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Water and water use in Europe: policies, targets, problems and driving forces

Background Paper

1st Integration Workshop, Brussels (6 September 2006)

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Introduction

This report aims at giving an overview of the environmental, economic and social problems, focusing on the environmental problems, which are related to water and water use. Water has been highlighted as an emerging, and critical environmental issue of the 21st century. All life forms and ecosystems on earth depend on its existence and availability. Since there has been growing pressure on water resources, conflicts are unavoidable as we are reaching the limits to growth. Moreover, it is becoming increasingly evident that several issues are now continuously converging: food security, water security and environmental security. Although water is a renewable resource, it is also finite and has to be allocated between competing interests. The need for additional resources implies an increase in the level of economic activity, which inevitably generates more pollution, whether from agricultural (non-point) or industrial (point) sources or both. This, together with the corresponding increase in domestic pollution, can cause environmental and water-quality degradation, which in turn constrains further development.

The initial era of intense water usage can be described as an exploitation era where the water resources were viewed as unlimited compared to the demand, and the basic function of a water agency was to provide no cost or low cost water for a specific purpose such as navigation, water supply, or hydropower. During an exploitation era, technology is the primary concern. Water for agricultural purposes, recreation, waste assimilation, and instream uses is abundant and does not appear to be impacted by use during this era. However, this unlimited water usage did not last long in Europe. The second era, the management era, was replacing the first, where conflicting uses for the same body of water exists, and the various water oriented institutions must share the water resources with competing users. This need to optimize multiple uses stimulated economists to participate with the technologists to develop strategies and facilities to meet the growing needs of many different types of water users.

The basic technology for storing, diverting, and transporting water has been practiced for centuries. Physical laws force water to run downhill. The classical strategy is to capture the water in the hills, and use gravity to facilitate the distribution to the low lands. Siphons are used to transport water over lower hills, and reservoirs are used to provide pressure heads to generate hydropower and pressurize urban water supply systems. If surface waters were inadequate, water could be pumped from underground supplies if energy was available. Most water resource systems have design lives of decades or centuries, and are major engineering structures. The original Roman aqueducts are still functional, and many dams were built many years ago. A common problem with the development of water resource facilities such as storage systems, flood protection systems, transportation systems, and treatment facilities is that the amount of water that flows in the rivers is not uniformly distributed in space or time.

Attempts for an early unified protection of water resources, mainly fresh water, began with “European Water Legislation by setting some standards for rivers and lakes used for drinking water in 1975, followed by setting quality targets for drinking water in 1980. The Water Framework Directive (WFD) came into force on 22 December 2000. The Water Framework Directive set the following key aims (WFD, 2000): water management based on river basins, achieving ‘good status’ for all waters, expanding the water protection to all types of water, i.e, surface water and groundwater, combined approach of emission limit values and quality standards. The WFD is also important as its holistic and trans-boundary attitude towards rivers defining them as a whole body, rather than an administrative or political entity, and its promotion of participatory approach.

The ultimate challenge of a sustainability oriented environmental management is to find the proper balance between humans and the impacts their activities have on ecosystems. Strong driving forces in terms of continuing population growth, industrialization and urbanization are at work.

Main policy goals and targets concerning the problem field

The fundamental principle of sustainable development is well established and widely accepted – economic growth can, and should, be made compatible with stewardship of the planet for future generations.

At EU and Member State levels, and within individual cities and regions, most policy-makers now appreciate the need to reconcile the triple objectives of wealth creation, social cohesion and environmental protection. Many even understand that win-win solutions are possible. But how can they find these solutions? What combination of policies, support measures and technologies will optimise benefits in all three domains? And how should their decisions respond to the often conflicting views of residents, businesses, public authorities and landowners? Europe do not have unlimited water resources.

Management of water resources is more a political and economic problem than a technical problem. Previous discussions on technology to support water resources management suggests that exact predictions of where and when water is returned to the earth by the hydrological cycle are not possible. Most economies subsidize systems: the construction and operations of systems that store, distribute, and clean water to support human activities. This makes the costs of using water much cheaper than it should be and encourages wasteful consumptions and use.

The future can never be accurately or completely known because of the multiplicity of forces that shape the future, their complexity and their interactions. Consequently, most planners and futurists today reject the idea that planning should be conducted against a single “most likely” image of the future. Rather, sets of scenarios should be used in planning; if the sets encompass a broad span of futures and plans are generated to cope with their eventualities, then the plans will be robust and the future can be met with some degree of confidence. Scenarios are narrative descriptions of the future that focus attention on causal processes and decision points. Accuracy is not the measure of a good scenario; rather, it is: plausibility (a rational route from here to there); internal consistency; description of causal processes; and usefulness in decision making. The scope of the FORESCENE project is covered in the parallel paper “Resource use and waste: Policy goals and targets, problems and driving forces.

Benefits of water protection policies

Protection and enhancement of *health and biodiversity* of the aquatic ecosystem, in particular since good ecological status requires good quality of the structure and the functioning of this ecosystem, to be able to provide the ecosystem services needed.

- Protection of *human health* through water-related exposure (e.g. through drinking and food production, bathing and consumption of fish).
- *Lower costs for water uses*, e.g. water supply or fisheries and *more cost effectively achieved improvements* by reducing treatment and remediation costs (e.g. drinking water supply, sediment pollution).
- Improvement of *efficiency and effectiveness* of water policy based on the "polluters-pays principle" (in particular by adequate water pricing policies and cost-effectiveness assessment of measures, example: reduction of amount of water use per capita).
- Increased *cost-effectiveness* of water management, in particular of measures to implement and apply, for example the Nitrates, Urban Wastewater Treatment and IPPC Directives.
- Integrated river basin management – as introduced by the WFD – should help authorities to *maximise the economic and social benefits* derived from water resources in an equitable manner instead of repeating the mistaken and fragmented approaches of the past, which dealt with problems in a local, and usually temporary, basis. This should translate, *inter alia*, in designing more cost-effective measures to meet the environmental objectives of other EU legislation (see above). Especially for new Member States, the cost-saving potential is great the lessons from the experiences in EU15 are learnt.
- Improvement of the *quality of life* by increasing the value of surface waters (e.g. for visitors, tourists, water-sports users, conservationist) and by increasing its non-use value and all non-market benefits associated. (Source; Environmental objectives under the water framework directive. Policy summary and background document, published 20 June 2005).

Background: The Water framework directive

Managing the water cycle is thus a case study in sustainable use of a key natural resource. Since 2000 the water framework directive (WFD) has been in place as the main European legislation to protect our water resources. With its two main principles focusing on the 'good status' of all water bodies, and assessing them in relation to activities in the river basin, the WFD follows an integrated approach to water resource management.

Europe adopted the water framework directive to bring together and integrate work on water resource management. The basis for the directive's work is the river basin. Most water, once it falls to the ground in precipitation, remains within a single river basin, flowing by gravity either to the sea or into groundwater reserves. Human management of the water cycle almost invariably follows this pattern. Water is sometimes moved between river basins, and this may be required more in dry climates in the future. Such bulk transfers usually involve pumping against the forces of gravity and are very expensive — cripplingly so for many uses, including agricultural irrigation.

The directive's second principle is to restore every river, lake, groundwater, wetland and other water body across the Community to a 'good status' by 2015. This includes a good ecological and chemical status for surface waters and a good chemical and quantitative status for groundwater. It requires managing the river basin so that the quality and quantity of water does not affect the ecological services of any specific water body. Thus, any abstraction has to maintain ecologically sustainable flows in rivers and preserve groundwater reserves. Discharges and land-based activities have to be restricted to a level of pollution that does not affect the expected biology of the water. In particular, the directive means that new measures will have to be taken to control the agricultural sector so as to manage both its diffuse pollution sources and its abstractions of water for irrigation.

The WFD will repeal several older pieces of legislation, such as the surface water directive, the freshwater fish and shellfish directives and the groundwater directive. In future, the objectives of these directives will be covered in a more coherent and integrated way by the WFD and daughter directives. Only four water-related directives will stay in place: the urban waste water treatment directive, the bathing water directive, the nitrates directive and the drinking water directive. Measures and objectives to combat extreme floods and droughts beyond securing a good quantity of groundwater are not covered by the WFD but will be dealt with by an action programme and a directive, which are currently under development. Europe has also recognized that, to achieve the aims of the water framework directive, 'the role of citizens and citizen groups will be crucial'. The implementation of the directive will require careful balancing of the interests of a wide range of stakeholders. The greater the transparency in the establishment of objectives, the higher burden of measures and the reporting of standards, the greater the care Member States will take in implementing the legislation in good faith, and the greater the power of citizens to influence the direction of environmental protection. Caring for Europe's waters requires more involvement of citizens, interested parties and non-governmental organizations, especially at the local and regional levels. Thus the framework directive has established a network for the exchange of information and experience to ensure that implementation will not be left unexamined until it is already behind schedule or out of compliance (EU Water Framework Directive, http://eur-lex.europa.eu/LexUriServ/site/en/oj/2000/l_327/l_32720001222en00010072.pdf).

Water as a natural resource

A water catchment area is a useful landscape unit for an integrated approach where a balance between humans and nature should be sought. In the water catchment area, the green water (vapour) flow supports terrestrial ecosystems and the blue water (liquid) flow supports both aquatic ecosystems and multiple forms of human use. The green water flow reflects the consumptive water use by both natural vegetation and agro-ecosystems. The blue water moves above and below the ground, from up- to downhill, and from land to water systems (see Figure 1).

The catchment can be seen as containing two usage systems: one of human water-related activities, the other of water-dependent ecosystems, terrestrial as well as aquatic. These usage systems are linked internally by water flows. The human activities include the following:

- Direct withdrawals, where the blue water after use is divided into two flows: consumptive use leaving as green water flow to the atmosphere and not available for reuse, and the blue water return flow to the system, often loaded with pollutants.
- In-stream blue water uses for power generation, navigation, recreation, etc.
- Land use influencing (blue) runoff generation, including urban, domestic and industrial waste water (Falkenmark and Lindh, 1993).

Ecosystems are of two types:

- Terrestrial, which are green water related.
- Aquatic, which are blue water related.

Evidently, human activities and ecosystems are, however, partly incompatible. Therefore, a management task is to orchestrate the catchment for compatibility. This will demand intentional trade-offs. The fact that the resulting trade-offs have to be socially acceptable makes stakeholder dialogues an essential component.

The crucial question is of course: where is that water now? A set of alternatives exist: irrigation appropriating additional blue water; reducing water losses (those now evaporating and those now recharging groundwater or rivers); horizontal expansion by appropriating green water now consumed by natural biomes (grasslands, wetlands, forests); and virtual water by import from better endowed regions. If consumptive use is going to be increased, runoff production may decrease, depleting rivers and producing effects on aquatic ecosystems. If more green water is going to be appropriated by infringing on natural biomes, terrestrial ecosystems will be affected. The issue of ecological security s well as ecosystem services therefore will have to be better penetrated, based on an awareness of these two unavoidable future encroachments (Falkenmark, 2004).

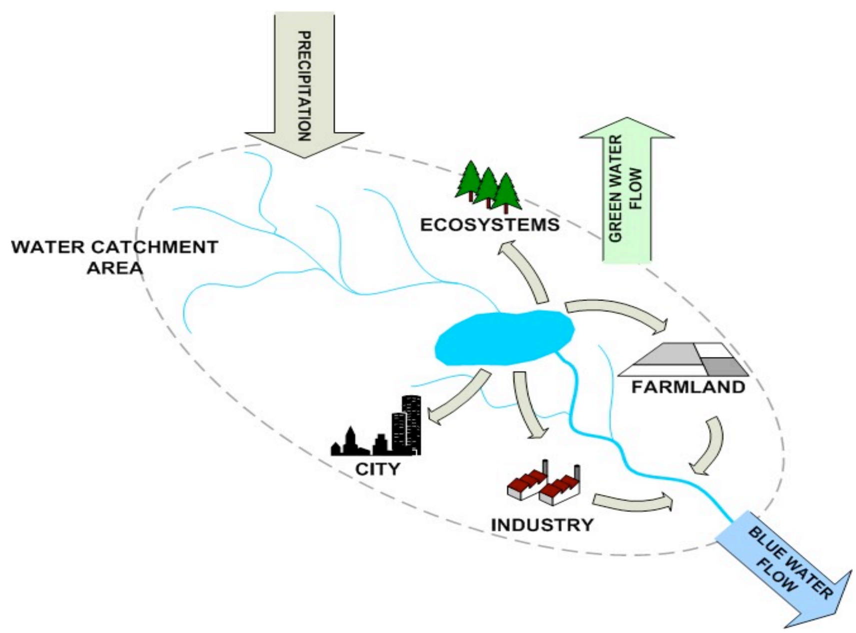


Figure 1. Water and water catchment area as a dynamic usage system (figure redrawn and modified from Falkenmark, 2004).

Water availability and main water use in European countries

Countries where withdrawals are greater than 20 % of total available supplies are generally regarded as water stressed. Four countries — Cyprus, Italy, Malta and Spain — already fall in that category (EEA, 2006). Others are likely to join them as climate change is expected to influence both the supply and demand for water (Figure 5). Irrigation, meanwhile, currently accounts for less than 10 % of water abstractions in most of the temperate countries of northern Europe, but in southern Europe, in countries such as Cyprus, Greece and Malta and parts of Italy, Portugal, Spain and Turkey, irrigation accounts for more than 60 % of water use. In the EU-15, 85 % of the irrigated land is in the Mediterranean countries (EEA, 2005a, EEA, 2006).

Overall in Europe, 80 % of the water used in agriculture is either absorbed by crops or evaporates from fields. In manufacturing and households, 80 % is returned to the local environment, albeit often polluted and at a different location or catchment. In electricity generation, 95 % of the abstracted water is returned, a little warmer than it left but otherwise generally unchanged. Warmer water can, however, negatively impact on local ecosystem structures.

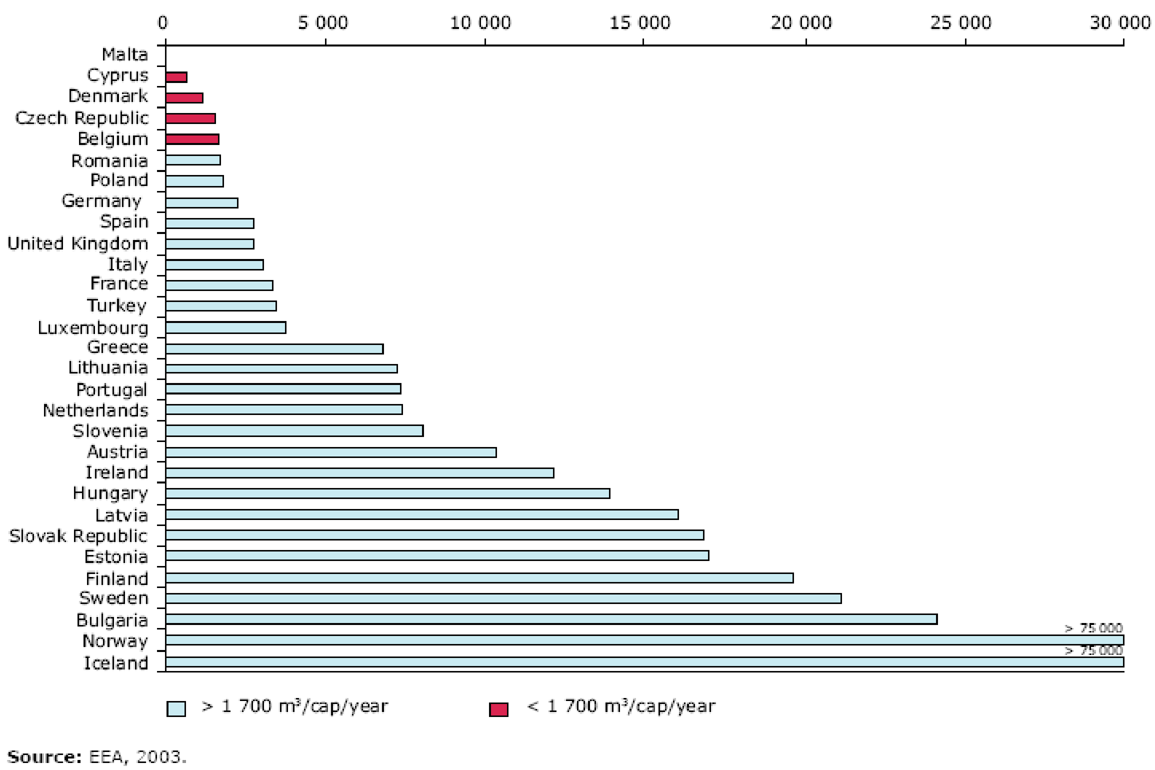


Figure 2. Annual water availability per capita per country 2001.

Meanwhile demographic and economic trends are likely to raise water use in other sectors. Domestic use, currently around 25 % of the European total, can be expected to rise with wealth and with diminishing household size, a function, among others, of Europe's ageing population. The increase in second homes and mass tourism, including water-intensive activities such as watering golf courses, also raises per capita water use. It is possible, however, that trends to increase domestic water use could be moderated by regulations or economic incentives to encourage people to switch to more water-efficient lavatories and household appliances. Water use in manufacturing is likely to be dependent on the future of the heavy industries that currently use around 80 % of the water in this sector (such as iron and steel, chemicals, metals and minerals, paper and pulp, food processing, engineering and textiles). Increases are expected to be greatest among the industrializing candidate EU countries, but use may decline elsewhere as heavy industry declines or adopts more water-efficient industrial technologies.

Current threats

Terrestrial ecosystems are water consumptive and linked to green water flow; their key water determinant is soil water and the macro- and micronutrients that they carry to plants. But the terrestrial ecosystems if altered will have effects on runoff generation, i.e. blue water flow, and therefore possibilities for the societal use of that water. In other words, the change in land use affects blue water. The aquatic ecosystems dwell in blue water habitats and their key determinants are river flow and seasonality, flood episodes and water quality. Since they tend to accumulate the impacts of all human activities upstream, these ecosystems are particularly vulnerable, i.e. to biodiversity loss.

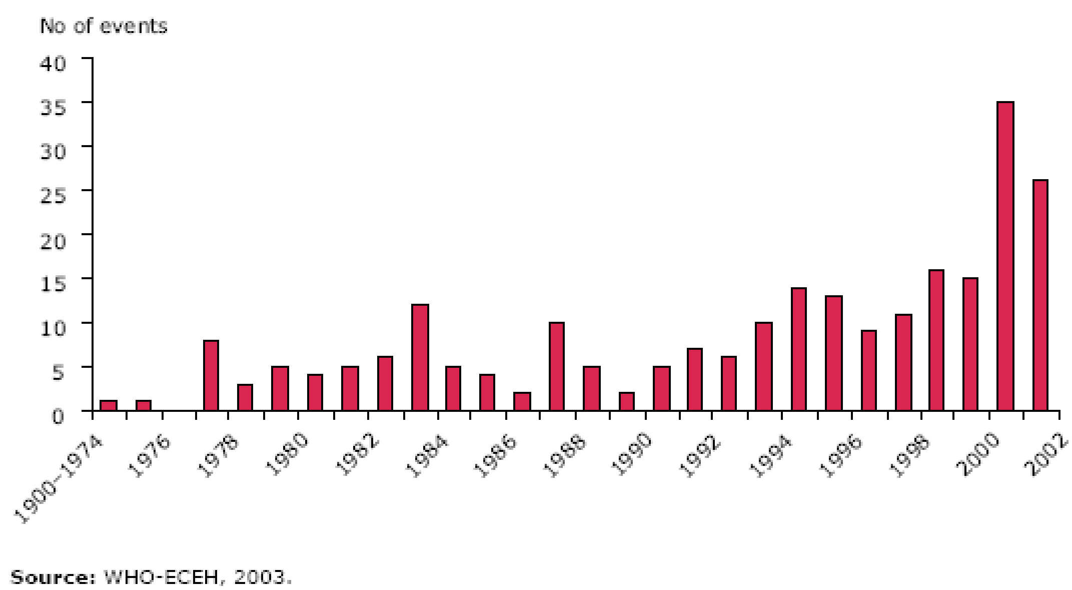


Figure 3. Number of flooding events in Europe. Source: EEA 2005.

Flood risk management - The EEA report «The European Environment – State and Outlook 2005" reconfirms that in general northern Europe is likely to become more flood prone and southern Europe more drought prone as the extra energy in the climate system increases the probability of extremes – including severe storms and floods, such as those witnessed in central Europe in recent years. The report also finds that urban areas continue to grow, with effects like removal of woodland cover that can radically alter rainwater run-off, provoking mudslides and other problems while increasing the areas at risk from flooding. Many remaining wetlands have also been lost to coastal developments, mountain reservoirs and river engineering works. These findings reinforce the importance of improving integrated flood risk management in Europe.

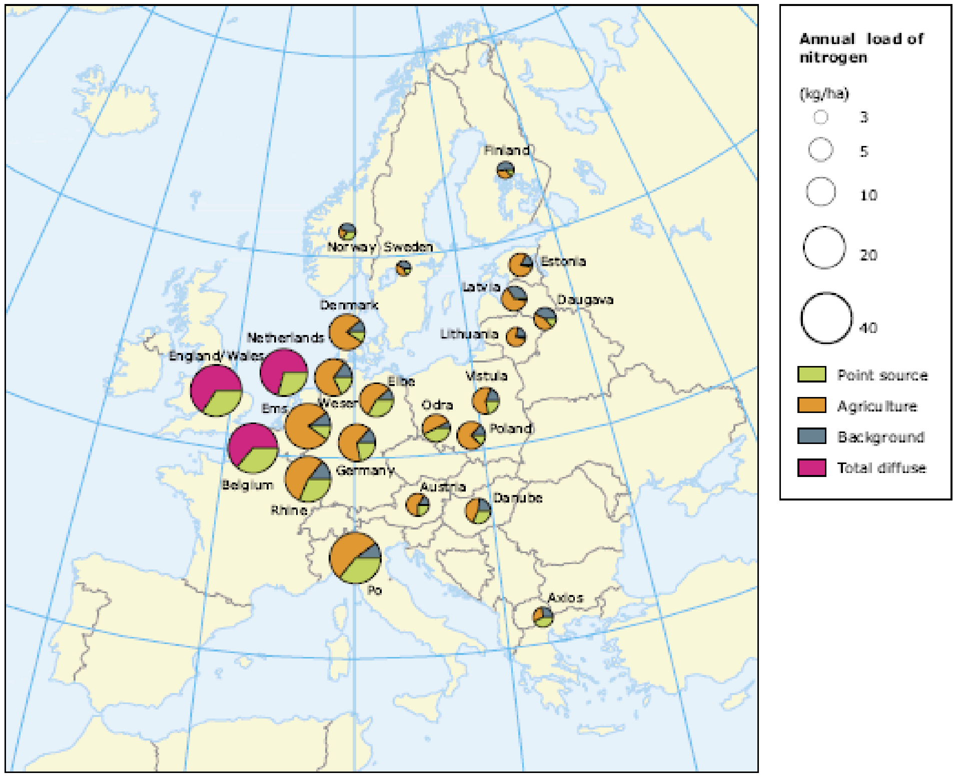
Many changes in climate and their impacts on ecosystems and human health are already visible in Europe, particularly in southern Europe where water shortages, fires and droughts are increasingly apparent, along with more unpredictable weather patterns. Meanwhile, the scientific evidence of climate change is getting firmer, with the manifestation of more robust indicators suggesting a much faster rate of change than previously thought (EEA, 2005, Eurostat, 2005).

Water quality

It is not only the amount of water available that matters. Also the quality of water is of importance. Water quality is usually defined by biological and chemical parameters. For instance, biochemical oxygen demand (BOD) is an index widely used to assess the amount of organic oxygen-consuming pollution in a river. Water quality is also influenced by the physical management of rivers and the wider hydrological environment of a river basin. Canalisation, dam building, river bank management and other changes to the hydrological flow can disrupt natural habitats, and change the seasonal patterns. Groundwaters, too, suffer from the consequences of intensive agriculture and the use of nitrogen fertilisers and pesticides. Nitrates contamination is widespread across Europe, where the EU drinking standard for nitrate is exceeded in many of the groundwater bodies (EEA 2005a).

Point sources of pollution are largely under control, while tackling the diffuse sources of pollution is more difficult. The main source of diffuse pollution to water is from the largest land use across most of Europe — agriculture. A particular focus of concern is nutrients, primarily nitrates and phosphates. Nitrates are generally the greatest problem. More than half of the nutrient discharges in Europe now come from diffuse sources. Agricultural emissions are now the dominant source of pollution in many river basins. In 1991, the EU introduced a nitrates directive, aimed at stemming the flow of nitrates into the natural environment and drinking water. However, the implementation of the nitrate directive has been rather poor. The patchy implementation of the nitrates directive has been reflected in a patchy pattern of trends in nitrate pollution across Europe.

Discharges of both nitrogen and phosphorus from point sources have decreased significantly during the past 30 years, whereas the loss from diffuse sources has generally remained at a constant level. These changes have been largest for phosphorus, where it has also resulted in the largest reduction in the total load due to the previously very high share of point source discharges. The loss from diffuse sources has become relatively more significant as a consequence of the reduced point source discharges.



Note: The area of each pie chart indicates the total area-specific load. Mixed approaches.

Figure 4. Nitrogen load in selected regions and catchment (source: EEA, 2005b).

The changes are mainly due to improved purification of urban wastewater. In the Nordic and western European countries, purification is now very effective and eastern European countries are now following a similar development. Measures to reduce the nitrogen surplus on agricultural land are now beginning to show results in terms of a reduction in diffuse losses of nitrogen but there is still a long way to go, see Figure 3 above (EEA, 2005a). In most of Europe, agriculture is a dominating anthropogenic source of pollution with nitrogen and phosphorus. Its current relative significance is partly a result of the great efforts to reduce point source pollution during the past decades. The estimates of agricultural diffuse loss range from about 0 to 30 kg/ha for nitrogen and about 0 to 1 kg/ha for phosphorus. The highest loss is found in agriculturally intensive regions in the north-western part of Europe, where the average (mineral) fertiliser consumption per country is commonly about 40–70 kg/ha of nitrogen and 8–13 kg/ha of phosphorus (FAO, Eurostat 2005).

At large scale, agriculture is the single dominating source of nitrogen pollution, typically contributing 50–80 % of the total load. The situation may be different in smaller catchments with high population densities (e.g. large cities), very poor wastewater treatment, or many industrial facilities discharging poorly treated wastewater. Moreover, due to a combination of processes affecting the nitrogen cycle in soil and water, the reduction in diffuse loading of the aquatic environment can be delayed by many years after measures have been implemented on land (EEA 2005b).

Climate change and water stress

Substantial changes in precipitation patterns, possibly linked to climate change, are already apparent in Europe. In some northern countries there has been a marked increase in precipitation in recent decades, particularly in winter, while declining rainfall is a recent feature of southern and central Europe, especially in summer. These trends are expected to continue, causing serious water stress in parts of southern Europe in particular.

In parts of the northern Europe, additional rainfall will increase river flow. Water availability may increase by 10 % or more in much of Scandinavia and parts of the United Kingdom by 2030. In southern Europe a combination of reduced rainfall and increased evaporation will cause a reduction of 10 % or more in the run-off in many river basins in Greece, southern Italy and Spain, and parts of Turkey. In southern Europe, this reduced supply will be made worse by sharply rising demand, particularly from farmers needing more water to irrigate their crops. In general, northern Europe is likely to become more flood prone and southern Europe more drought prone as the extra energy in the climate system increases the probability of extremes (EEA, 2005a).

Higher temperatures are likely to have an even larger impact on water demand in southern Europe, where the need for irrigation of crops will undoubtedly increase. Baseline assumptions foresee a 20 % increase in the area of southern Europe under irrigation by 2030. In many places, there is simply not the water to meet this demand, so there will be strong pressure for significant improvements in the efficiency of irrigation systems.

Even allowing for such improvements, current projections see a rise of 11 % in water demand for agriculture. The question remains whether this water will be available in practice, and how countries will meet the competing needs of agriculture and the ecological protection of aquatic ecosystems. This will raise further questions about the sustainability of certain patterns of agriculture, particularly in southern Europe, in the light of projected changes in climate in already water-short areas, see Figure 4.

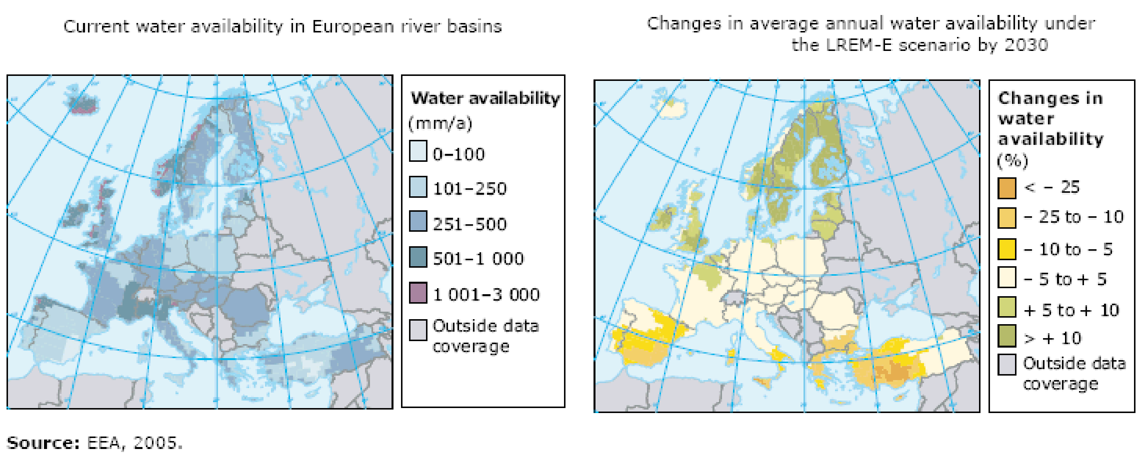


Figure 5. Current water availability in Europe, and under a climate change scenario. Source: EEA 2005a.

Not all these expected increases need occur. The potential for greater efficiency in water use may be much greater than currently anticipated. Such improvements may be unlocked by more realistic water pricing, which would make investment in efficiency more attractive, especially in agriculture (Roth, 2001). It requires Member States to ensure that water pricing policies provide adequate incentives for users to use water more efficiently and it requires that the environmental objectives of the Water Framework Directive are supported.

Domestic water use could be cut through tougher water efficiency standards for household appliances such as washing machines, dishwashers and lavatories. Perhaps the greatest potential for water saving lies in reducing leakage rates in water distribution systems, particularly for domestic use. In some older cities in Europe, losses exceed a third. Average leakage rates for Public Water Supply (PWS) range from 10% in Austria and Denmark to 33% in the Czech Republic (OECD 1999). Incentives for more efficient urban water use and supply are therefore urgently needed.

In some places this leakage is not strictly 'lost', since it recharges groundwaters, from where it can be pumped to the surface again. However, in many places this is impossible because the groundwaters beneath cities are too contaminated to be used (EEA, 2005b).

Driving forces

Increasing water stress or shortage of water, affecting an increasing part of the world and is of increasing severity. Primary drivers for water stress are high population density, extensive and inefficient irrigation, rapid industrial growth, changes in rainfall patterns, and various uses of water sources for waste assimilation and exploitation for hydropower generation, but also other factors (see Table 1 below).

- *Urbanisation and agglomeration*. Rapidly increasing urbanization is one of the most distinctive changes seen over the previous and current century. Flexible and innovative solutions are needed to cope with sudden and substantial changes in water demand for people and their associated economic activities. There is an increasing need for innovative water supply methods and technologies, while water re-use options have to be further developed and implemented.

- *Extreme events.* The climate change challenge is not just about long term changes in average precipitation, but also about increased frequency and severity of extreme events such as droughts and floods. There is a need for appropriate, timely and readily understandable mitigation, warning and management methods and measures to minimize short and long term damages. Solutions are required which will significantly reduce the social and economic impact.

- Many rural and under-developed areas *lack significant infrastructure* such as water and waste water services. People are self supporting and have small scale agricultural activities, while industrial activity is mostly absent. These areas often lack financial support from private enterprises (and public funding) as well as know-how for proper improvement, which would make them more attractive for new activities and boost the development in such regions.

Economic practices are the obvious causes of bio-physical impacts. The most important economic practices as drivers of the adverse biophysical impacts are:

- Irrigation, Use of Fertilizers and Manure, Use of Pesticides and Herbicides, Agricultural Land use, Disturbance of Natural Vegetation which occur through Agriculture,
- Urban Waste, Primary Water Consumption, Water use for Electricity, Urbanisation, Urban Sprawls, and Transportation through Services,
- Water use for Cooling, Water use for Cleaning, Release of Waste and Use of Fossil Fuels through Industry,
- Dam Construction, Changing Water Levels of the River, Changing the Course of the River, Water use for Cooling and Release of Waste through Energy Production.

Table 1. Conflicting needs of water use (Source: Mar, 1998).

	Flow	Quality	Level	Other
Navigation	No current	No large debris	Deep enough for boat traffic	No blockage, dredge to maintain depths
Power	Releases match energy demand	No debris to damage turbines	Maximum head	
Irrigation	No release after irrigation season, maximum release during season	No salts, herbicides, toxics	Store as much as possible	Ground water is also used
M & I Supply	No release unless demands met	Meet water quality standards for drinking water	Store as much as possible	Ground water is also used
Drainage	No flow		No water	Drain land for alternative use
Flood control	Regulate flows below flood levels		Keep reservoir empty	Channelize to increase releases to oceans
Waste assimilation	Maximum flow	Maximize use of assimilative capacity	Increase minimum flows	Store water for wast assimilation
Protect habitat	Maintain natural flows	Maintain natural water quality	Preserve natural fluctuations	No use
Fish and wildlife	Maintain natural flows	Maintain natural habitats	Preserve natural fluctuations	Hatchery fish not a substitute
Recreation	Conflict between white and flat water needs	Meet health standards	Constant level	Conflict between wild and scenic needs and high density use

Summary

Three major activities drive water consumption in Europe: agriculture (irrigation, pollution), industrial production (process and cooling water) and household consumption (potable water). These drivers are all likely to increase.

The major threats of the water sources of Europe, including both surface as well as ground water are; Non-point source contamination, over-consumption and irrigation, and changes in water regimes due to climate change. EU's Water Framework Directive is a progress in the right direction, but needs to be firmly implemented throughout Europe, ensuring water accessibility and water quality for future generations.

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Terminology

Urban waste water - means domestic waste water or the mixture of domestic waste water with industrial waste water and/or run-off rain water;

Domestic waste water - means waste water from residential settlements and services which originates predominantly from the human metabolism and from household activities;

Industrial waste water - means any waste water which is discharged from premises used for carrying on any trade or industry, other than domestic waste water and run-off rain water;

Agglomeration - means an area where the population and/or economic activities are sufficiently concentrated for urban waste water to be collected and conducted to an urban waste water treatment plant or to a final discharge point;

Collecting system - means a system of conduits which collects and conducts urban waste water;

Primary treatment - means treatment of urban waste water by a physical and/or chemical process involving settlement of suspended solids, or other processes in which the BOD5 of the incoming waste water is reduced by at least 20 % before discharge and the total suspended solids of the incoming waste water are reduced by at least 50 %;

Secondary treatment - means treatment of urban waste water by a process generally involving biological treatment with a secondary settlement or other process in which the requirements established in Table 1 of Annex I are respected;

Appropriate treatment - means treatment of urban waste water by any process and/or disposal system which after discharge allows the receiving waters to meet the relevant quality objectives and the relevant provisions of this and other Community Directives;

Sludge - means residual sludge, whether treated or untreated, from urban waste water treatment plants;

Eutrophication - means the enrichment of water by nutrients, especially compounds of nitrogen and/or phosphorus, causing an accelerated growth of algae and higher forms of plant life to produce an undesirable disturbance to the balance of organisms present in the water and to the quality of the water concerned.

(Terminology list derived from Council Directive 91/271/EEC of 21 May 1991 concerning urban waste-water treatment, http://eurlex.europa.eu/LexUriServ/ LexUrierv.do?uri= CELEX:31991L0271:EN:HTML).