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Clean Water for a Healthy World

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Frequently asked questions on water quality

What defines the quality of water?

Water quality is an important parameter touching on all aspects of ecosystems and human well-being such as the health of a community, food to be produced, economic activities, ecosystem health and biodiversity. Therefore, water quality also is influential in determining human poverty, wealth and educational levels.

From a management perspective, water quality is defined by its desired end use. Consequently, water for recreation, fishing, drinking, and habitat for aquatic organisms require higher levels of purity, whereas for hydropower, quality standards are much less important. For this reason, water quality takes on a broad definition as the ''physical, chemical, and biological characteristics of water necessary to sustain desired water uses'' (UN/ECE 1995). It needs to be noted that after its use water usually returns back to the hydrological system and if left untreated can severely affect the environment.

What is the state of water quality on our planet?

Worldwide water quality is declining mainly due to human activities. Increasing population growth, rapid urbanization, discharge of new pathogens and new chemicals from industries and invasive species are key factors that contribute to the deterioration of water quality. In addition, climate change will further affect water quality. Major risks are the lack of water quality data and monitoring worldwide as well as lack of knowledge about the potential impact of natural and anthropogenic pollutants on the environment and on water quality. The lack of prioritization of water quality in many countries has resulted in decreased allocation of resources, weak institutions and lack of coordination in addressing water quality challenges.

How do population growth, urbanization and industrial production affect water quality?

Deterioration of water quality occurs when existing municipal and industrial water treatment and/or sanitation infrastructure is overloaded or the relevant infrastructure is absent or outdated and waste and waste water are discharged directly into the environment from where they find their way into surface or groundwater. Enhancing and expanding infrastructure can be very costly and therefore in general is not keeping up with rapid development. Waste water management therefore is emerging as a major global challenge. In addition agricultural and industrial production result in new pollution problems that have become one of the biggest challenges facing water resources in many parts of the world.

Water quality can be affected by organic loading (e.g. sewage), pathogens including viruses in waste streams from humans and domesticated animals, agricultural runoff and human wastes loaded with nutrients (e.g. nitrates and phosphates) that give rise to eutrophication and oxygen stress in waterways, salinization from irrigation and water diversions, heavy metals, oil pollution, synthetic and persistent engineered chemicals (e.g. plastics and pesticides), medical drug residues and hormone mimetics and their by-products, radioactive pollution, and even thermal pollution from industrial cooling and reservoir operations.

Water quality degradation can result in the deterioration of the functioning of ecosystems and can lead to abrupt and nonlinear changes. Once certain thresholds are exceeded, the system may change to a very different state and collapse. For example, excessive nutrient loading in freshwater and coastal ecosystems can cause abrupt and extensive changes, possibly leading to algal blooms and oxygen-depletion which makes most animal life impossible.

How does climate change influence water quality?

Climate change and in particular increasing temperatures and changes in hydrological patterns such as droughts and floods will affect water quality and exacerbate water pollution from sediments, nutrients, dissolved organic carbon, pathogens, pesticides and salt, as well as thermal pollution. Further, sea-level rise is projected to extend areas of salinisation of groundwater and estuaries and thereby impacting the availability of freshwater for humans and ecosystems in coastal areas. Gaps still exist in the knowledge about the impacts of climate change on water, especially its quality. Although observational data are required for adaptive management, many observational networks are shrinking. There is a need to improve the understanding and modelling of climate changes with respect to the hydrological cycle at scales that is relevant to decision-making. Information about water-related climate change impacts is inadequate, particularly regarding water quality, aquatic ecosystems and groundwater.

How can water quality be sustained? How can polluted water be treated or purified?

Both in terms of sustainability as well as of investment and affordability, prevention should be the preferred option. Prevention of water pollution must therefore be the first priority to sustain water quality. The other two options are treatment and restoration. While treatment in some cases is necessary in natural environments due to contamination (pollution caused by environmental influences, e.g. arsenic), it usually becomes more complex when tackling pollution caused by human activities.

Finally, restoration of water quality that has been degraded usually is expensive, and more costly than prevention since the rehabilitation of a degraded ecosystem actually means to reestablish the natural environment in all its complexity to the original one.

Water purification is a service that ecosystems provide, through recycling nutrients, trapping silt, and breaking down waste. Wetlands, for example, can filter out high level of nutrients and toxic substances. On the other hand, ecosystems themselves depend on the availability of adequate water quality.

How does water quality affect human health?

Sufficient quality of water is critical to ensure a healthy environment and human health. The basic requirement per person per day is 20 to 40 liters of water free from harmful contaminants and pathogens for the purposes of drinking and sanitation, rising to 50 liters when bathing and kitchen needs are considered.

In many countries, however, the amount of water required daily for drinking and sanitation is not provided in the required quality. Developing countries undergoing rapid urbanization suffer from lack of sewage treatment facilities which results in the contamination of drinking water, thus it becomes a major cause of illness (which impacts poverty and education) and death.
According to the World Health Organization (WHO) 4 billion cases of diarrhea each year in addition to millions of other cases of illness are associated with lack of access to water that is safe for human consumption. Per year 2.2 million people die as a result of diarrhea most of them are children under the age of five. Human health is severely impacted by water-related diseases (waterborne, water-washed, water-based, and water-related vector-borne infections) as well as by chemical pollution discharged to water.

Despite progressive improvement in the provision of sanitation since 1990, providing safe water and sanitation to large parts of the human population remains a challenge. Today, 1.1 billion people around the world still lack access to improved water supply and more than 2.6 billion people lack access to improved sanitation. The most significant gaps exist in sub-Saharan Africa, then to a lesser extent in Western Asia and Eurasia. Improvements in sanitation have been far less in rural areas than in urban areas, and there has been even a decline in the provision of sanitation services in rural areas of Oceania and the former Soviet Union.

Are there any international agreements regarding water quality?

There are no global binding environmental agreements obliging states to safeguard water resources against pollution as this is a national government responsibility. The 1997 UN Convention on the Law of the Non-Navigational Uses of International Watercourses, which provides that international watercourses shall be used balancing the interests of the watercourse States concerned and the adequate protection of the watercourse, has not entered into force yet. However, the importance of protecting freshwater resources has been recognized in international non-binding instruments such as Agenda 21, adopted in 1992 by the United Nations Conference on Environment and Development. In particular, Agenda 21's Chapter 18 on the Protection of the Quality and Supply of Freshwater Resources: Application of Integrated Approaches to the Development, Management and Use of Water Resources sets as its general objective "to make certain that adequate supplies of water of good quality are maintained for the entire population of this planet, while preserving the hydrological, biological and chemical functions of ecosystems, adapting human activities within the capacity limits of nature and combating vectors of water-related diseases."

Concerning groundwater resources, in December 2008 the UN General Assembly (UNGA) adopted the Resolution (A/RES/63/124) on the 'Law of Transboundary Aquifers'. Through this resolution the UNGA encourages aquifer states to make appropriate bilateral or regional arrangements for the sustainable management of their transboundary aquifers, taking into account the provisions contained in the annexed draft articles.

At the regional level, there are a number of agreements which address the issue of water quality. Of particular importance are the 1992 UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes and the 2000 Revised Protocol on Shared Watercourses in the Southern African Development Community (SADC).

The 2007 Resolution on Forests and Water within the FOREST EUROPE policy process is of particular relevance in the pan-European region. FOREST EUROPE is the pan-European policy process for the sustainable management of the continent's forests. The resolution emphasises the vital role of sustainable forest management in protecting water quality and promoting overall watershed management. It was endorsed by the responsible ministers of the 46 participating FOREST EUROPE countries and the EU at the 5th Ministerial Conference on the Protection of Forests in Europe. The countries committed themselves to maintaining and enhancing the water and soil protection functions of forests, as well as those for mitigating local water-related natural disasters, through sustainable forest management, including the use of public and private partnerships. They stressed the importance of developing, improving and co-ordinating policies for forest and water resource management.

The European Union has established a framework for Community action in the field of water policy in the EU Water Framework Directive (Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000). The primary objective of the directive is to prevent further water deterioration and to implement the necessary measures to achieve "good water status" in all EU waters by 2015. The criteria for determining what constitutes "good" water status is assessed on the basis of detailed qualitative and quantitative factors, such as abundance of aquatic flora and fauna, the level of salinity, the quantity and dynamics of water flow, nutrient concentrations, and so on. Specific requirements apply to drinking water, to pollution, and to the management of aquifers, among others.

A great number of agreements concerning specific river/lake basins have been concluded by relevant riparian countries to establish an institutional and legal framework for the joint management and sustainable use of the shared resource, e.g. the International Joint Commission of Canada and the United States.

What water quality issues are directly related to unsustainable bioenergy production?

As the nexus between bioenergy and water has been receiving more attention in the scientific and political spheres, it has become evident that unsustainable bioenergy production has the potential to contribute to worsening water quality. Like other agricultural cultivation processes, if farming systems involve the heavy application of agro-chemicals, run-off from these fertilizers (e.g. nutrients like nitrates and phosphorous) and pesticides can adversely affect downstream aquatic ecosystems and their services as well as downstream human activities and uses. Depending on the specific bioenergy system, the wastewater from conversion processes can also affect the quality of surface/ ground water. Discharge water from bioenergy processing facilities if treated improperly, for example, can deteriorate water quality. Although more research needs to be undertaken on this nexus, it is evident that improved farm and plant-level practices can reduce the risk to water quality.