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Water Security and Water Geopolitics

Water challenges can no longer be connected exclusively to arid regions of the world. They become a global security challenge, and humanity has to make worldwide steps to cope with them. Europe needs to take action, as increasing hydrological extremes, such as floods, droughts and water scarcity are all linked one way or another to climate change. These are just some of the threats that have more or less affected Europe in recent times. Just think of the major devastating flash floods that occurred recently in Germany with unprecedented losses. To confront these threats, Europe needs a long-term, perceptive and progressive water strategy. It also needs to set an example to the rest of the world that expects Europe to proceed constructively and collectively to the most pressing natural resource matters facing the world. These highlight the fact that water crises should be approached not only in isolation through policy reforms, technological innovation or investment, respectively. These will require increased co-operation among all stakeholders. Therefore, a comprehensive approach is needed. Experience shows that unless the parties are able to come up with a shared vision of the transboundary issues at hand, the finding of a workable solution is difficult. Negotiation support systems, ranging from the hydrology of the basin, up to finding multi-criteria feasible solutions, or Pareto optima for that matter, are key to the effective solution(s). Europe might not have an entirely developed water security strategy as of now, but it has a strong commitment to evolve one. This basis is contained in the comprehensive water legislation of the European Union and this is extremely important as the problems related to water, especially to water security, are soon becoming one of the most important issues on Europe's environmental agenda. Among the issues connected to water security, the pollution of seawater and freshwater has to be considered also due to the huge physical, chemical and biological impacts. A rapidly growing worry concerning environmental and human safety has stimulated interest in the potential risks induced by the chemicals associated with microplastics. Studies reporting the presence of microplastics in treated tap and bottled water have raised questions and concerns about the potential health impacts from microplastic exposure and the removal of microplastics during wastewater and drinking water treatment.

Keywords: water security, water policy, water strategy, climate impacts, flood, drought, pollution, microplastics, water conflicts

Acronyms

DWD	Drinking Water Directive
EC	European Commission
EC	European Communities
EU	European Union
GDP	Gross Domestic Product
SDGs	Sustainable Development Goals

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UN	United Nations
UN DESA	United Nations Department of Economic and Social Affairs
UNESCO	United Nations Educational, Scientific and Cultural Organization
WEI	Water Exploitation Index
WHO	World Health Organization

Introduction

Water is a fundamental natural resource. Moreover, it is the most essential necessity for life. As Scocca (2019) stated, water involves all biotic and anthropic activity – activities which are strong socio-economic determinants for the well-being of human communities, but also affect ecosystems and the environment. Water-related issues encouraged the movement of the human right to water, and actions for safe and clean water. The water consumption of a society (e.g. per capita) shows the economic advancement of that society nearly as precisely as the GDP per capita.

As a result of population explosion in the twentieth century, when, in a single century, the Earth's population nearly quadrupled from 1.6 billion to 6.1 billion (Worldometer 2021), water abstraction has increased sixfold worldwide. In consequence, a growing gap has opened up that is impeding the sustainability of our human and environmental systems (UNESCO 2018). The impact of climate change and the increasing frequency of water-related natural disasters such as floods, droughts and desertification are detected as new emergencies and aggravated by population growth. These factors induced the formulation of the notion of water security.

Water security is defined as "the capacity of a population to safeguard sustainable access to adequate quantities of acceptable quality water for sustaining livelihoods, human well-being, and socio-economic development, for ensuring protection against water-borne pollution and water-related disasters, and for preserving ecosystems in a climate of peace and political stability." (UN-Water 2013) Water security is based on four main pillars. Firstly, on good governance, which means adequate legal regimes, institutions, infrastructure and capacity are in place. Secondly, transboundary co-operation, that is to say, sovereign states discuss and coordinate their actions to meet the varied and sometimes competing interests for mutual benefit. Thirdly, peace and political stability, where the negative effects of conflicts could be mitigated and/or avoided, including reduced water quality and/or quantity, compromised water infrastructure, deteriorating human resources, related governance, and social or political systems. And, fourthly, financing, including innovative sources of financing complement funding by the public sector, including investments from the private sector and micro-financing schemes. Achieving water security requires collaboration across sectors, communities, disciplines and political borders, in order to reduce the risk of potential conflicts over water resources (UN-Water 2013).

Water Security on the global scale

On the global scale the average annual water supply per capita has decreased dramatically since 1975. From a global multi-annual average of approximately 15,500 m^3/person/year to an average of 5,000 m^3/person/year. This number is a global average for the current population of 7.8 billion, with a very wide range from 120,000 m^3/person/year in Canada to 11,700 m^3/person/year in water to 120 m^3/person/year in Jordan (or even less; today 70 m^3/person/year, due to migration from the war zones of the region).

Today, the Earth's freshwater supply is as much as it was in the period between 5,000 and 9,000 years ago. 97.5% of all water is contained in the seas and oceans, while the remaining 2.5% is humankind's freshwater supply. About 60% of this is solid water, i.e. ice and snow found in the Arctic, Antarctica, glaciers, alpine snow cover and permafrost. 90% of the remaining freshwater is non-frozen groundwater. What is left is a total of 42,000 km^3 of easily accessible surface water (Shiklomanov–Rodda 2003), 90% in lakes and reservoirs, and the remaining 10% in watercourses.

Since the industrial revolution, the number of consumers has increased in an exponential manner. This is the primary reason for the drastic decline in water resources per capita. The global water crisis does not mean that we "run out" of water, since the hydrological cycle is a continuous cycle. The crisis stems from the way our institutions manage water: legal framework and its effectiveness, the operation of the hydro-meteorological observation systems; making the data about water publicly available. Lastly, how, if at all, scientific research supports government decisions (Szöllősi-Nagy 2020).

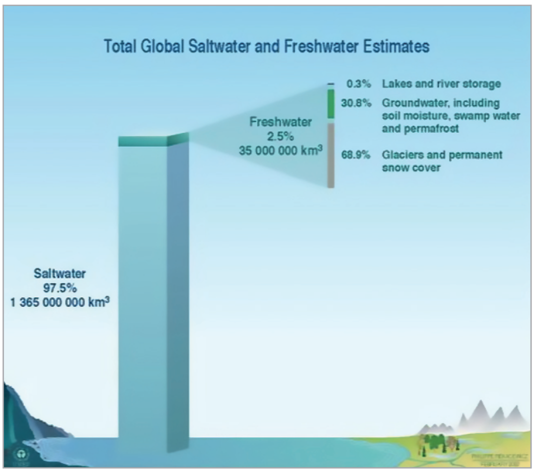

Figure 1: Global share of water resources according to the World Water Development Report
Source: UN WWAP

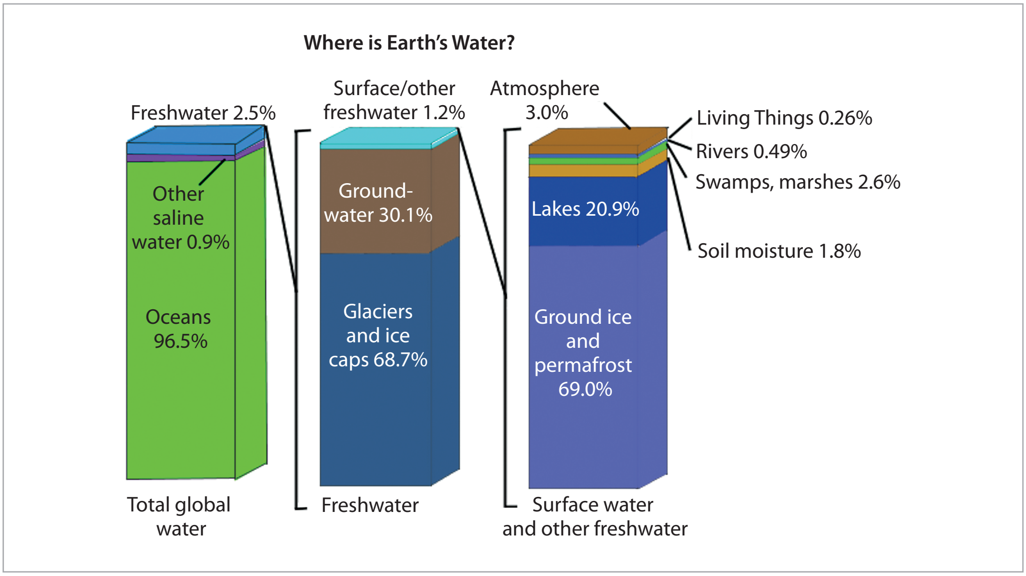

Figure 2: The distribution of water on Earth
Source: Compiled by the authors based on Shiklomanov–Rodda 2003

The acceleration of the hydrological cycle

The acceleration of the hydrological cycle can have many serious consequences, namely, that more extreme hydrological events will likely occur per unit time. The degree and frequency of droughts and floods will increase. In the 20th century nearly 80% of all natural disasters were water-related (Szöllősi-Nagy 2018). Drought refers to a temporary decline in water availability, for instance, when the precipitation level is expected to diminish over a long period of time. Water scarcity arises when the available sustainable water resources fail to meet the water demands. We must develop strategies to prevent water scarcity. An adequate supply of good-quality water is a pre-requisite for economic and social progress: we must prepare for saving water, and manage our resources more efficiently (EU 2010).

With the changing temporal and spatial variations in rainfall patterns, groundwater reserves will also likely change significantly. Therefore, climatic change and fluctuations affect the entire hydrological cycle. Climate change is thus superposed on anthropogenic effects – granted it is partly anthropological in nature as well – that is, it is expected to further exacerbate the uncertainty of hydrological events and thus the risk factors related to water management.

One needs to note that nearly 30 percent increase in the global population will take place over the next 35 years. The resulting population of nearly 9.5 billion (UN DESA 2019) is expected to cause security changes by orders of magnitude greater than those expected from climate change during the same period in the hydrological cycle and water management. Unfortunately, however, it is precisely the hydrological cycle that receives the least attention in debates and research on climate change. The importance of solving this is a vital question central to humanity's survival, and the importance of adaptation via water management cannot be emphasised enough. The reasons for the change are global developments that define the boundary conditions of our potential local actions within a sovereign territory. In addition, our existing water resources are under pressure from global demographic trends including migration and radical urbanisation. In 2020, there were more than 280 million international migrants worldwide (UN Population Divisions 2020). In 2020 more than 55% of the world's population – 4.2 billion people – lived in cities. By 2050 the urban population is expected to be 8.4 billion inhabitants, which would be more than 70% of the world's population (World Bank 2020).

Water pollution

A problem of similar magnitude arises from issues related to water quality. According to recent data, 2 million tons of waste and sewage is discharged into the world's waters yearly (Corcoran et al. 2010) where 80% of the pollution is released untreated into the recipients. In severe cases of water pollution contaminants interfere with the environment and affect human health transitionally (Haseena et al. 2017). The risks of contamination are aggravated as water is a universal solvent in which any kind of pollutants might occur. WHO reports that 80% of diseases are spread through polluted water as they are waterborne (Scocca 2019).

The massive population expansion and the daily use of polymers for producing and consuming non-reusable objects for different purposes (packaging, cosmetics, textiles, detergents, greenhouses, mulches, fishing nets, coating and wiring, trays and bottles, covers, bags and containers) cause wild waste accumulation, with consequent significant complications owing to its management and disposal (Lionetto–Esposito Corcione 2021). The municipal solid waste worldly production passed from 1.3 billion of tons in 1990 to 3.81 billion tons after 25 years (Valdés et al. 2014). Even if the waste flow comes from different sources, plastics represent a substantial portion of the municipal solid waste. In 2016, about 27.1 million metric tons (Mt) of plastic litters were stored in the European Union (EU), of which 31.1%, 41.6% and 27.3% were recycled, reused (for energy production), and dumped again in landfill sites, respectively (Plastics Europe 2019). Among polymer materials, the greatest contribution is provided by thermoplastic polymers, the consumption of which (about 80% of all synthetic polymers) is mostly attributable to packaging and containers, as well as the production of textile fibres. Hence, plastics can be considered highly responsible for waste management issues, not only because of their extensive usage but also because of their short service life together with their long (bio)degradation time (Issifu–Sumaila 2020). In addition, a great universal worry is due to the storage of plastics in landfills because of their easy accessibility in the environment. In particular, mismanaged plastic waste of polyethylene containers and poly (ethylene terephthalate) bottles of beverages, the most common polymers found in urban waste, lead to a huge amount of surface water and seabed marine litter.

Plastic pollution of the marine environment has recently been recognised as one of the most impacting threats for the environment, causing numerous hazardous and ecologically negative consequences, such as the entanglement of the marine species within the plastic or their ingestion. In particular, juvenile fish, reptiles (i.e. turtles, etc.), and mammals often become entangled in plastic waste with consequent severe damage for the animal growth (Sazima et al. 2002) and restriction of movement precluding them from correctly feeding and, in the case of mammals, breathing. A wide variety of species have been reported to be harmfully crushed by plastic trash, such as marine birds, sea turtles, cetaceans, fur seals, sharks and filter feeders. Marine birds are very prone to the ingestion of plastic objects that they mistake for food (Gregory 2009). Plastic ingested by these marine organisms remains in the digestive tract and can lead to reduced feeding stimuli, gastrointestinal obstruction, decreased secretion of gastric enzymes, and lower levels of steroid hormones, causing reproduction difficulties. Specific classes of litter found in the oceans, involving the Antarctic, have been observed in the sea for at least four decades (Horton–Dixon 2018).

Microplastics (MPs) are generally defined as polymer particles with a regular or irregular shape and a size ranging between 5 mm and 1 μm and are insoluble in water, while bigger particles, such as pellets, are called mesoplastics (Acharya et al. 2021). However, a clear and accepted terminology and classification is still under discussion, as well as a standardisation of the plastic collection and analysis methods (Hartmann et al. 2019). Microfibers (MFs), very fine fibres (approximately 3–10 μm in diameter), spun as endless filaments can be of both synthetic and natural origin. The size to diameter ratio is also quite high, on the order of 103, which is an additional crucial property of MFs. The most common constituents of MPs include polyethylene (PE), polystyrene (PS), polyethylene terephthalate (PET), polyvinylchloride (PVC) and polypropylene (PP). MPs generally arise from the plastic pollution of seaside and beaches, deriving from fragmentation phenomena or from powders employed, for example, in cosmetics (Park et al. 2020).

Both microplastic and mesoplastic litters can be eaten by marine species and, thus, can reach the marine food network. In contrast to macroscopic plastic litters, MPs on the seaside, seabed, or surface water, frequently combined with sand, are complicated to store and, at present, there is not an easy and universal method for the calculation of their amount. Furthermore, the degradation of marine MPs due to prolonged external light exposure, mechanical abrasion and biodegradation can cause the creation of nanoplastics (NPs) with sizes lower than 1 μm. In particular, marine MPs have been investigated by several researchers, and their presence has widely been proven in coastal environments (Aslam et al. 2020). The freshwater system is also considered a potential sink of MPs (Wagner–Lambert 2018). Zbyszewski and Corcoran (Zbyszewski–Corcoran 2011) reported for the first time the presence of MPs in the freshwater system during the coastline of Lake Huron, Canada. Very recently, it has been evidenced that there are different concentrations of MPs in Australia, Asia, North America and Europe (Li et al. 2020).

The current literature underlines that MPs are found in every sea basin around the world, with higher concentrations occurring in intense human activity areas demonstrating that plastic debris transport can be extremely efficient, and that the prediction of the plastics' fate is of paramount importance (Lionetto–Esposito Corcione 2021). Additionally, the study and modelling of the transport of MPs in the marine environment attracts increasing interest.

However, even if it is noted in the literature that micro (MPs) and nanoplastics (NPs) represent one of the emergent environmental pollutants and that the release of chemicals/additives used in synthesis of plastic materials may carry flowing effects on marine species, full knowledge of their impacts on living organisms is still lacking. In detail, the relationship between the migration/dispersion of MPs/NPs from one compartment to another and all the environmental compartments (terrestrial, aquatic and atmospheric) need to be better analysed (Lionetto–Esposito Corcione 2021).

Many chemical contaminants, derived from human activities, are released into the marine environment causing serious damage to water and long-term effects on organisms due to chronic exposure. The most common contaminants present in the microplastics in the marine environment are: polychlorinated biphenyls (PCBs), bisphenol A (BPA), polycyclic aromatic hydrocarbons (PAHs), perfluoroalkyl (PFAs), pesticides, pharmaceutical compounds and metals.

The European Union has promised to tackle microplastic pollution. The European Chemicals Agency proposed banning all microplastics added to cosmetics, paint, detergents and nearly all other consumer and commercial products where they are used to fill, bind, coat, absorb, thicken, be abrasive or control the release of medicines or pesticides. The ban would stop 10,000 to 60,000 tonnes of plastic leaking into the environment every year, which is, however, a lower content compared to the plastic that breaks up on beaches, rivers, the soil or spewing out of our washing machines.

Water scarcity and aspects of social security

Over the recent years, both understanding and awareness of the linkages between climate change and issues of security have significantly increased, particularly in developing countries. However, those links are not simple and clear. One could conclude that the growing impacts of climate change do not automatically lead to more violence and conflict. Rather, climate change acts as a threat multiplier.

More specifically, and as for water scarcity, the Sahel region particularly constitutes a remarkable case study. In the Sahel region agriculture remains the main – and in most cases the only possible – economic activity. Consequently, the local economies are highly vulnerable to climate shocks, whether slow or fast. As a net result, the region is also struggling with issues of food insecurity and malnutrition. According to the "Food Crisis Prevention Network" in 2019, 9.5 million people were facing malnutrition crises across 16 countries in the West African region. This number is expected to increase to 14.4 million, with the majority of people at risk living in the Lake Chad basin area (RPCA

2019). In some areas in Niger and Burkina Faso, 2.7 million people were in immediate need for food assistance. Further, almost two-thirds of the world's population, nearly 4 billion people, are facing austere water scarcity, and more than 2 billion people live in countries experiencing high water stress. At the same time, water supply obviously is not equitably distributed across the Earth. For example, in Sub-Saharan Africa about 40% of the population lack safe drinking water (UN Water 2021).

A significant dimension of water inequality is gender. According to a study conducted in 2019 by UNESCO, in 25 Sub-Saharan African countries women are estimated to spend almost 16 million hours per day collecting drinking water, 6 hours daily, while men spend almost 6 million hours. According to the above it seems that women take the responsibility for finding a vital natural resource, not only for drinking, cooking and hygiene, but also for their families to survive. For this purpose, women in these areas may have to walk long distances to collect water and may stand in lines waiting. As a result, women have less time to diversify their activities and improve their daily lives (Blackden–Wodon 2006). Further, and because there is no toilet at home, women and girls spend a lot of hours finding a safe place to go. Consequently, women and girls are left with little or no time for work, education, family care and personal care. Further, the above-mentioned circumstances might be dangerous for women in pregnancy. The long walking distance might constitute a potential danger situation for women and girls collecting water for their families. Moreover, violence, sexual attacks and social repercussion resulting from these attacks are also some of the cases (Sorenson et al. 2011). When women are empowered with water and toilets at home, they could have better health, better care for their families, better opportunities for education and they could start small businesses and a better and safer habitat, respectively. In general, access to safe water gives women and girls more hope and better future.

A second dimension is children's vulnerability. Children are also affected by climate change and water scarcity. Despite the fact that the link between climate change and violence against children may not seem obvious, they are linked. Climate change leads to water scarcity, degradation of fertile soil and land scarcity, food insecurity, displacement and loss of livelihoods. As families struggle to survive, devastating measures might seem as solutions. These measures, sometimes include child marriage and labour under dangerous working conditions. Another possibility is the involvement of children in conflicts and political violence; a development that fundamentally changes their lives.

A third dimension has to do with conflicts. Climate change has gradually more negative impacts on the livelihood of many countries and regions through water and land scarcity, food insecurity and migration. This dimension makes the affected population vulnerable not only to climate developments but also to recruitments by violent groups such as Al-Qaeda, Islamic State, Al-Shabaab or other militia. These groups can present alternative ways of life, economic motivations and a significant response to political anger and dissatisfaction (Charalampopoulos 2020). This does not imply that there is a direct link between climate change and political-related violence and conflict. However, large-scale environmental factors, such as water scarcity, land scarcity and climatic change contribute to creating an environment in which these groups can thrive.

Further, violent groups are using natural resources as a weapon of war. In unstable environments these groups can use water and other resources as a weapon of war and a means of political pressure. This tactic creates a dynamic for these groups taking into consideration the fact that the scarcer the resources become, the more power is given to those who control them (Nett–Rüttinger 2016).

Moreover, studies show that as the climate is changing, conditions are better for organised crime groups to operate. As it was said before, this does not imply that there is a direct link between climate change and violence and conflict arising. However, large-scale environmental and climatic change contributes to creating an environment in which those groups can better develop their strategies. A low level of rural development, environmental scarcity and reliance on sensitive crops make people vulnerable to the impacts of climate change, pushing them towards illicit activities and contributing to rapid migration to the cities, where they are exposed to organised crime, violence and recruitment by criminal groups. Further, this rapid migration is putting problems on the receiving urban areas. Many of these cities are largely dominated by youth street gangs creating a culture of violence that puts women and youngsters at risk.

Rapid urbanisation in conflict and post-conflict societies that have failed to carry out major reforms is more likely to increase the vulnerability of youth to engagement in illegal activities and recruitment by groups of organised crime. Last, but not least, in recent years, human trafficking and new forms of slavery have increasingly been linked to climate-induced disasters. In Bangladesh, a rise in cases of slavery and human trafficking could be observed in the aftermath of climate disasters and NGO representatives stress that the "link between climate change and slavery could not be more clear" (Conaway 2013).

It is obvious that climate change will increasingly challenge the states' abilities to provide services and stability. In particular, extreme climate events can threaten the social contract between governments and populations. In such a case a poor and slow government's response could contribute to instability, fragility, violence and further strengthen violent groups. Unfortunately, most of the states which are in the regions (Africa, the Middle East, Central America, Southeast Asia) which are most threatened by climate change are at the lower bottom of the Fragile State Index. Those states could not provide enough protection or help their citizens to remain in the area amid the negative changes caused by climate change (Fund for Peace 2020). And if a state fails to cope with the challenges, people start to move toward a better place to live, so mass migration will begin. International borders are just theoretical obstacles. In the affected regions most of the states could not manage to take care of tens of, or hundreds of thousands of refugees. The situation could deteriorate very fast and a new migration crisis could rise.

The situation in the European Union

The vast majority of people in Europe enjoy access to safe drinking water. This is partly due to over 30 years of EU legislation on ensuring water quality. In February 2018, the European Commission proposed to revise the EU legislation for improving access to higher quality of drinking water and provide widely available information to citizens (Scocca 2019). According to the EC, the new measures are capable of reducing potential risks associated with drinking water from 4% to below 1%.

Despite the fact that The Charter of Fundamental Rights of the EU does not contain a specific provision with respect to water, certain principles set out in the text can be interpreted as also being of relevance for access to safe drinking water and sanitation, such as the right to dignity (Article 1) or the right to life (Article 2). A significant chapter relies on the protection of the quality of Europe's water resources. In the region, about 50% of drinking water is taken from groundwater and 40% from surface water, while 10% is from other sources, such as artificial groundwater recharge or bank filtration. The matter of environmental preservation has been a high priority since the mid-1970s, when the European Communities (EC) started adopting the first directives on this subject. The EC adopted a directive that set standards for the discharge of dangerous substances into natural water bodies (EEC 1976).

In 2000, the EU adopted a unified approach to water legislation, the Water Framework Directive (WFD) (EU 2000). This legislative measure aims at a legal framework to ensure the protection and restoration of water quality, improving the ecological and chemical quality of water as well as the sustainable use of water resources. This is in conjunction with the Drinking Water Directive (DWD) (EU 1998), concerning the quality of water for human consumption.

Harmonising the essential quality standards in the EU, the objective is to protect human health from adverse effects of any contamination of water. Water security is also covered at Member State level in terms of regulation. These legislative initiatives illustrate water quality priorities (Scocca 2019).

The physical security of water in the EU mostly relies on the Floods Directive (EU 2007), providing regulation for inland and coastal waters. This has been the catalyst for introducing a risk management approach in the Member States prone to floods. The two other Directives on Groundwater (2006/118/EC) and Quality Standards (2008/105/EC) as well have been the catalyst for introducing a risk management approach in the EU.

The Sustainable Development Goals (SDGs) were adopted by all United Nations Member States in 2015 as a universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity by 2030. There are 17 goals among which SDG 6 is specifically related to water security. The new approach of the EU is in line with SDG 6 to "achieve universal and equitable access to safe and affordable drinking water for all".

Water scarcity and drought in the EU

In general, Europe is not an arid continent, although the decrease of suitable water resources for nearly half of the EU population is alarming. The water exploitation index (WEI) indicates the amount of water abstracted each year as a proportion of total long-term freshwater resources. It is an indicator of the pressure on freshwater resources.

A WEI above 20% implies that a water resource is under stress, and values above 40% indicate severe water stress and unsustainable use. There are several countries, such as, for instance, Malta (48.8%) or Spain (29.2%) which usually use up at least 20% annually of the long-term supplies available. During the long lasting disastrous drought in Cyprus from 79.6% to 64.4% of the country's renewable supplies were used up from 2012 to 2018. Countries with most favourable weather conditions are also in – of course, to a lesser level – danger. In 2018 Romania WEI was 16%, Poland consumes 17.1%, and in 2016 Belgium WEI was 16.6% (Eurostat 2021).

"Europe's geography and climate mean that water distribution is uneven in the EU, a situation made worse by human activity. In southern Europe, for instance, tourist development has increased demand for water, resulting in desertification and salt-water intrusion to aquifers located in coastal freshwater zones. Water scarcity is most acute in the south, but by no means limited to these areas: most Member States have suffered episodes of drought since 1976, and many now report frequent water scarcity problems and over-exploited aquifers" (EU 2010).

Conclusions

While climate change is a slow process, the direct impact of human activity has been measurable for decades. The primary cause of the impact is demographic change. With the demographic dynamics of the 9.6 billion population projected for 2050 (growth, mobility, migration) and the consequent changes in secondary land and water use, the functioning of the hydrological cycle will fundamentally change. About 80% of the consequences of climate change, which is caused by human activity, are water related. Sustainable water management is therefore a key issue for humanity's sustainability. As a result of the expected acceleration of the hydrological cycle, the likelihood of extremes will increase, meanwhile the Earth's water supply will not change. As a result of population growth, water resources per capita will be drastically reduced by the middle of the century, which could obviously be unsustainable and a serious source of conflict, both internationally and domestically (Wolf 2007).

Obviously, more water storage is needed to achieve water, food and energy security. The rational and sustainable management of highly sensitive and highly vulnerable groundwater is extremely important. If we connect the various aquifers to 80-meter wells without any consideration, hydrogeological expertise, measurement, or monitoring, then we are transferring the first aquifer completely polluted with non-point contaminants into the downstream aquifers, depriving future generations of clean water (Szöllősi-Nagy 2020).

The current water legislation of the EU ensures a strong basis for public health and environmental protection in the whole Union. The EU WFD states that "water is not a commercial product like any other but, rather, a heritage which must be protected, defended and treated as such" (EU 2000). It is a very important and forward-looking feature of EU water policy to ensure the good quality of waterbodies while implementing public participation and improving transparency.

Although the introduction of water security approach happened relatively early in the EU, more efforts are needed in order to further improve the role of water in environmental legislation, for example, the encouragement of public–private partnerships or a better coordination across sectors would be highly desirable. These directions could also be advised universally in order to make the concept a coherent and functional principle for a conscious integrated water management (Scocca 2019).

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