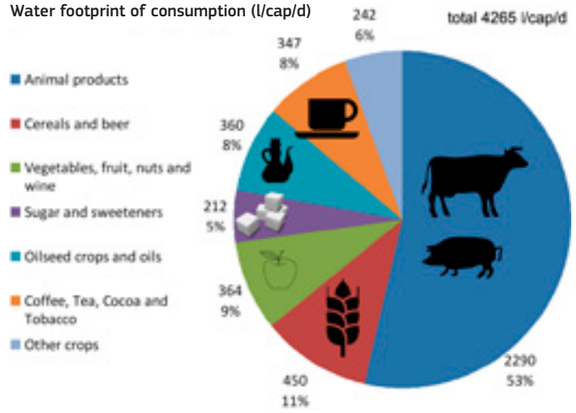
Water governance

Rivers and seas are a common resource for the countries that share their basins. A key example in Europe is the Danube river which is 2 800 km in length and passes through 10 countries and the Mediterranean Sea, which is shared by 21 countries. The JRC provides scientific support to the EU's Danube strategy, helping find trans-boundary solutions for the restoration of water quality and the management of water-related risks. At the Mediterranean level, the JRC's work focuses on the assessment of water availability in the region, tackling the major sources of pollution and investigating the effects of EU policy and international conventions on water scarcity and quality.

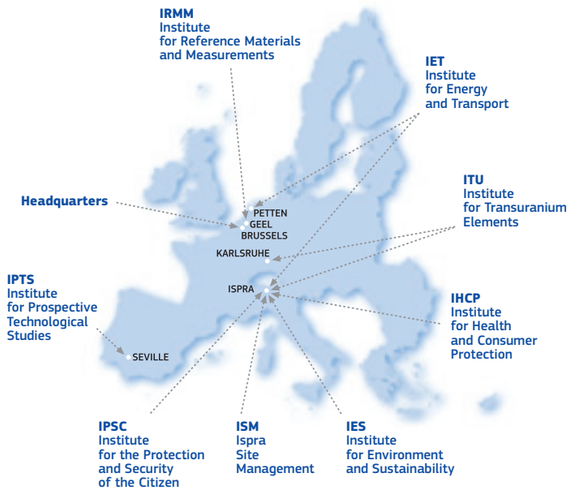
At a global level, the JRC is highly committed to supporting developing countries, mostly in Africa and Latin America, in finding their own sustainable solutions to water challenges through technology transfer and capacity building.

The AquaKnow website developed by the JRC is the first interactive online workspace and content management system dedicated to technical and scientific knowledge for the sustainable development of the water sector.

Resources:
• http://www.aquaknow.net/



Water footprint of consumption of different product groups for the EU-27 and Croatia. Graph produced by the JRC based on data from Mekonnen and Hoekstra, 2011.



JRC's structure

As the Commission's in-house science service, the Joint Research Centre's mission is to provide EU policies with independent, evidence-based scientific and technical support throughout the whole policy cycle. Working in close cooperation with policy Directorates-General, the JRC addresses key societal challenges while stimulating innovation through developing new methods, tools and standards, and sharing its know-how with the Member States, the scientific community and international partners. Key policy areas include: environment and climate change; energy and transport; agriculture and food security; health and consumer protection; information society and digital agenda; safety and security, including nuclear; all supported through a cross-cutting and multidisciplinary approach.

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European Commission

Science at the core of water solutions

Some JRC examples

Water has become a societal challenge. On a planet where 70% of the surface is covered by water, only 1% of this amount is actually usable freshwater. In the European Union, water scarcity and droughts already affect one third of the European territory and yet 44% of the global abstraction of freshwater is used to cool thermal power plants and 24% for irrigation. As water scarcity and droughts regularly affect large parts of the European territory, water availability and its efficient use are also issues in Europe. Degradation of marine and aquatic ecosystems will deprive our society of natural services, such as the provision of drinking water or flood prevention.

The EU Blueprint to Safeguard Europe's Waters, to be adopted in 2012, aims to ensure that good quality water is available in sufficient quantities for all legitimate uses. Competing demands for scarce water resources may lead to an estimated 40% global water supply shortage by 2030.

Science can be the key for water solutions, and the European Commission's in-house science service, the Joint Research Centre (JRC), provides the scientific knowledge to help decision makers identify the best policy options. Sampling exercises to assess water quality throughout the EU, modelling tools to predict climate change impacts on water, scientific assessment of future water needs by economic sector, assessment of water governance in developing countries and studies on the preservation of ecosystems are just some of the examples of the support provided.

Water availability

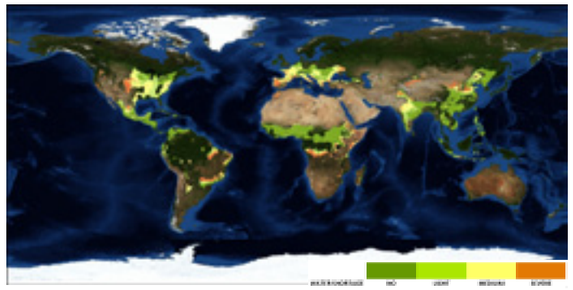
State-of-the-art hydrological models have been developed by the JRC and integrated into a modelling framework that addresses several parameters such as land use, irrigation, energy consumption and the cost-effectiveness of various policy options and scenarios. This allows for the assessment of current and future global water availability and demand.

By studying the water footprint of products – the amount of water that is consumed or polluted directly and indirectly over the entire production chain, both directly and indirectly – the JRC can cross-check results with water availability data and contribute to a more sustainable management of water. To give an example: the average EU citizen directly uses about 120 litres of water per day, but his/her daily water footprint amounts to 4 815 litres in total due to agricultural and industrial products consumed.

Globally, agriculture is by far the largest consumer of freshwater, consuming around 70% of total global supplies, and 24% of EU supplies. The JRC is actively involved in studying the impact of agriculture on the quantity and quality of water resources, as agriculture is also one of the major sources of water pollution. For example, the Global Water Satisfaction Index (GWSI) helps to detect water stress hotspots for specific crops. In addition, high resolution maps of irrigated areas and crop water requirements have been

JRC, the European Commission's in-house science service

Joint Research Centre

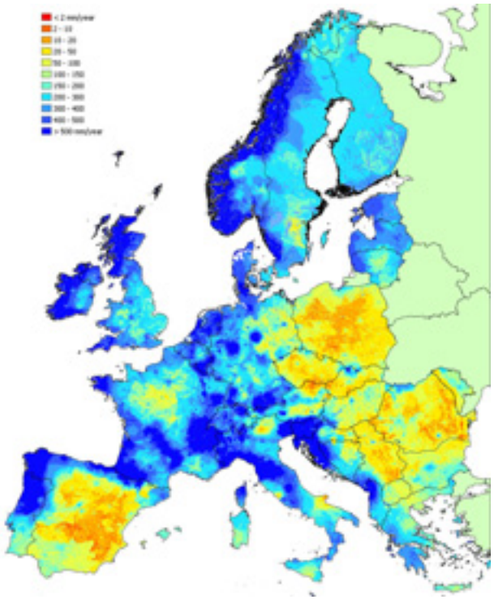


Water Satisfaction Index for maize as assessed on 31 July 2010.

developed to allow scientists to identify areas in which irrigation is the major factor in crop yields.

In terms of efficiency, the JRC pays particular attention to the water footprints of the energy and agricultural sectors. An assessment of freshwater abstraction and consumption by the EU power industry indicates that water consumption in this sector will remain at current levels. This could, however, be problematic as the gross hydropower potential is projected to decrease in Southern Europe.

Similarly, the JRC is examining the potential and environmental impacts of eco-industries and their emerging technologies to address solutions for water saving, water reuse and the harvesting of new water resources from the sea (desalination), groundwater and wastewater, as water supply and wastewater management account for 1/3 of the current European eco-industries. In addition, an optimisation module was developed, based on economic and environmental constraints, that allocates available water to all end users while ensuring the best trade-offs in the interest of economic and environmental sustainability, thereby improving water efficiency.



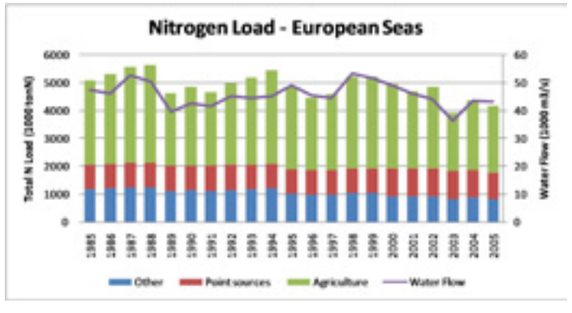
Annual freshwater availability (mm/year) (average 1990-2010).

Resources:
• http://ies.jrc.ec.europa.eu/the-institute/units/water-resources.html

Water quality

The general objective of the Water Framework Directive (WFD) is to achieve 'good status' for all surface waters by 2015. The 'good ecological status' is defined as the biological, chemical and morphological conditions that do not deviate too much from a situation with no or very low human pressure. The JRC provided pivotal support to this process by contributing to the definition and coordinating an intercalibration exercise highlighting the need for more robust bio-indicators. In response to this, novel methods were developed including a tool for quantifying the frequency of algal blooms and new approaches for harmonising classification methods.

The JRC also assesses and monitors the impact of pollutants and chemicals in aquatic ecosystems at regional and pan-European level, and develops Environmental Quality Standards (EQS) that set the maximum concentrations of aquatic pollutants. This is complemented by modelling-based scenario analyses of the impacts of policy options in controlling pollutant emissions to aquatic bodies. This information is publically available via interactive maps that allow users to identify "hotspots" of pollutants.



Total nitrogen entering all European seas split by sector of activity.

Resources:
• Environmental Marine Information System – http://emis.jrc.ec.europa.eu/
• Fate and impacts of pollutants in ecosystems – http://fate.jrc.ec.europa.eu

Preserving ecosystems

Ecosystems have a role in water purification, flood prevention and carbon storage which are directly linked to the health of the ecosystem habitats. As nature-based solutions, such as using wetland ecosystems for water purification, may be more cost-effective than technical infrastructures performing the same function, it is important to map and value ecosystem services. The JRC contributes to this through data collection and delivering modelling-based scenarios and trade-off analyses. New pan-European indicators to quantify the provision of ecosystem services have been developed. For example, research is carried out to evaluate the role of water bodies (wetlands, lakes and rivers) in water purification services using nitrogen as a common water quality reference. The JRC also combines data on coastal topography, habitats and geomorphology to identify areas vulnerable to flooding and erosion.

Another factor that threatens ecosystems both ecologically and economically is the invasion of alien species; species that are non-indigenous to a specific habitat. Indeed, alien species represent one of the main pressures directly driving biodiversity loss in Europe and worldwide. It is therefore important to track such invasions and prevent further occurences. The JRC has created an online platform called EASIN (European Alien Species Information Network) with the aim of enabling easy access to information on alien species which was incomplete in previously existing online databases. Such work helps policy makers and scientists in their efforts to prevent further alien species invasions.

Wetlands provide a natural solution to water purification.

Resources:
• EASIN – http://easin.jrc.ec.europa.eu

From floods to droughts

Extreme water events, such as droughts, floods or tsunamis, have enormous environmental, social and economic impacts and are expected to become more frequent and more extreme. The JRC helps address these problems by forecasting, monitoring and evaluating floods, droughts and tsunamis both across Europe and worldwide.

The JRC's work on floods focuses on increasing preparedness and support during a crisis. The European Flood Awareness System (EFAS) forecasts the possibilities of floods in Europe up to ten days in advance and communicates this information to Member States. It is based on a hydrological modelling system which is coupled with meteorological forecasts. The system is further integrated into a wider modelling framework allowing the simulation of the impact of climate and land-use change on hydrological extremes.

The JRC has also developed the Global Flood Detection System (GFDS) and the Global Flood Awareness System (GloFAS). The GFDS

Floods are expected to become more frequent and more extreme.

provides up-to-date information on the impact and extent of floods occurring across borders using real-time satellite observations. GloFAS, developed in collaboration with the European Centre for Medium-Range Weather Forecasts (ECMWF), couples weather forecasts with a hydrological model in order to produce real-time global flood forecasts.

The JRC is developing the European Drought Observatory (EDO), which allows for real-time monitoring and forecasting of droughts across the European continent. In addition, the JRC assists in the development and testing of advanced drought indicators, in the frame of the EU Water Scarcity and Drought Expert Group.

The JRC's expertise in methodology for droughts and desertification is also transferred to the global scale by contributing to the ongoing development of the Global Drought Early Warning System (GDEWS) and by leading the development of a new World Atlas on Desertification. The JRC's work also covers tsunamis as it manages the Tsunami Alerting Device (TAD). This is based on sophisticated seismic and hydraulic modelling and communication technologies, and is part of the EU-UN Global Disaster Alerts and Coordination System (GDACS).

Finally, in support of EU climate change policy, the JRC has developed a pan-European integrated framework that aims to assess the impacts of global warming, and the adaptation and mitigation policy options on water resources.

Resources:
• Floods Portal – http://floods.jrc.ec.europa.eu/
• EDO – http://edo.jrc.ec.europa.eu
• GDACS – http://www.gdacs.org/