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Executive summary

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List of themes

Introduction

Water engineering and management is a specialization in Civil Engineering. Civil Engineers perform a key role in the delivery and management of water (ICE). Other professions as from mechanical engineers, chemists, biologists, geologists, economists, social scientists etc. also perform an important input. Water management includes a considerable frame of themes, as are the water supply, water and wastewater treatment and disposal, drainage, flood control, energy, irrigation, erosion control, water pollution control, etc. Respectively, in water engineering, engineers are invited to display competent and responsible skills in many engineering sciences as the hydraulics, water and wastewater treatment, water resource management, hydrology, problem analysis and solving, system analysis and optimization, etc. At the same time, they have to display ethical approach to the society, the public and to their clients.

Water scarcity and climate change are considered as the main causes of water related problems around the Globe. These problems get even worse due to the anthropogenic stresses put at the water systems struggling to meet the rapidly growing water demands. At the same time the Humanity pursuits higher living standards for all, compared to those inherited by the ancestors. (Procedia Engineering 162 (2016) 1–2).

According to the United Nations, by 2025 more than two thirds of the world's population could be living under water stressed conditions (www.un.org/waterforlifedecades/scarcity.shtml). At the same time there is an increasing demand on water resources to meet the needs of a growing population while, over 660 million people (UN, 2015-www.un.org/sustainabledevelopment/water-and-sanitation) still lack access to clean, safe water and more than 3.4 million people die every year as a result of water related diseases (WHO-www.voanews.com). One of the Millennium Development Goals (already achieved) was to reduce by half the proportion of people without access to safe drinking water by 2015.

Water is a (public domain, public trust) resource, human right and a service at the same time. The engineers have a significant role in the first part (resource) and a key role in the second (service). ECCE realizes its role and responsibility to provide guidance to its members, to society and to governments regarding expertise water management in relation to economics and technical solutions for a sustainable development enhancing protection of water resources and water bodies.

The society has to keep giving the tools to engineers to further develop knowledge and skills in water engineering in either public or private sector. At the same time, funds have to be allocated for the research in water engineering issues to maximize the benefits from technological advances. In water management, it is also essential to understand the interaction of activities of the various economic sectors and target a balanced solution without deteriorating the water resources.

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Scope of the position paper

This paper is intended as a position paper harmonizing the general position regarding the water issues within the engineering community and promote the understanding and communication with other professions and sectors.

It is formulated in a way to understand the common reality and specific reality in which the water management from the engineering point of view is recognized.

The paper covers aspects related to water infrastructure and water resources management including, climate change adaptation, water scarcity and droughts, sanitation, sustainable water resources management, water supply and demand management, exploitation of alternative sources of water, infrastructure asset management, water loss management in distribution networks, water pricing, public awareness, pollution control and protection of water bodies and their ecosystems, drinking water and flood risk management.

For all the aspects presented, background information is presented and commented and the position of the ECCE is then reported.

Technical Committee

Coordinator

European Council of Civil Engineers

Water governance

Water and sanitation

Nearly 660 million people have no access to safe drinking water while, about 2.5 billion people worldwide live without adequate sanitation.

Every day, about two million Cubic meters of sewage and other effluents drain into the world's waters. (UN-Water Decade Programme on Advocacy and Communication). In developing countries, 70 % of industrial waste is dumped untreated into waters where they pollute the usable water supply (http://www.unwater.org/statistics/statistics-detail)**.** Each day, nearly 1,000 children die due to preventable water and sanitation-related diarrhoeal diseases. (www.un.org/sustainabledavelopment/water-and-sanitation).

Potable water and sanitary systems are critical to improve quality of life eliminating poverty and upgrading public health.

To protect water, the Urban Waste Water Treatment Directive (UWWTD 91/71) provides for the construction of sewerage systems for communities over 2,000 habitants. The implementation of this provision helps in most areas with sensitive water bodies.

Water as a human right and water as a service

The balance between the "right to water" and different "water services" can be traced throughout the history and still remains a challenge. Nowadays, emerging issues like climate change, population growth, globalization and digitalization are requesting re-definition of this domain.

Decision making in water management

The decision-making process in water management has been identified in the early stages of the development of every society, addressing present water related challenges and the unknown, changing future. The main decisions refer to investments in water management e.g. water supply, irrigation, flood defences, water supply, hydropower production systems etc. that usually have economic and technical life span of more than 30, 50 and even 100 years. Thus, timing is very important in decision-making. Considering that usually the elected representatives are given a period of 4-5 years to govern, the challenge to perform the services is enormous.

Human right to water and sanitation as defined by the UN Human Rights Council Resolution A/HRC/RES/15/9 in 2010 is an important step forward. It is rather a fuse for the turbulent societies that neglect their historical priorities and a pillar for the protection of vulnerable parts of the society.

Thus, ECCE supports that:

i. In terms of planning, implementation, maintenance, historical memory, archives and decision-making process, it is better to think in a long time frame.
ii. At all times, a balance between water as a right and water as a service is needed.

In principle, ECCE supports the position by the European Commission on the importance of the human right to water and sanitation and of water as a public good and fundamental value. Also, ECCE supports that "water is not a commercial product" and recognizes the access to and the adequate supply of water and sanitation as a fundamental human right, as declared by the UN.

People must have access to the amount of water necessary for their survival. This amount has to be protected as a non-commercial public resource, the opposite being a thread to the poor. At the same time, ECCE agrees with the provision of the Water Framework Directive about the recovery of costs

for water services. It is important to consider water as a human right but also to provide tools to recover the costs.

ECCE supports the cooperation between nations to improve water and sanitation facilities of population globally. This is achieved with increased investments and smart management of water resources to benefit society, governments and businesses.

Developments that not only foster technologically advanced solutions for water supply, but also solutions that are manageable by the technology which is locally available with the empowerment of local skilled technicians should be in the focus.

Central sewerage systems are costly thus; we suggest that in communities with population near 2,000 it is preferable first to contact a cost benefit analysis taking into account the impacts on the environment and especially the water resources and water bodies of the area and alternative sewage treatment methods like onsite sewage facilities.

This will help governments to prioritize their obligations and allocate budgets in other needs. For example, in dry areas with dry climate and high porosity ground with no underground water bodies but with costly construction problems as in rocky or unstable ground, the construction of a central sewerage system may be of secondary importance. On the other hand, in areas with sensitive or shallow ground water bodies or ground with limited porosity, the installation of a sewerage system even in cases where the population is less than 2,000 must be considered.

Technocratic approach

Management of water has to be more dependent on technocratic decisions and less affected from political approaches and strategies or expediencies. It is more beneficial to the society to regulate the procedures with legislation and directives in order to minimize political interference and achieve a state of the art implementation. We have to respect the expert's opinion at each field of management e.g. engineers, chemists and microbiologists and support the joint effort of experts when a variety of issues is affected. It is important to employ staff with expertize on water management and protection at each level of work. While political bodies should be in the position of supervisors of the technocratic approach, water issues should not be abused for political point winning.

The European Union with its directive WFD, 2000/60 while it is providing a significant step ahead in identification of good status of water bodies supported by a combined approach, the economics and decision-making process are addressed in a very general fashion. The member states are left alone with a relatively under-defined implementation. The public has to be aware that professionals committing their professional life to this wonder perform the water services (drinking water, sanitation, flood defence, irrigation, etc.)

Asset Management

ISO 24510:2007 defines asset management as the procedures that enable a water utility to direct, control and optimize the provision, maintenance and disposal of infrastructure assets, including the necessary costs for specified performances, over their life cycle.

Infrastructure

For Engineers, the design and construction of infrastructure is based on customers' needs and on the prediction of the factors affecting the infrastructure. Most of the factors for water infrastructure are based on historical data and National planning that more or less also depend on prediction.

Experiencing the increased frequency of extreme events due to climate change, shows that we cannot base our prediction only on historical data. Flooding and droughts occur more often and their maximum intensity may be more frequent and more lasting. With respect to the various models for predicting the consequences of climate change, there is a consensus only for the increase in global temperature and increase of frequency of extreme weather conditions. There is no consensus on the effect of the climate change on precipitation variation on regional basis.

With respect to reliability, infrastructure developed in many regions suffers from increased water main failures. With a weak infrastructure, raw sewage may leak into waterways or water bodies. At the same time, the increase in temperature and other consequences of climate change will increase water demand and evaporation losses, it will increase the damages on the water networks and reduce the flow in sewers, the soil will become drier and pipe networks may be more susceptible to damages.

In case of increase in rainfall intensity and higher peak flows, the capacity of storm sewers and the ability of structures to resist unpredicted events may prove to be inadequate with severe consequences including pollution of water bodies. Asset management overall will be challenged.

Efficiency of water distribution networks - Water loss management

Efficiency of water distribution networks is an important tool for demand management. The reasons for this inefficiency vary from country to country. Water utilities have to manage integrally and maintain infrastructures in good condition. The Infrastructure Leakage Index (ILI) is a good indicator to assess the efficiency of the distribution networks.

The loss of water is among the major challenges the water utilities are facing. Losses range from 3% (Germany) to more than 50%. High levels of losses reflect to high losses in revenues thus affecting the financial status of the utility. At the same time, utilities lose their credibility and accountability. Furthermore, especially in water scarce areas, water lost through leakages increases water demand and stress on the limited water resources.

Utilities have to implement water loss studies on a regular basis estimating the difference between input and output water. Estimated lost water should further be analysed to separate between true network leakages and unaccounted for water from illegal connections, faulty metering etc. Investments in this sector should include geographic information systems, bulk water metering, establishing mass balancing zones and lost water detection and reduction measures. These investments pay back quickly leading to satisfied customers, better economic situation and protection of water resources.

It is the responsibility of engineers to manage distribution networks applying the best practices in combination with engineering background to minimize damages due to pipe corrosion, traffic

loading, ground movement, nearby excavation works, poor workmanship, material aging, degraded material quality, etc.

For ECCE, the approach “out of side out of mind” is not professional neither ethical and underground infrastructure should not be neglected.

We urge the need to develop or upgrade financing and funding programs and to establish procedures and policies to keep the infrastructure reliable to use for water works and to make it possible to offer to people the service they deserve. The cost to rebuild or repair the infrastructure, whatever is appropriate, is huge but the consequences of doing nothing or do less than what is needed will cause much more than economic damages since, most probably it will deteriorate human health. At the same time, research has to continue on materials and technologies that offer more economic and lasting solutions that upgrade human health and protect the environment.

Civil Engineers are committed in implementing the best practices and standards to produce and maintain the infrastructure proactively so they will not be challenged.

With transparency, engineers owe to keep people and governments informed on the strengths and weaknesses of the infrastructure.

Countries are encouraged to define water infrastructure as critical and introduce programs to assure their protection and their sustainability.

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Sustainable Management of water

Sustainable management of water means that the average water use may not exceed the average carrying capacity of the environment.

Considering sustainable development, human beings have to be at the centre of concern. People are entitled to a healthy and productive life in harmony with nature.

Respectively, water demand may not exceed available renewable water resources on the long term. The opposite will lead to deterioration of aquatic ecosystems and consequently to degraded welfare of people. Accordingly, all the fields related to water have to be considered integrally and assess how they interact, how they affect sustainability and how the pressure on water is eliminated.

It is ECCE's position that the right to development must be fulfilled to equitably meet developmental and environmental needs of present and future generations.

Water supply and demand management

Traditionally, urban water managers have relied on large-scale, supply-side infrastructural projects to meet increased water demands; however, these projects are environmentally, economically and politically costly. Urban Water Security argues that cities need to transition from supply-side to demand-side management to achieve urban water security. Leading developed cities of differing climates, incomes and life styles from around the world have used demand management tools to modify the attitudes and behavior of water users and managed to achieve urban water security. (Urban Water Security, Robert C. Brears).

Water pricing policy for efficient use.

Article 9 of the Water Framework Directive requires the implementation of pricing policies that will motivate consumers to efficient use and saving of water. In addition, the article requires cost recovery including environmental and resource costs of water services in accordance with the principle "the polluter / user pays".

According to the Blueprint for safeguarding Europe's water, "A Blueprint to safeguard Europe's water resources" (2): *Pricing is a powerful awareness-raising tool for consumers and combines environmental with economic benefits, while stimulating innovation. Metering is a pre-condition for any incentive pricing policy. Not putting a price on a scarce resource like water can be regarded as an environmentally harmful subsidy.*

To achieve the above objectives, more intense effort is needed to implement the following policies:

i. Installation of meters and introduction of volumetric recording of all consumption / water uses paying more attention in private abstraction from groundwater and surface water bodies as experience shows that the problem of non-registration of consumption may be particularly acute.

ii. Payment of the resource and of the environmental costs of water users, especially those that draw directly from groundwater and for a large quantity do not undergo any charge. In addition, users have to pay the administrative monitoring/metering costs based on the principle the user pays. The funds collected from these payments should be used for actions to protect and safeguard water resources and water bodies.

iii. Promotion of synergies and cooperation between the Authorities for water/sanitation and electricity consumption services in the monitoring, recording and collecting of water charges for water consumption from private abstracting. Cooperation may include estimate or verification of water consumption where pumping is made using electricity with separate power supply.

iv. Integration of the Water Footprint and Carbon Footprint assessment.

v. Pricing policies of water as a scarce resource have to convey the right messages. Right pricing can be used as a tool in Demand Management.

Intermittent supply

Periods of intense water shortage forced some countries (e.g. Cyprus 2008-2010), to urgently apply restrictions of the water supply to households. The consequences of the intermittent supply are the increase of the number of leakage incidents and uncontrolled damages in the infrastructure, the increase of the non-revenue water and additional measures to avoid deterioration of water quality that create a huge economic deficit.

It is our position that intermittent supply should be avoided. Countries should follow procedures that guarantee continuous water supply to households.

To prevent pushy decisions similar to intermittent supply, make people aware and motivate them to participate in campaigns of water consciousness and introduce technical solutions with active leakage control. At the same time introduce alternative water supply options, wisely manage available quantities of water and establish strategic reserves.

Public awareness and Transparency

By raising public awareness specifically of young people, nations can achieve change in mentalities and bad behaviours on water resource management. To convince people, nations have to prepare and implement with commitment their own plans for water resource management and drought management with the involvement of all stakeholders.

We invite everybody for action. We urge all stakeholders to question what we can do to safeguard water resources and water bodies. Suppliers can increase water protection, governments can offer motivation to users to decrease water demand and introduce methods that need less water.

With respect to the extent of information available to the public, we consider that this must always be assessed in relevance with the sensitivity of each information, as is the case of safety, defence etc.

Monitoring and Benchmarking

Whatever the scale, good knowledge and easy access to data and information on the status and evolution of water resources and of their use is a key to a successful water policy. (INBO June 2015)

Monitoring and accurate data are critical tools for safeguarding water quality and water conservation.

Advances in technology in sensors, alarms and monitoring equipment provide the capacity for installing early warning systems for detecting deviations and failure events to safeguard the quality of water and infrastructure.

ECCE considers that, the intention of European Commission to promote benchmarking of water services helps to introduce a critical tool to monitor and manage water activities with regards to financial and technical performance indicators. It also recognizes that the control of quality and

efficiency of services provided by water utilities is better performed by local authorities as being closer to the citizens.

Best practices and high accuracy metering devices have to be introduced as a tool for water management. Targeted parameters should be recorded and assessed in relation to predefined levels of "best" infrastructure and water quality. It is without question that the quality of data will reflect the quality of water management.

At the same time we note that, while the benchmarking systems for the drinking water supply and wastewater collection and treatment are already well defined and often well operational in many countries, other water services like drought and flood management are dramatically lagging behind.

The regulatory bodies, which are usually important promoters of the benchmarking process and using its results are currently defined by national legislation. ECCE supports that, the position of regulatory bodies in water services should be enhanced by European legislation.

Information Management Systems

Water management authorities can make use of many tools to manage water resources. The efficiency of monitoring and quality of data are improved by implementing and using state of the art information systems and remote sensing technologies. Reliable and advanced information systems are critical for water management in order to optimize the operation and maintenance of infrastructure.

Information management should be considered as an interoperability issue, with the integration of water management in other systems resulting in optimized management of all services.

Regarding the data and information management, we are supporting increased transfer of the data into public domain following the requirements of the Aarhus convention and the EU INSPIRE Directive.

Cooperation between authorities

Cooperation with other authorities (e.g. electricity) may help in identifying illegal abstraction by comparing consumption or production data. In addition, many synergies in billing, monitoring, metering etc. can be achieved.

Ground water body protection and management

Groundwater is an important water resource in many countries. The use to a greater degree of underground aquifers as water storage areas while reducing storage in artificial surface reservoirs helps in many ways as with better protection of water against pollution, reduction of losses due to evaporation (e.g. from surface reservoirs), reduction of environmental impacts on water bodies and ecosystems and reduction of cost for the infrastructure.

Unfortunately, on the other hand, experience shows that human activities degrade groundwater quality. The restoration of the quality of ground water is economically demanding and difficult to achieve.

Apart from research and monitoring, it is important to develop legal mechanisms to control land use and to ensure that abstractions are efficiently regulated in order to manage protection of groundwater.

In drought stricken regions where the underground water is of low quality, environmental studies could be performed to examine if water of better quality characteristics could be used to recharge the aquifer. For example, aquifers suffering from seawater intrusion due to over-pumping could be recharged implementing the appropriate monitoring program.

It is our position that successful protection and management of ground water needs cooperation and coordination at all levels of governance i.e. state, regional and local.

Water professionals must be given the opportunity to inform decision-makers and the public about the situation of ground water and the available means to manage it.

Protection of water bodies

Water body protection is most probably the biggest global challenge. This challenge motivated people from all parts of the world to seek consensus on water body protection and management.

The good status of water bodies is threatened by pollution, ecosystem degradation, over abstraction, hydro morphological alterations and the loss of riparian zone and floodplain from agricultural, residential or industrial developments and activities.

Therefore, one of the important measures to protect water bodies is to regulate the land use in the riparian zone and floodplain with the establishment of protection zones and buffer strips. The benefits include protection of water bodies and ecosystems, reduction of flood risks and protection of water quality from pollution. Protection of water bodies at source also reduces treatment efforts, which are associated with high costs. The protection zones can be used for nature based recreational activities like walking trails, parks etc. At the same time, it is essential to thoroughly define and communicate the necessity for the riparian zones as the changes might affect other priorities – e.g. agriculture.

In addition, more robust strategies for addressing pollution of water bodies, need to be developed all across Europe by monitoring and linking major pollutants with polluting activities within the watersheds and establishing more strict quality standards. ECCE considers that the EU Directive on Environmental Quality Standards (Directive 2008/105/EC) (EQSD), also known as the Priority Substances Directive is a good step towards this direction.

According to the "A Blueprint to safeguard Europe's water resources" (2) the second greater pressure on the ecological status of water bodies in the EU is derived from excessive abstraction of water.

To deal with this pressure the following should be promoted:

i. Financing of studies for more accurate assessment of the needs of ecosystems dependent on water to identify the sustainable quantities that can be abstracted and the time distribution of the abstraction over the year.

ii. Financing of studies for optimization of releases from multipurpose reservoirs in order to achieve the greatest benefits for multiple objectives including ecological flows and flood protection.

iii. Rating with greater accuracy the real environmental costs of water use and the relevant billing and cost recovery from users.

iv. Ensuring the use of financial resources from the collection of environmental charges from water consumption to promote compensatory measures to mitigate the environmental impact of water use.

ECCE alerts its members to contribute to this effort by implementing best practices and advanced technological solutions and managing the resources and infrastructure sustainably, eliminating the risks to water resources in order to achieve the Goals of Sustainable Development of UN.

Drinking water sources protection

With expanding global population and economic activity, pollution pressures on drinking water sources are dramatically increasing. Many drinking water sources both ground and surface are being abandoned globally due to pollution at a high pace. At the same time new emerging pollutants like pharmaceuticals, endocrine disruptors, nanomaterials, etc. make drinking water treatment more difficult and more expensive. To face the above challenges we need to increase efforts on protecting and safeguarding drinking water sources from pollution pressures.

A watershed based approached needs to be employed in drinking water sources protection. The further increase of pollution pressures need to be halted by restricting new potentially polluting activities within the watershed of drinking water sources. This can be achieved by the establishment of protection zones and identification of potentially polluting activities that should not be allowed within the zones. At the same time, existing potentially polluting activities within the watersheds and protection zones need to be carefully monitored and strictly regulated. Furthermore, regulating authorities need to invest in pollutant monitoring and fate and transport modelling for the identification and pinpointing of sources of pollution to their drinking water sources in order to take the necessary measures against the polluting activities.

Restoring confidence in public water supply systems

In many countries, despite the good water quality, a large proportion of the public do not trust the water network for drinking purposes thus resorting to other sources such as bottled water, water in tanker tracks from other water sources, from private individuals etc. This brings humanity decades back where people were compelled to carry their water jugs from the water sources. This also creates a significant economic burden on citizens since the price of bottled water is much greater than that of the public water supply and environmental problems due to the thousands of tonnes of plastic bottles, etc.).

Integrated efforts should be done in order to restore public confidence in tap water for drinking purposes.

Studies and market research should be done to estimate the extend and reasons of the problem. Also, more transparency and public information is needed. Where necessary, improve quality of water supplied.

Climate change

Although the increase in temperature due to climate change is predicted with reasonable confidence by most climate models, the same does not apply to the rainfall regime, for which there is relatively high uncertainty. Most probably, climate change will increase the frequency and extend of droughts, water scarcity and flooding globally, diminishing the economic environment and leading to financial disruption and losses in energy and agriculture.

During the past few decades, many countries suffered from severe droughts and water shortage. In some countries (e.g. Cyprus, Greece), water use and supply restrictions have been imposed in urban areas and in some rural communities for several years. It seems that water is the main victim of climate change.

Flooding is also one of the most severe consequences of climate change. In the past decades, thousands of people lost their lives due to severe floods, which also resulted in damages worth billions of Euros.

Targeted investments have to be associated with adaptation to a changing climate. Governments invest large portions of their budget in water resources management and exploitation as well as in developing alternative water sources and managing flood risks.

It is obvious that water related investments made could be better and more economically planned if there was a less uncertain projection of the future conditions influenced by climate change.

Given the uncertainty of climate change impact on rainfall, which is the principal factor in water resources balance, ECCE supports the following:

A. Focus adaptation efforts in No-regret Type Measures

The No-regret measures are measures that have benefits regardless of the evolution of climate change and thus in case of implementation of these measures there will be no regret for them even if future impacts of climate change are not the expected.

The most important no-regret measures are:

i. Maintaining and increasing strategic reserves of water resources especially in ground water bodies where water is better protected from contamination and evaporation.

ii. Funding research for new water saving technologies, promoting smart irrigation systems including soil humidity sensors, better assessment of the needs for irrigation of various crops, replacement of plantations with large water needs with crops of smaller needs.

iii. Promotion of viable alternative water sources such as desalination and use of recycled water where applicable.

B. Reduce uncertainty of the impact of climate change through tracking of trends in environmental parameters.

We support expansion and densification of monitoring of environmental parameters (rainfall, river flow, evaporation, etc.) and further research to develop more accurate climate change models to project future climate conditions.

C. Cooperation between countries and organizations to build and share common knowledge

While the EU Water Framework Directive (WFD) is providing a key mechanism in transboundary water management, cross-border water management is still fully in the hands of member states and bilateral agreements with limited interactions.

We recommend that the European Countries should increase funding and strengthen institutional framework to enhance cooperation between countries and organisations for managing water resources under climate change considering actual cross border impacts. Cross-border water delivery should be supported as such, bridging the gaps between countries and the differences between them.

D. Risk identification and management in water sector

Uncertainty management and risk management have an extremely long tradition in water management. Managing risks of water shortage and pollution, that go well beyond the day-to-day operational practice in long lasting framework reduces risk of water shortage.

New approaches addressing water resources like resilient water management should be treated with much care considering the important work of generations of experts.

Water scarcity and droughts

Water scarcity occurs where there are insufficient water resources to satisfy long-term average requirements. It refers to long-term water imbalances, combining low water availability with a level of water demand exceeding the supply capacity of the natural system. (hhtp://ec.europa.eu/environment/water/quantity/about.htm). Water scarcity can be a limiting factor for economic development.

Thus, it is important, when planning or developing an area, to take into account the available renewable water resources of the area and the possible risks to loose these resources due to either pollution or climate change, adjusting the population capacity and the requirements for agricultural and industrial activities in order to have sustainable development.

Droughts can be considered as a temporary decrease of the average water availability due e.g. to rainfall deficiency. (http://ec.europa.eu/environment/water/quantity/about.htm)

Drought Management Plans should be developed. These plans should be based on technical criteria and be independent of political decisions so they can be implemented smoothly. The plans should cover water management on an ongoing basis using indicators rather than implementing the plans only during drought periods.

The objective should be the long-term rational management for preventing water shortages and ensuring adequate water resources during periods of drought.

Flooding

Floods Directive 2007/60/EC defines a flood as temporary covering by water of land not normally covered by water. Floods develop mainly as an overflow of water from water bodies, e.g. from river, lake, or ocean, but also other sources like combined sewerage systems. During a flood event, water spreads from its usual watercourse or accumulates from rainwater and may cause loss of life and severe damages to properties and infrastructure. The speed for a flood event to develop varies from some minutes to many hours.

Apart from damages, floods may bring benefits by recharging ground water and improving soil fertility and ecosystems, etc.

Experience shows that flooding may occur in areas with low or high precipitation. In our changing environment where flooding occurs more frequently and in a more intensive way, the challenge is to build resilience in our communities in order to prepare for living with floods.

Flood Risk Management

Flood risk management should be focused on Nature Based solutions (https://europa.eu/research/environment/index.cfm?pg=nbs) like Natural Water Retention Measures. The use of natural water retention measures in managing flood risks is one of the key tools promoted by the EU because of the multiple benefits offered to both, the management of floods and the protection of ecosystems and the environment. The land use of flood plains in EU is primarily agricultural. Periodic flushing of flood plains every few years is a natural phenomenon which is important in protecting the ecological status of river water bodies. Apart from the environmental benefits of the physical retention, periodic flooding of floodplains also helps to enrich the soil with nutrients helping to soil fertility and thus it helps in increasing agricultural production and reducing fertilizer use. On the other hand there are some disadvantages e.g. soil erosion.

States should promote to a greater degree natural water retention measures by the controlled flooding of agricultural land in upstream parts of watersheds to protect downstream development areas where the cost of damage from flooding is greater. To achieve the above the following should be done:

i. Funding for the construction of the necessary infrastructure for the controlled flooding.
ii. Improving resilience of rural areas to periodic flooding.

The use of technological advances to improve flood forecasting with alarm systems is essential to protect life and property. To respond to this challenge, nations have to invest in mapping and evaluating flood hazards and in flood prediction models.

It is essential that all nations introduce legislation providing the obligation to prepare flood risk management plans as provided by the EU Floods Directive defining specific milestones.

Furthermore, Sustainable Urban Drainage Systems (SUDS) should be further implemented where appropriate.

Storm water should not be regarded as “waste” that needs to be disposed but as a valuable resource of water. To manage storm water, it is more efficient to collect and reuse the water at its source, so storm water management systems at property level, like green roofs, rainwater-harvesting systems, retention ponds and polders should be promoted to a greater extent.

Engineers can make use of innovative technologies to protect people and property from severe flooding.

Alternative sources

A. Desalination

With the sea as an inexhaustible source of water, the use of desalination in water shortage areas for water production seems to be a very promising solution for the future. In areas with no water shortage, desalination is a viable option in the case that other alternatives are exhausted.

Provided the following challenges are addressed, ECCE supports the use of Desalination as an alternative source of water:

i. The high cost of production, which can be reduced through the motivation for investment in the development of more efficient production technologies and reduced energy costs.

ii. The environmental cost, which consists mainly of the greenhouse gas emissions since it is an energy intensive process and the management of brine. The environmental cost of emissions should be included in the selling price of water and it should be equal to the cost of production of the corresponding energy using Renewable Energy Sources. Funds collected from the environmental tariffs should be used in subsidizing energy production by renewable sources. Regarding the brine management based on applications so far, showed that the impact is limited to a very local level and is manageable if the brine is successfully dispersed and diffused using the appropriate infrastructure.

B. Recycled water

The implementation of the Urban Waste Water Treatment EU Directive with the obligation for central wastewater treatment facilities for communities above 2000 resulted in increasing quantities of available treated wastewater in EU countries.

i. The re-use of treated wastewater for the artificial recharging of degraded, due to over-pumping and pollution, underground water bodies (aquifers) and then re-use of the water through pumping from wells for irrigation or other purposes appears to be a promising practice that is gaining ground. The main advantage of this practice is that the quality of the recycled water is further improved as it moves underground through the unsaturated zone, which acts as a biological filter retaining and further absorbing pollutants, which persist after sewage treatment.

ii. The reuse of treated wastewater in agriculture and industry in areas of water scarcity is gaining ground as the cost of other alternatives like desalination is prohibitive for such purposes. According to a UN forecast, the number of people on Earth will grow from todays 7.3 billion to 11.2 billion by the end of the century -- piling further pressure on our planet and its finite resources (http:www.france24.com/en/20160807-earth-overshoot-day-resources-depleted-quickest-rate-ever-2016).

About 70 % of the world's freshwater is used for irrigation, 22 % for industry and 8 % for domestic use. As population is growing, new water sources for irrigation in areas of water scarcity need to be utilized more efficiently to cover the upcoming needs for food.

Provided that the appropriate environmental impact assessment studies show no harm to the environment and the water bodies, ECCE supports the promotion of recharging of underground water bodies with treated waste water.

The switching from linear to circular economy leads to better resource management and reduced extraction and pollution since nothing is wasted (European Economic and Social Committee, 2016). Water could not be considered differently. Water scarcity increases the need to upgrade the use of

treated wastewater as a resource for agriculture, industry artificial water recharge and other purposes.

Use of recycled wastewater should be promoted and at the same time best practices should be applied and minimum requirements should be introduced to prevent any adverse impacts on public health, the environment, soils and crops, as a result of the use of treated wastewater for irrigation. Research on the effects of irrigation with treated wastewater on soil and crops should be promoted.