

THEME PAPER

***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

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## 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 approach.

Climate change affects the quantitative and qualitative status of water resources by altering hydrological cycles and systems which, in turn, affect the intensity and frequency of floods and droughts; water availability and demand; water quality and parameters critical for ecosystems such as temperature and nutrient content. Changes in the aforementioned variables lead also to impacts on the socio-economic and environmental goods and services.

In this context, water management will become increasingly difficult.

Hydrological variability and extremes are indeed the main challenge of maintaining water security. This will require significant adaptation, which in turn implies the application cluster of measures and practices not easy at all, particularly for countries that lack the infrastructure and institutions to store, manage, distribute and deliver water resources. Water demand will also be affected through the expected increase in 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 as well as 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 of 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 most parts of 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 food and overall security in the immediate future.

## **1.2. North Africa**

In North Africa, as more generally in Africa, vulnerability over water and climate change 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. and to aggravate health issues, thus likely to exacerbate 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 (of the order of 50%) in run-off and stream flow 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 may 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.

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. Furthermore, 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 also vulnerable to natural hazards such as floods and, together with Morocco, could also be partly 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, high 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 conflicts, 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 to drop by 25-35 per cent, according to FAO.

Snowfall and in particular snow cover in high mountains might change and are expected to decrease with hydro-geological, ecological and economic consequences.

Unless adequate and urgent action is taken to reduce vulnerability to climate change, the sub-region will be exposed to large economic and social risks 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 electricity supply, decrease in precipitation and shorter periods of snow cover in the mountains 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.

#### **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 could affect tourism activities as well as people' health and enhance energy consumption for cooling purposes. Decreased precipitation and run-off will moreover be an issue for hydropower generation.

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 already affect flood generation -, an increasing risk of flooding in the region is expected under climate change and the shortening of the stay of snow cover in the mountains.

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 aquifers are already heavily abstracted and over-exploited, and some will not be suitable as drinking water because of saline intrusion exacerbated by rising sea levels. Even aquifers 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, in addition to the currently experienced severe water scarcity, are particularly at risk also from sea level rise with a number of sites under 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-demand 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.

▪ **15<sup>th</sup> 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. In fact, under the Water Frame Directive a group of experts is developing a guidance document about how to adapt to climate change with regard to water issues and EU water legislation that will be ready at the end of 2009.

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. It furthermore offers opportunities for funding adaptation under the Thematic Programme for Energy and Environment (ENRTP) and the ENPI national and regional programmes. 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 **MED-HYCOS**, the Mediterranean component of 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 combining 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 rapidly growing 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.

The impacts of climate change on the marine environment and fisheries are virtually unknown but the reduced freshwater input with higher nutrient concentrations might increase the risks of eutrophication and toxic algae blooms thus increasing vulnerability of those whose livelihoods depend on fisheries.

### **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.

The current 'water culture', which is more focused on water supply than on water demand management, poses additional problems to the sound management of the resource in the light of occurring climatic changes. Integrated Water Resources Management (IWRM) is still in a very early stage in most of the countries in the region. So, currently, it is time to include in their basin management plan, or in their hydrology national plan in case countries don't have the mentioned management tool, strategies to cope with climate change.

Furthermore, in many Mediterranean countries, governance issues, including lack of transparency and corruption are still affecting public administration, and the relevant management of water resources. 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 prevention and 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**

In addition to the already direct links between climate change, reduced precipitation and hydropower, 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 human activities, ecosystems will be even more severely affected by the climatic changes. Wetlands especially, which constitute important buffer zones for the water quality and flood prevention, are under immediate threat due to reduced water availability, further water abstraction and aggravated evaporation due to higher temperatures, while forests due to reduced humidity are more and more exposed to wild fires and vegetation cover is more and more limited, a development which worsens 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 management and application of measures aiming at enhancing resilience/ reducing vulnerability of people and the environment to already observed as well as to expected changes in climate. There is a wide array of potential adaptive responses/measures to be taken separately or in combination: ranging from policies to technological, behavioural/social and managerial. Most of them are compatible or

already integral part of IWRM. For this reason and since adaptation is a cross-cutting issue, IWRM could provide an appropriate framework for streamlining adaptive measures into overall water management.

It is also true that in the meanwhile most of the people of the Mediterranean region are already trying to cope with 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 both in the agricultural and the 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, may result 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 – different – water management will be necessary 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 the balanced combination of coherent and appropriate measures and the rapid and proper implementation of these measures.

To a certain 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 should not be restricted to infrastructural means. As important are the institutional mechanisms that, again in a formal or informal manner, directly and indirectly, could help to deal with climate variability and to achieve goals such as water supply for people, industries and farms, the protection of communities from flooding while sustaining ecosystems, the latter playing an important role in jugulating the impacts of climate change (i.e. as buffer zones, for groundwater recharge, etc.). IWRM and water demand management also offer a set of soft tools that are often cheaper and more effective than the infrastructural approach.

In the Mediterranean particularly, when addressing potential water shortages, priority should be given to managing demand over increasing supply, notably by introducing new or more efficient technologies, notably by adjusting prices, as well as simply by informing, educating and promoting a culture of conservation in view of the declining water availability 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 population growth and increasing affluence, arguably, have already a similar or an even greater and more immediate impact on the water environment in the Mediterranean region.

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 damages/disasters due to climate change and proactive policies aiming at reducing vulnerability.

Integration of higher “margins” in all water calculations and provisions may be sought after in the National Strategies for Sustainable Development (NSSDs), IWRM/National Water Resources Management Plans, National Adaptation Plans (NAPAs), Environmental Accounts, 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 could help developing anticipatory strategies that 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 frequently flooded coastal areas or river plains...) and in particular careful designing of water infrastructure are all extremely useful tools.

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. The adaptive capacity of individuals as wells as institutions and authorities must be enhanced.

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. The relevant technical measures in the present case are closely linked to legal and socio-economic measures. They 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 and recycling techniques in the industry and energy sectors.

### **▪ Development of water supply and alternative water resources**

In combination with water demand management, supply-side measures will be necessary to match the increasing water requirements of the people and of the various sectors of the economy. These include the development of non-conventional water resources such as rainwater harvesting, reuse of treated waste water, desalination techniques, as well as 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 or area 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 of climate predictions at the lowest possible level and for reducing uncertainties will thus be crucial for more accuracy in the water resources management and the planning of risk reduction activities. National hydro-meteorological services should be strengthened as regards skills, technical and financial means. Researches about the potential effects of climate change in water resources in natural regime, water demand (irrigation, urban supply and industry), available resource in water management systems and ecological status of water bodies should be carried out in all countries in order to cope with new scenarios.

#### 4.4. Economic instruments

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

When developing adaptation strategies, all the range of economic instruments should be considered including sound pricing, positive and negative incentives, taxes, levies, charges, etc., either to enhance water demand management, to promote the use of alternative water resources 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 to **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 hydro-meteorological services, are an additional option. **Education for Sustainable Development** – including on aspects of climate change, production and consumption patterns – 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/or river basin level 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 implications (i.e. water pricing, etc.). **Voluntary agreements** should also be sought after with the private sector, where applicable. There is moreover an urgent need to take into account **women's consideration and 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 adaptation processes. This is also valid for disfavoured social groups (i.e. poor, rural communities, refugees), that will be hard hit by climate change consequences.

Addressing **transparency issues and corruption** and **reducing bureaucracy** in relation with access to water, in view of the forthcoming water stress situations is a must.

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

#### 4.6. Integration with other sectors

Some sectors are of particular relevance to water resources management due to their dependence from and footprint on water and 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 all these concerns into policy formulation.

With regard to **tourism and industry**, there is a need to develop water efficiency measures and expand the 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, water-intensive tourism activities in arid areas (i.e. golf complexes) and to promote in parallel alternative/sustainable tourism activities during seasons less prone to drought and heat waves.

In this context, the links between the development of the **Euro-Mediterranean Free Trade Zone** and additional stresses on the water resources in the light of climate change deserve to be explored.

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 (i.e. minimum flows, etc.) as well as value biodiversity services that need to be maintained when devising adaptation strategies. Functional ecosystems play moreover an important role for adaptation in securing water recharge and in preventing extreme events under drastic climatic conditions.

#### 4.7. International cooperation

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

North-South cooperation in the technical and scientific fields (hydro-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 the development of tools assisting decision-making.

At the regional level, international cooperation for the common definition of sound adaptation measures in the water sector of the region (i.e. transboundary water bodies, joint contingency plans, etc.) 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 Mediterranean Strategy on Water 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.

It is important to develop research studies for identifying the potential effects of climate change, as well as define measures and instruments in order to develop climate change mitigation and adaptation strategies.

Moreover, the importance of maintaining **functional ecosystems** in enhancing resilience to climate change should not be underestimated and instead be fully considered as an important adaptation tool in any future Mediterranean Strategy on Water.

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