European Climate Adaptation Platform
Climate-ADAPT factsheet


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Sectoral Climate Change Impacts and Adaptation Responses:

Water resources and flood management

Water is essential to life, to the health and functioning of ecosystems and ecosystem services and is indispensable for almost all sectors of socio-economic development. While the causes of climate change are primarily associated with current energy use practices, the impacts will be felt mainly through water since it is intricately linked with the climate. Therefore, climate change is projected to lead to increased variability of the hydrological cycle and subsequently will have serious effects on the frequency and intensity of extreme events. Sea level rise, increased evaporation, more intense precipitation and prolonged droughts are just a few manifestations of climate variability directly impacting on the availability, the quantity and the quality of water. Consequently, climate change will add to the many economic and social challenges already faced by water management, such as balancing competing demands and ensuring that supplies meet human and environmental needs, both in terms of quantity and quality. The sector's capacity to adapt to climate change, thus, presents one of the key issues that needs to be addressed to ensure the future sustainability of water resources in Europe.

This factsheet presents an overview of the main climate change impacts and adaptation options available to policy-makers and to practitioners in the water sector.

Climate change impacts on water resources and flood management

As demonstrated by Figure 1, the climate change impact on Europe's water resources will vary greatly from region to region. Many countries are already experiencing impacts: annual precipitation trends indicate that northern Europe has become 10%-40% wetter over the last century, whereas southern Europe has become up to 20% drier. Recent analyses show a significant extension of water scarcity across Europe, a trend which is set to continue and worsen with climate change impacts, a trend exacerbated by growing population numbers and lifestyle changes. Indeed, recent EEA figures show that, in Europe, some 30 million inhabitants already live under water stress conditions, meaning that both water quantity and quality meet human and ecological needs insufficiently. This figure skyrockets during summer time to 70 million. This corresponds to 6% and 14% of the total population of Europe respectively.

Around 20% of the total population of the Mediterranean region live under permanent water stress conditions. More than half (53%) of the Mediterranean population is affected by water stress during the summer. At the same time, flood risk is expected to increase in Eastern and Northern Europe and along the Atlantic coast.

Changes in Europe's water resource's quantity and quality, as well as the frequency and severity of floods, will also result in negative consequences for other sectors. Sectors expected to be negatively affected include the built environment, human health and many parts of the economy including agriculture (increased demand for irrigation and forestry), energy (reduced hydropower potential and cooling water availability), recreation (threats to water-linked tourism), fisheries, and transport.

Figure 1: Observed and projected climate change impacts on the water sector in the different regions of Europe (Source: EEA 2016)

Adaptation responses and options

Possible responses and measures vary depending on the climate change impact they aim to address. The table below provides a non-exhaustive list of examples of adaptation measures that can be undertaken in the water sector to respond to specific climate change impacts.

Table 1: Overview of adaptation measures available to respond to climate change impacts on water resource and flood management

Flood risks
Increasing existing protection and construction of new protection structures Construction of new dikes, dams or tidal barriers, enhancing the capacity of sluices and weirs and adapting the design for flood protection measures.
Nature-based solutions Making room for rivers/increasing natural retention and storage capacity e.g. through wetland restoration/conservation, reconnection of old river arms or of rivers to floodplains (levee setbacks or removal), afforestation, increasing soil retention capacity through crop rotation, increase of organic matter content in soil, and by avoiding excessive tillage and compaction.
Forecasting and early warning systems Using a mix of the most appropriate early warning/forecasting systems, including: near real time (hours to days), short-term (days to weeks), medium-term (month to season), long term (years to decades), effective communication systems for informing the public.
Protection against urban flooding Upgrading of storm drain capacity, e.g. by replacing existing assets and combining underground storm drains with overland retention/flow paths in new developments, increasing soil infiltration, e.g. by using permeable surfaces and sustainable drainage systems (SuDS), promoting flood resilient design features ('wet-proofing), such as green roofs and water gardens, combined recreational and flood control facilities e.g. by installing storage ponds in public parks, or elevated buildings.
Drought risks
Demand-side management Water pricing, improving water efficiency, raising public awareness of water-saving behaviour, mandatory and voluntary water use restrictions, leakage detection and repair, pressure management, water metering, fostering water efficient technologies and practices.
Supply-side management Augmentation of surface reservoir storage, reservoir operation rules, appropriate use of irrigation reservoirs, managed aquifer recharge, identification of alternative water sources, such as desalination of saltwater and brackish water, harvesting and treating storm water, and reusing treated wastewater, interconnection of water supply networks.
Water allocation and planning Making new housing development water-neutral, developing drought management plans (DMPs); defining minimum environmental flow in rivers to avoid permanent damage to aquatic ecosystems.
Impaired Water Quality
Develop monitoring programmes for water quality Regulation of wastewater discharge, temporary wastewater storage facilities, regular monitoring of drinking water.
Develop management strategies for fertiliser and waste Improved waste water treatment, increased safety and effectiveness of waste water systems, restrictions to wastewater discharge and implementation of emergency water storage, isolation of dump sites in flood risk zones.

The information in this factsheet is based on the following sources:

CIS (2009) *River basin management in a changing climate*, Guidance document no. 24, Technical Report-2009-040, available at https://circabc.europa.eu

EEA (2016) *Climate change, impacts and vulnerability in Europe 2016, An indicator-based report*, available at http://www.eea.europa.eu/publications/climate-change-impacts-and-vulnerability-2016

Iglesias, A. (2015) Adaptation strategies for agricultural water management under climate change in Europe, *Agricultural Water Management*, 155, pp. 113-124.

IPCC (2014) *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects*. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, available at http://www.ipcc.ch/report/ar5/wg2/

Straub, M. and Moreau-Le Golvan, Y. (2012) *Catalogue of European adaptive initiatives of the water sector to face climate change impacts*, report, PEPARED project report D1.1.1, available at http://www.prepared-fp7.eu/prepared-publications

UNFCCC (2014) *Technologies for Adaptation in the Water Sector*, Technology Executive Committee, November 2014.

IWA Specialist Group on Climate Change (CCSG) (2010) *Climate change and the water industry - Practical responses and actions, Perspective on Water and Climate Change Adaptation*, available at http://www.worldwatercouncil.org/fileadmin/wwc/Library/Publications_and_reports/Climate_Change/PersPap_10._Water_Industry.pdf

Box 1: Climate-ADAPT: The European Climate Adaptation Platform

Climate-ADAPT is the European Climate Adaptation Platform. It contains a vast database of sources and information about: climate change impacts, vulnerabilities and risks in different countries, regions and sectors; adaptation options, national strategies and case studies. It also allows users to share their own information and to find useful links to other adaptation networks and databases. Climate-ADAPT has a dedicated Water sectoral page that contains the most relevant information about climate change and adaptation in the sector including the relevant EU policies, research initiatives and funding.

Useful sources for further information

- DG Environment: http://ec.europa.eu/dgs/environment/index_en.htm
- EU climate change policy - DG Climate Action: http://ec.europa.eu/clima/policies/adaptation/index_en.htm
- Data services – Copernicus Climate Change Services: https://climate.copernicus.eu/
- Transitions to the Urban Water Services of Tomorrow: http://www.trust-i.net/
- European Innovation Partnership on Water: http://www.eip-water.eu/
- PREPARED – Enabling Change: http://www.prepared-fp7.eu/
- EU water policy: http://ec.europa.eu/environment/water/index_en.htm
- Natural Water Retention Measures: http://www.nwrm.eu

The factsheet is developed by the project *Climate-ADAPT: Dissemination and capacity-building supporting adaptation in the framework of the EU Adaptation Strategy. CLIMA.C.3/SER/340202/2015/718400* carried out for the European Commission by Milieu Ltd.

More information on Climate-ADAPT:
Website: http://climate-adapt.eea.europa.eu/
Newsletter: http://climate-adapt.eea.europa.eu/newsletter

Useful resources:

European Commission Climate Action website and social media:

ec.europa.eu/clima
facebook.com/EUClimateAction
twitter.com/EUClimateAction
youtube.com/EUClimateAction
pinterest.com/EUClimateAction