European Climate Change Programme

Working Group II
Impacts and Adaptation

Water Management
Sectoral Report

The EU's Adaptation Programme

Adaptation is a new policy area for the European climate change policy. The Impacts and Adaptation Workgroup has been set up as part of European Climate Change Programme (ECCP II). The main objective of the workgroup is to explore options to improve Europe's resilience to Climate Change Impacts, to encourage the integration of climate change adaptation into other policy areas at the European, national and regional level and to define the role of EU-wide policies complementing action by Member States.

The aim of this initial programme of work is to identify good practice in the development of adaptation policy and foster learning from different sectoral experiences and explore a possible EU role in adaptation policies.

The Commission has led a series of 10 sectoral meetings looking at adaptation issues for different sectors. One of these meetings looked at the impacts on the water cycle and water resources management and prediction of extreme events in particular. This report summarises the state of play in the Water Resources sector in relation to adaptation to climate change on the basis of the information gathered at the stakeholder meeting on 11 April, 2006.

Key impacts of climate change on the water sector

Water-related climate change impacts sector are cutting across a number of key concerns for adaptation policies like extreme weather events, water supply, droughts, floods.

The water cycle
A recent report by the EC Joint Research Centre[1] stated that:

- the average increase in the observed annual mean temperature across the European continent is 0.8°C. The temperatures during the winter season have in general increased more than during the summer,
- annual precipitation over Northern Europe has increased by between 10 and 40% in the last century while the Mediterranean basin has experienced up to 20% reduction in precipitation,
- the summer of 2003 was very likely the hottest summer and the last 30 years appear to have had the warmest climate within the last five centuries.

Changes in river flows have been assessed, and variations have been observed both in terms of increases and reductions in flow. It was possible to attribute some of the increases in river flow to increased precipitation.

There is no evidence that flooding in Europe has been systematically increasing in frequency or intensity.

In general, the hydrological cycle is expected to become enhanced as global temperatures increase. For every degree Celsius of warming theoretically the air can absorb 7% more water vapour. Climate models predict an increase in precipitation of approximately 3% for each degree increase in temperature. The expected impacts of climate change across Europe on the water cycle include the following:

[1] JRC 2005, Climate Change and the European Water Dimension, EU Report No. 21553

- projections up to 2100 show precipitation increase in the north of Europe (mostly in winter) and decrease in summer precipitation in the south of Europe,
- extreme precipitation will occur more frequently, especially in winter, which may lead to more frequent flooding,
- in central and southern Europe, the drought risk is likely to increase,
- changes in precipitation patterns may alter the availability of surface water, which could lead to increased exploitation of groundwater resources,
- reduction of snow and ice cover in combination with higher potential evaporation may lead to decreased river discharge and downstream water availability in summer,
- sea-level rise may affect fresh water resources in low-lying coastal areas by saline intrusion,
- there may be an increased risk of forest fires during droughts.

Water quality
Water quality can change in response to climate change, through the increased mobility of chemical compounds, changes in hydrology and changes in timing of biological and meteorological patterns. Water quality in particular relates to nutrients, oxygen, natural organic matter and hazardous substances, contained in the water, as well as to the temperature of the water.

Peak discharge (flash) events can cause water quality problems by causing a “flush” of sediment or water pollutants, or indirectly by causing a leaching of waste disposals and water treatment facilities. Flash events can also result in the spread of pathogens.

Changes in lake water temperatures and resultant impacts have been observed.

Impacts on water resources management
The economic impact of floods, droughts, and related impacts like forest fires can be considerable. For instance, in Africa, reductions in GDP of up to 25% have been observed in the African countries of Kenya, Mozambique, and Zimbabwe. Resilience to the water-related variability can depend on water storage capacity, which varies across the world. Reservoir storage is much greater in North America and Australia, than in Africa, for instance. Water security is an essential element for climate adaptation.

Europe has experienced an increasing number of severe floods disasters in the last decades, some of which have seen unprecedented damages. For example, the direct damage caused by the August 2002 flood event in Central Europe amounted to an estimated €18.5 billion.

The 2003 heat wave and drought event in large parts of Europe created an estimated economic damage of €12 billion. During the latest drought situations in Europe, such as in 2005 on the Iberian Peninsula and southern France or in the first half of 2006 in northern Italy, U.K., and France, hydro power generation was considerably reduced, and thermo and nuclear power plants had to reduce energy production due to lacking or too warm cooling water, with consequently rising energy prices on the short-term energy markets. The water service-providing sector has been threatened by impacts of water shortage even on the local level, such as the request for gardening after the declaration of a hosepipe ban in Southern U.K.

Other factors

It is important to note that climate change is only one factor posing threads to a sustainable water resources management. Other influences include:

- unsustainable water use for agriculture and industry,
- dams, embankments, dykes or water transfers used to serve a number of activities, including safety, hydropower and navigation,
- nutrient loads and other emissions of substances that affecting water quality, thus reducing the availability of clean water,
- changing land-use patterns and structural measures that affect river geometry and water storage on river flows may result in increased peak discharges on the one hand (floods), and to reduced water availability in a later period (droughts),
- changes in agriculture may affect water resources, especially in a drying climate,
- unsustainably urban sprawl that does not respect the given limitations of water supply,
- increased build-up of former flood plains that lead to a higher risk of damage and fatalities in case of a flood event.

These other factors are in some cases currently more important than climate change impacts, but climate change is likely to worsen the situation. In some instances, these may also moderate the climate change impacts on these sectors. For example, improving water efficiency may reduce the impacts of climate change when water shortages would become more frequent.

Existing/Relevant policies at the EU level

Water quality
The Water Framework Directive (WFD; Directive 2000/60/EC) aims at establishing a good surface water quality status in the EU Member States. The WFD has been in place since 2000. In 2001, the 25 member states (plus Norway) agreed a Common Implementation strategy led by EU Water Directors in each member state. Goals have been set for 2009, after which a six-year period for review and renewal will follow.

The WFD is a key instrument in climate adaptation policies in the water sector that in principle includes the requirements needed for addressing climate impacts. The way it addresses the water sector could be seen as a template or scheme also to be used for other adaptation policy areas because it requires Member States to:

- undertake a comprehensive stocktaking of environmental pressures including the additional climate pressures, and of the economics of water uses,
- apply an ecosystem (catchment area) approach (across administrational boundaries),
- look at the ecosystem management in a long term perspective,
- monitor the relevant environmental (climate related and other) impacts,
- define clear (environmental quality) targets,
- devise and implement management plans with concrete measures to achieve these targets, including market based instruments, like recovery of water service costs including environmental and resource costs from the water users,
- review management plans regularly in order to take into account recent data and information.

Relationships between water scarcity and droughts, such as in 2003 in Europe, and the WFD have been assessed in the report “Water scarcity management in the

context of WFD". This report, prepared by a group led by France and Italy, addresses definitions and an assessment of the drought phenomenon as well as long-term imbalances in supply and demand, and emphasises the planning for drought events and water shortage management. It also identifies open questions between water quality and quantity, e.g. the achievement of a good ecological status for intermittent rivers or the derogation from WFD water quality objectives under drought conditions, and tries to draw general lessons.

The Council has produced a document on European action on water scarcity and drought[2] (document 10742/06).

The Common Agricultural Policy and activities under the Rural Development Programme also influence water quality (see also the sector reports on Agriculture and Regions).

Water quantity and extremes
The European Flood Action Programme has three components, which include the exchange of knowledge and experience and support research efforts, and developing a best use of EU funding instruments for flood risk management.

The third component is the development of a legislative instrument. A draft Flood Directive has been proposed[3] (COM(2006)15), which has been adopted by The Council. The Flood Directive contains an element of flood risk assessment, which includes climate change impacts, and the development of flood risk management plans.

The following knowledge and experience exchange efforts have been developed under the European Flood Action Programme:

- the European Exchange Circle on Flood Forecasting and Early Warning (EXCIFF) was piloted jointly by JRC and French Ministry of the Environment. It was launched in December 2004 and has 22 Member State or agencies and 31 operational hydrological and meteorological centres or organisations as members. Its main objective is to facilitate the exchange of information on flood forecasting practices to practitioners and to end-users,
- the European Exchange Circle on Flood Mapping (EXCIMAP) consists of 33 participants, among which 15 European countries, International hydrological commissions, EU funded projects, European organisations, and other interested stakeholders. A first draft guide of good practices will be presented in January 2007,
- a European exchange circle on land use planning is to be set up as well, which is an initiative of Norway.

The EU Solidarity Fund[4] helps the EU respond to requests for aid in the event of major natural disasters. It may therefore create important links to the management of weather related risks, such as floods and droughts, within the EU. The Fund has an annual budget of one billion Euros (see also the sectoral report on Insurance).

With respect to droughts, the already mentioned document on water scarcity management has demonstrated the need for a pro-active approach for a sustainable water resources management that foresees a series of measures starting already

[2] http://register.consilium.europa.eu/pdf/en/06/st10/st10742.en06.pdf
[3] http://ec.europa.eu/environment/water/flood_risk/pdf/com_2006_15_en.pdf
[4] Council Regulation (EC) No 2012/2002 of 11 November 2002

under non-drought conditions, opposite to the reactive approach, which still often applied today. To this end, the JRC is developing a European Drought Observatory in close collaboration with Member States that addresses the issue of early warning within a comprehensive drought management on the European, national, and regional level.

Other relevant water policies
Other relevant water-related policies in the context of climate change adaptation include:

- the Bathing Water Quality Directive (76/160/EEC),
- the Drinking Water Directive (98/83/EC),
- the existing Groundwater Directive (80/68/EEC) and the Commission proposal for a Directive on the protection of groundwater against pollution (COM(2003)550),
- EU Water Initiative, focusing on the implementation of the Millennium development goals on clean water, adopted in Johannesburg in 2002.

Examples of existing initiatives at member state level

Recent Member State National Communications that have been sent to the UNFCCC show that all countries mention that action should be taken on adaptation. However, few countries have mentioned specific adaptation activities. Where actions are being taken, they often relate to the general integration of adaptation elements into water resource management approaches. For instance, in the UK and The Netherlands, climate adaptation measures consist of flood management measures. Such measures are treated as risk management approaches, rather than as explicit adaptation activities.

Some examples of Member State approaches presented at the meeting are listed below.

Flood management approaches
The Netherlands water policy relates to a large extent to climate change adaptation. Current flood protection measures take into account an increased peak discharge at the Rhine, in view of expected climate change. The government has recognised the need to widen the river floodplain, rather than increasing the height of the dykes. This policy is called “Room for the River”. Although this policy removes the increased risks that would be associated with higher dykes the costs are high in terms of the area of land needed. It is also important to involve different stakeholders in these decisions.

At the local scale, attempts are also made to reduce flood risks. For example, in the KLIWA project (climate change and consequences for water management) of the federal states Baden-Württemberg and Bavaria of Germany, the impact of climate change on mean flood levels have been studied using regional climate scenarios.

Drought management approaches
The 2006 drought in parts of the UK has led to restrictions on water use, the promotion of water efficiency, and the issuing of drought permits that help to temporarily increase supplies. Water UK, which represents 23 UK water and wastewater service providers, both public and private, has published a 5-year strategy which has 8 priority areas, one of which is climate change.

In the UK water companies have set up and funded an independent nongovernmental organisation, Waterwise[5], to promote large-scale water efficiency projects, and the industry is also actively involved in the Ministerial-led Water Savings Group.

Spain is developing a National Adaptation Plan, which will take into account links between sectors and systems. The Plan will focus on water, biodiversity, coastal zones, and further development of regional scenarios. Specifically, quantitative scenarios of water resources in Spain will be developed and the impacts on the ecological status will be assessed qualitatively. Finally, the potential impacts on irrigation demands will be assessed.

Gaps identified

There are some areas where further work is needed, although this could be at the local, regional, national or EU level.

Impacts of climate change vary by geographic location. There is also a large amount of diversity in terms of current approaches to climate change adaptation. Consequently, there is a need for a framework for adaptation within which Member States can operate.

There is also a need for better engagement with other sectors, as many response strategies are still targeted mostly at the water sector itself.

Policy options for the EU level

Information and knowledge
A strong evidence-base is needed for supporting decision-making, awareness raising and communication. Industry and policy-makers to develop a better understanding of the uncertainty of the assessment of impacts and adaptation options associated with climate change.

The Commission is currently in the process of drafting the 7th Framework Programme. One of the areas of priority is water and climate change e.g. higher resolution integrated modelling (e.g. continuation of ENSEMBLES project), and with an improved coupling between land surface and atmosphere processes and looking more particularly at the sectoral impacts.

It is important that EU activities are further coordinated with research activities at national level (95% of the research that takes place in the EU is nationally-funded). There is a need for member states to disseminate their own research, alongside the need to disseminate EU research.

Cross-sector studies, such as in the agriculture and water resources sector, are needed in order to arrive at conclusions about what actions should be taken. Proper assessment of climate-induced changes in the hydrological cycle and cost-benefit analyses of adaptation options requires major research advances in the fields of climatology, hydrology, land use planning, socio-economy and multi-objective decision-making under uncertainty. It will be necessary to integrate data and methods across scientific disciplines, economic sectors and stakeholder groups, which consider possible climate, land-use, and socio-economic changes, as well as water management strategies, in a coherent and consistent way.

[5] http://www.waterwise.org.uk/

Some important areas for attention are:

- direct attribution of hydrological changes to anthropogenic influences needs to be assessed,
- there is a need for sustained, high-quality climate and hydrological observations, reference data sets and improved reanalyses of historical data for climate change detection studies, trend analyses, process research, data assimilation, model development and testing,
- the Global Monitoring for Environment and Security[6] (GMES) effort could contribute to delivering data and monitoring services in order to deal with the prediction of extreme events,
- there is a central question of the appropriate scale for prediction models for policy formulation and planning. The ENSEMBLES project uses a scale of 25 km, which is not sufficient for flood prediction. Some regional models now have a resolution of 10 km. An important challenge of scale is computer time and power, as well as the necessity to adapt the model physics to the new higher resolution,
- despite increased resolution, basic uncertainties and conflicts between models will remain,
- information is needed on the level of metering in Europe. Also assessment across Europe of the effectiveness of metering,
- there is a need to develop methodologies to evaluate the efficiency of measures for flood and drought management,
- research on risk mapping and risk management in the face of these uncertainties is an important challenge.

Policy planning process
Integrated water resources management can be the general framework in which climate adaptation can be addressed for the water sector. Therefore, a number of water related policies at the EU-level would need to take account of climate adaptation.

Adaptation actions and European policies could be integrated into current legislation and the overall planning process. Links could be made with the WFD at the level of objectives, and implementation.

The WFD has been identified as the key regulatory framework at the European level for adaptation policies in the water sector (requiring Member states to apply an ecosystem (catchment area) approach in a long term perspective, do a comprehensive stocktaking and monitoring of relevant impacts, define clear target and devise and implement management plans that are regularly reviewed). It can be used as an extremely helpful tool to manage climate adaptation needs in the water sector including flooding and water scarcity adaptation. For this purpose, the explicit management of surface water quantity, in addition to the existing water quality concerns, must be taken into consideration.

Climate change adaptation is not yet part of the explicit goals of the WFD, but are implicitly addressed through a dynamic and ecosystem based objective setting at river basin level. As impacts on water resources occur at a regional and sub-national level, adaptation actions need to be taken at those levels. However, there may be a role for the EU in offering support to member states or regions. Further climate change related guidance for the implementation of the WFD at the Member States

[6] http://www.gmes.info/

level is needed in order to exploit this useful tool for climate change adaptation. Some gaps exist in the WFD including quantitative measures being supplementary (apart from groundwater quantity measures in combination with the groundwater good quantitative status objective) and unforeseen events need a clearer definition.

The EU could have a role in setting the overall strategic framework for water policy for the next 20 or 50-year horizon, which may have implications for future updates of the legal acts, like the WFD and related implementation.

Key is also for the EU to play a co-ordinating role for research. The forecasts and projections on the national and regional levels need further downscaling of climate models in order to provide local and regional decision makers with more detailed information basis on respective climate impacts.

There may be an opportunity for the introduction of tools to give support on water planning in the adaptation context. Such a tool or approach could support member states in prioritising their activities.

Several potential actions to take on both the water supply and demand side were identified. On the demand side these include public awareness, reductions in leakages, water reuse technologies, taxes and pricing systems, and irrigation technologies. On the supply side, measures include preservation of natural catchments and restoration work of other catchments, obligatory cost/benefit analysis of new water-requiring projects and more efficient use of the water infrastructure.

The EC should also take account of other initiatives outside Europe, such as the UNFCCC five-year plan on adaptation and the OECD processes on the topic of adaptation.

Economic stimuli
Particular attention could be paid to the proper implementation of Article 9 of the WFD, which requires the development of water pricing policies, based on the cost recovery and polluter/user pays principle, in order to achieve sustainable and efficient water management. The effect of subsidies on elements of this agenda is important to avoid encouraging mal-adaptation, (e.g. criteria of CAP subsidies, etc. (see also the sector report on Agriculture and Forestry).

The EC could stimulate and coordinate, together with other adaptation measures, the use of insurance and other financial services as a pro-active means of planning for (pre-disaster) and dealing with (post-disaster) adverse impacts of extreme weather events, which contribute to enhancing economic and social recovery. The EU Solidarity Fund also plays an important role here (see further discussion in the sector report on Insurance).

Disaster and risk management
The role of policies related to disasters in Europe, such as the Flood Directive and water scarcity management, could be included in the implementation and eventual adjustments of the WFD. See also the Flood Directive and European Flood Action Programme under 'Water quantity and extremes' above. Increasing the warning time may be important for reducing flood losses. The European Flood Alert System (EFAS)[7] has been developed at the JRC, which complements national warning systems.

[7] http://efas.jrc.it/)

Actions relevant at national/regional/local level

The key action at the national, regional and local level is the comprehensive implementation of the WFD with full integration of climate change impacts and dedicated adaptation measures.

Some further recommendations are:

- cross-sectoral issues in relation to adaptation of water resources management must be explored, for instance in the context of agriculture,
- the connections between the water issues and land-use planning, in particular in relation to flood risk management, should be addressed,
- the communication of the need to undertake action now, in the face of uncertainty, needs to be developed,
- in some instances, further clarity is required over responsibilities, for example in relation to sustainable urban drainage systems (SUDS) in new developments,
- a better balance between technical solutions, and the influence on customer behaviour in relation to water, and economic incentives, needs to be developed,
- the approach already taken for energy efficiency in many Member States may provide insights on how to tackle demand-side issues,
- apart from the demand side, other issues, such as leakages need to be addressed,
- better drainage design may be needed for the future, as sewers designed for the SUDS framework may not be able to contain high flows. With increases in storm intensities it may be necessary to design drainage systems that can contain larger volumes of water.

Further references and weblinks

- A conference on Climate Change Impacts on the Water Cycle, Resources and Quality was organised jointly by JRC-IES, DG RTD.I4 and DG ENV.D2 on September 25-26, 2006 in Brussels.
  http://cordis.europa.eu/sustdev/environment/ev20060628.htm
- The German Presidency will hold an international conference in February 2007 on the links between water and climate change.
  http://www.climate-water-adaptation-berlin2007.org

- The Third international conference on climate and water will be held in Helsinki, Finland, 3-7 September 2007.
  http://www.ymparisto.fi/default.asp?contentid=169172&lan=en