularly important since overall water availability will decline in the region.

In all this, it is important to recognise that many of these challenges are not new and are certainly not the product of climate change alone. Thus the changing lifestyles and dietary patterns associated with growing affluence will, arguably, have an even greater and more immediate impact on the water environment.

The main fields of intervention for adaptation measures relevant to water resources management to be further explored are described below.

4.1. Policy formulation, strategic planning and institutional approaches

Sound water resources management in the era of climate change will increasingly presuppose the mainstreaming of adaptation strategies and measures into water resources management at all levels, including national, river basin and regional levels, and vice-versa. These may be any activity in between the response to climate disasters and proactive policies aiming at reducing vulnerability of people.

Integration may be sought after in the National Strategies for Sustainable Development (NSSDs), IWRM/National Water Resources Management Plans, National Adaptation Plans (NAPAs), Poverty Reduction Strategies (PRSPs) as well as River Basin Management Plans, as applicable. Some countries of the region have already made important efforts into this direction, such as Morocco with its very successful *National Human Development Initiative*.

Such an integrative approach will help developing anticipatory strategies that will help reduce countries' vulnerability vis-à-vis the higher climate variability and the increased occurrence of extreme weather events.

To climate-proof the water sector, adaptation tools, such as climate scenarios, vulnerabilities assessments, priority adaptation options, climate risk management schemes could be used extensively at all levels of decision-making. Land-use planning *inter alia* for civil protection (i.e. relocation of communities under risk in coastal areas or river plains...) and in particular water infrastructure,

Existing water-related climate adaptation activities may be reviewed, assessed and submitted to multi-criteria analysis so as to determine the best combination of measures and prevent the "maladaptation" potentially associated with the uncoordinated or contradictory action in different sectors or government agencies. This could also help forecast the impact of adaptation measures (generally) on water resources (i.e. groundwater quantity and quality, salinity) and evaluate necessary trade-offs as well as identify "no regret" measures/investments.

Adequate regulatory frameworks will need to be developed and enforced; the institutional set-up might also be reformed so as to respond to emerging climate risks in a holistic approach.

Developing Inter-institutional cooperation and dialogues between the institutional actors of the water sector and respective actors in the health, social, educational, environmental, infrastructure sectors at national level (i.e. ministries, national agencies, etc.) and regional/international level would constitute another considerable step in climate-proofing.

4.2. Technical solutions

There is a wide array of technical measures that could assist in coping with the impacts of climate change. Most of them are already linked to sound water management in a context of scarcity of the resource and growing pressure from human development.

§ Water demand management

Water conservation and efficiency measures (also called demand-side measures) will be of utmost importance for the protection especially of groundwater resources from over-abstraction and should therefore be given priority. These range notably from household water cuts, water metering and economic incentives in the domestic field to the development of water-saving devices, leakage reduction in distribution networks, drip irrigation in agriculture and cleaner production techniques in the industry and energy sectors.

§ Development of water supply and alternative water resources

In combination with water demand management, supply-side measures, *inter alia* the development of Non-Conventional Water Resources will be necessary to match the increasing water requirements of the people and of the various sectors of the economy. These include: rainwater harvesting, treated waste water reuse, desalination techniques, smaller, medium and water collection and storage systems, large dam structures, sustainable drainage systems, inter-basin transfers and artificial groundwater recharge.

§ Climate risk management

To ensure or at least enhance civil protection in the face of climate-related disasters, such as floods, persistent droughts, storms and heat waves, climate risk management and contingency planning tools need to be developed and made available region-wide and at country level.

This implies notably the strengthening of hydrological monitoring capacities, the development of early warning systems, civil protection mechanisms (i.e. fire-fighting equipment), drought management plans and flood risk mitigation schemes (i.e. strategies combining watershed management and land planning). Climate-proofing of water infrastructure (i.e. dams, water collection devices) is another aspect of climate risk management.

4.3. Climate information and research

Access to climate data and especially model-generated data and their analysis, in terms of scenarios or re-analyses, is critically dependent on computational, storage and internet bandwidth facilities, which is a major challenge for many countries of the region.

Moreover, with a few exceptions, there is a lack of reliable national systems of data collection and modeling for water resources. Nevertheless suitable management of water resources can only be guaranteed if a body of reliable data is available.

Further research and development in this field for downscaling at the lowest possible level and to reduce uncertainties will thus be crucial for more accuracy in the water resources management and the planning of risk reduction activities. National hydro-meteorological should be strengthened as regards skills, and technical and financial means.

4.4. Economic instruments

Among the relevant activities that could be carried out, the first would be documenting the sector-wide impacts of climate change, providing estimates of their cost and that of possible adaptation measures.

When developing adaptation strategies, all the range of economic instruments should be considered including sound pricing, positive incentives, taxes, etc., either to enhance water demand management or encourage diversification, in particular for sectors that are likely to be heavily impacted (i.e. irrigated agriculture).

4.5. Cross-cutting measures

There is a recognized need to **increase awareness** of and **build consensus** among stakeholders/ water users, especially those located in risk zones, so as to enhance their adherence to water efficiency/conservation measures and pro-active adaptive attitudes. This could include informing local communities on possible actions that would protect their livelihoods and ecosystems from the effects of water-related climate change events as well as alternative options or the dissemination of best practices on water and adaptation in the region.

Capacity building activities, such as training of civil servants, officials and professionals of the water sector as well as in the meteorological services, are another important option. **Education for Sustainable Development** at all levels will allow for developing water conservation and efficiency approaches.

Governance issues can be further addressed through bottom-up approaches such as the regular **consultation and involvement of stakeholders** in decision-making processes, especially at local and river basin levels where the planning of adaptation measures is most suitable. Such approaches also facilitate the acceptance by the concerned public of important trade-offs and decisions with economic dimension (i.e. water pricing, etc.). **Voluntary agreements** should be sought after with the private sector, where applicable. There is also an urgent need to take into account **women's needs**, as key water users, in adaptation policies, to empower them further and to include them in all stakeholder involvement schemes related to water resources management so as to help them voice their concerns and participate in decision-making processes. This also valid for disfavoured social groups (i.e. poor, rural communities, refugees), that will be hard hit by climate change consequences.

The interlinkages between impacts of climate change, **MDGs and migratory trends** and their consequences on regional/ international security and integrate these into policy formulation (especially relevant to EU) could be further explored to develop security strategies.

4.6. Integration with other sectors

Some sectors are of particular relevance to water resources management due to their footprint on water and/or vice-versa.

In the **agricultural sector**, it will be crucial to obtain "more crop per drop" not only through more efficient irrigations systems but also through switching to more drought resistant crops, in

particular in arid zones and factoring the “virtual water” principle into rural development, trade and macro-economic policies.

It will be necessary to study the interlinkages between water and **energy** with respect to climate change (i.e. water footprints in the energy sector, energy footprints in the water sector combined to climatic challenges) and integrate these into policy formulation.

With regard to **tourism and industry**, there is a need to develop water efficiency measures and use of non conventional water resources (i.e. waste water reuse) in these sectors. It would also be sound to avoid the development of large-scale and/or water-intensive tourism activities in arid areas (i.e. golf complexes) and to promote alternative/sustainable tourism activities during seasons less prone to drought and heat waves.

As one of the several water users, **nature** will be severely impacted by changes in the hydrological system induced by global warming. It will therefore be crucial to take into account ecosystems needs as well as valuate biodiversity services when devising adaptation strategies.

4.7. International cooperation

Given the severity of the impacts of climate change on the region’s water resources and the transboundary nature of several water bodies, international cooperation should be further enhanced to explore common solutions for shared benefits.

North-South cooperation in the technical and scientific fields (meteorological data collection, forecasting, development of early warning systems, etc.) are crucial, including the transfer of technologies for analysis, risk assessment, the adaptation of the infrastructures needed for managing water resources and to develop tools assisting in decision-making.

At the regional level, transboundary cooperation for the common definition of sound adaptation measures in the water sector of the region (i.e. transboundary water bodies, contingency plans) jointly with regional/ international actors, countries’ authorities and other major stakeholders should be further explored and adaptation, development and water issues (i.e. EU Global Climate Alliance, PRSPs, NAPAs, MDGs) streamlined. Some initiatives undertaken by countries of the region, such as the successful Moroccan *National Human Development Initiative*, could serve as best practices/models and be replicated in other countries.

Conclusions

IWRM promotes a holistic approach to water management and recognises that there are multiple pathways to building resilience. IWRM seeks to identify, and then to achieve tradeoffs between different water management objectives including environmental sustainability, economic efficiency and social equity. It encourages the structured engagement of communities and sectors impacted upon by water into its management both to seek and promote “win-win” solutions but also to ensure that a better understanding of water constraints and challenges is developed and diffused into the society.

A future Strategy on Water in the Mediterranean should take in due account issues of Climate Change Adaptation and respond, in an IWRM approach, to challenges emerging from new conditions in the region.

References

Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK

Climate change and water adaptation issues, EEA Technical report No 2/2007, European Environment Agency, 2007, ISBN 978-92-9167-917-1
(http://reports.eea.europa.eu/technical_report_2007_2/en/eea_technical_report_2_2007.pdf)

El-Fadel, M. and E. Bou-Zeid. 2001. Climate Change and Water Resources in the Middle East: Vulnerability, Socio-Economic Impacts, and Adaptation. The Fondazione Eni Enrico Mattei. June. (<http://www.feem.it/NR/rdonlyres/7EAE52F3-44AD-4F9A-AA9A-9899AED8F203/432/4601.pdf>)

Action Plan of Tunis for Adaptation to Climate Change in Africa and in the Mediterranean Region in a context of International Solidarity (http://www.mdptunisie.tn/fr/conference/images/pdf/action_plan_en.pdf)

MED EUWI Climate Change Adaptation and Integrated Water Resources Management in the Mediterranean - Position Paper (http://www.minenv.gr/medeuwi/meetings/Bled.Slovenia.10-11.December.2007_en/OTHER_CC%20Adaptation%20%26%20Water%20Draft%20PP%20071207.pdf)

Communication from the Commission to the European Parliament and the Council on "Addressing the Challenge of Water Scarcity and Droughts in the European Union", COM(2007) 414 final, 18.7.2007 (<http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2007:0414:FIN:EN:PDF>)

Implementing the Nairobi Work Programme on impacts, vulnerability and adaptation to climate change through the World Meteorological Organization and National Meteorological and Hydrological Services WMO-No. 1025, 2007, World Meteorological Organization, ISBN 92-63-11025-5

Technical report on water scarcity and drought management in the Mediterranean and the Water Framework Directive, Mediterranean Water Scarcity & Drought Working Group (Med WS&D WG), April 2007, <http://www.emwis.net/topics/WaterScarcity>