Implementing improvements in water quality and protecting ecosystem services

Information brief

Why water quality matters

Water is essential for life. The amount of freshwater on Earth is limited, and its quality is under constant pressure. Preserving the quality of freshwater is important for the drinking-water supply, food production and recreational water use. Water quality can be compromised by the presence of infectious agents, toxic chemicals, and radiological hazards.

Quick facts

- Over **80%** of wastewater generated in developing countries is discharged without treatment into surface water bodies.
- Globally, **2 million tons** of sewage, industrial and agricultural waste is discharged into the world's waterways.
- Currently **245,000 km²** of marine ecosystems are affected with impacts on fisheries, livelihoods and the food chain.
- Worldwide around **2.2 million** people die each year from diarrhoeal disease, mostly children under five in developing countries. 88% of that burden is attributable to unsafe water supply, sanitation and hygiene.
- An estimated **748 million** people do not use an improved source for drinking water.
- **2.5 billion** people lack access to improved sanitation (more than 35% of the world's population).

Source: UNEP and UN-Habitat (2010), WHO (2014)

Sanitation in big cities

Big cities with poor sanitation infrastructure can be swamped by human waste. In Jakarta, with a population of 9 million people, less than 3% of the 1.3 million cubic metres (enough to fill more than 500 Olympic swimming pools) of sewage generated each day reaches a treatment plant – there is only the capacity to process 15 swimming pools' worth.

Source: UNEP and UN-Habitat (2010)

Sanitation in urban slums

Slum dwellers often rely on unsewered communal public toilets or use open space. The lack of water, poor maintenance, plus the user-pays system in place for many communal toilets means they are not widely used. A study in the slums of Delhi found that the average low-income family of five could spend 37% of its income on communal toilet facilities.

Source: UNEP and UN-Habitat (2010)

Desalination and impacts on the marine and coastal environment

Desalination of sea water is often the only option for providing safe drinking water in arid, coastal or isolated regions such as small islands. An established technology since the 1950s, by 2006 approximately 24.5 million m^3 of water were being produced per day for drinking water, tourism, industry and agriculture (58% of all desalinated water produced). Production is expected to increase to 98 million m^3 a day by 2015. But it is not without consequences: it's expensive, energy intensive, and has implications for the environment and societies. Yet there is scope to improve the sustainability of the desalination process.

Source: UNEP and UN-Habitat (2010)

Commitment to progress

Water quality has been a neglected topic in global debates, even if wastewater management is a key component of the Millennium Development Goal 7: "to halve, by 2015, the proportion of the population without sustainable access to safe drinking-water and basic sanitation", progress towards the sanitation target is off track.

The post-2015 development agenda provides an opportunity to address this gap.

Open Working Group (OWG) adopted water-quality related targets

6.3 by 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater, and increasing recycling and safe reuse by x% globally.

6.6 by 2020 protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes.

6.a by 2030, expand international cooperation and capacity-building support to developing countries in water and sanitation related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies.

6.b support and strengthen the participation of local communities for improving water and sanitation management.

12.4 by 2020 achieve environmentally sound management of chemicals and all wastes throughout their life cycle in accordance with agreed international frameworks and significantly reduce their release to air, water and soil to minimize their adverse impacts on human health and the environment.

15.1 by 2020 ensure conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements.

15.8 by 2020 introduce measures to prevent the introduction and significantly reduce the impact of invasive alien species on land and water ecosystems, and control or eradicate the priority species.

Source: OWG (2014)

Challenges

- **Financing**. One of the main implementation challenges is the **need for improved water financing**. Unmanaged wastewater receives a low and often poorly targeted share of development aid and investment in developing countries. Implementing economic policy to initiate change is difficult: such policies tend to require a high level of **institutional capacity**.

- **Infrastructure**. Most **wastewater infrastructure in many of the fastest growing cities** is lacking, outdated, not designed to meet local conditions.

- **Regulation and enforcement**. One of the main governance problems is lack of or limited regulation and enforcement, which cause environmental degradation and health risks, particularly in developing economies. For instance, many countries do not have national **guidelines** for acceptable use of **wastewater for irrigation**.

- **Coherence and coordination**: There is an enormous disconnect between water policy and spatial planning and other sectors (e.g. agriculture, energy, industry, trade). In developed countries non-point-source pollution remains a critical issue, in part because management requires **multijurisdictional approaches** that make implementation difficult.

- **Accountability and transparency**: Meeting water quality targets can also be hampered to a lack of accountability and transparency in complying with existing standards for quality and wastewater treatment, in particular when governments do not have the capacity to monitor their performance.

- **Improving water governance** by addressing wastewater management is a key challenge particularly in **urban areas**. Global populations are growing rapidly in cities; in many cases the rate of urbanization outstrips planning and wastewater infrastructure development.

- **Accounting for water quality: Data** on the rates and levels of collection and treatment of sewage are limited and often difficult to compare. No global datasets exist on the ambient water quality status of water bodies or ambient water quality standards.

- **Technology**. **The technology development, transfer, adoption and/or dissemination** as well as the **integration of scientific with indigenous and local knowledge** are important challenges. Implementing appropriate technologies is limited, mainly to high-income countries.

- **Lack of capacity** to manage wastewater, which compromises safe water for drinking, washing and hygiene, water for irrigating crops, and for sustaining ecosystems. For instance, farmers lack knowledge of water quality, including nutrient content, so they combine nutrient-rich irrigation water with chemical fertilizers making from agriculture a source of pollution. In many countries the capacity to apply the **Guidelines on the Safe Use of Wastewater, Excreta and Greywater in Agriculture and Aquaculture** is lacking.

Challenges for developing water quality accounting

- **Scale** - Translating information from landscape and river basin scale to national accounts.
- **Data** - Increasing data availability and quality.
- **Ground-truthing and relevance** - Calibrating accounts with real world measurements.
- **Coverage and representativeness** - Deciding which services to include and the meaning of results.
- **Added value for decision-making** - Providing more added value than other accounting tools supplying evidence to decision making.
- **Trade** - Dealing with resources and impacts embedded in imports.
- **Monetary valuation** - How appropriate and feasible is it? How do we develop it?

Source: TEEB (2013).

Tools for implementation

Sustainable management of wastewater demands innovative methods that engage the public and private sector at local, national and transboundary scales. Planning should provide an enabling environment for innovation. Wastewater management requires collaboration between partners who may not usually talk; for example farmers, public health officials, municipal and waste managers, planners and developers.

1. Tools for increased and improved financing and use of economic instruments

Innovative financing of wastewater infrastructure should incorporate the **full life cycle** of the facility (design, construction, operation, maintenance, upgrading and/or decommissioning), while taking into account the livelihood opportunities.

Economic instruments are tools that can be used to support regulatory frameworks by recovering some of the management costs. For instance, **economic valuation** is useful in understanding the costs and benefits of wastewater management to justify investment policies and financing mechanisms. In some cases, **innovative economic policy instruments** might be useful for restoring damaged ecosystems or improving water quality – such as the water quality trading systems in the US.

To ensure effective pollution control, **pollution charges** – a source of revenue that can be earmarked for environmental funds and programmes – need to be **combined with regulatory measures**. In practice, trading schemes for water pollution quotas are rare and difficult to apply. They are especially difficult to apply to farmers – agriculture being an important source of non-point water contamination.

The availability of adequate quantities of water, of good quality, is a service provided by ecosystems. The management of and **investment in ecosystems** is essential for water security.

Major investments are needed to reverse the decline of hydrologic observation networks, including water quality **monitoring**.

Approaches to investing in environmental assets and reducing pollution

- Public policies should provide incentives for private sector investment, production and consumption patterns that reflect the social benefits of environmental sustainability and the costs of environmental protection.

- Payment for environmental services to protect upper watersheds and preserve ecosystems services downstream.

- Unitary tax over agrochemicals.

- Pollution fees to finance effluent collection systems and water treatment plants.

- Mark-ups over water prices can finance river restoration programmes or create water protection funds.

- Trust funds formed with voluntary contributions from firms and individuals.

- Reduction of risk premiums over loans to finance water infrastructure by means of loan guaranties to help the projects tap debt markets in local currency.

- Performance based price rebates (provided water users demonstrate a sizeable reduction in pollution loads or water consumption).

Some Payment for Environment Services (PES) Schemes

Direct Public Payments: The government body makes payments (from general revenue or user fees) directly to providers of ecosystem services.

Direct Private Payments: Organizations or businesses "buy" the ecosystem service directly from those able to provide it.

Cap-and-Trade Schemes: A government body sets a limit (a "cap") on the amount of ecosystem degradation permitted in a given area; firms or individuals subject to these regulations meet their obligations either by complying, or by financing other landowners to undertake activities that offset damage. "Credits" reflecting such offsets may be traded and thus acquire a market price.

Eco-Certification Programmes: Consumers opt to pay a premium price for products produced in a certified ecologically friendly way.

Source: CBD (2010)

Nutrient credit trading

Farmers earn nitrogen-reduction credits when they go beyond legal obligations to remove nitrates from the watershed. These credits can then be traded. This can be achieved by changing fertilizer application rates; changing production practices; growing different crops, or retiring cropland.

Source: UNEP and UN-Habitat (2010).

2. Appropriate technologies

The development and diffusion of environmental technologies significantly benefit from **policy incentives** in the form of tax breaks, subsidies, tariff protection, preferential terms of trade or government endorse promotional programmes. Strong institutions are needed for this.

The **environmental technology** adoption can enable societies to reduce their environmental impacts, reducing the risks and costs of ecosystem degradation, and to adapt to environmental changes. Environmental technologies development may be the result of leading edge R&D, which relies on the protection of intellectual property (e.g. through patents) to recover upfront investment costs. In countries where intellectual property laws are weak or ineffective, or where technology plagiarism is high, technology investors prefer to stay away.

WIPO GREEN – The Sustainable Technology Marketplace

WIPO GREEN consists of an online database and network that brings together a wide range of players in the green technology innovation value chain, and connects owners of new technologies with individuals or companies looking to commercialize, license or otherwise access or distribute a green technology. It is a specialized platform administered by WIPO (World Intellectual Property Organization) and includes partners from a range of public and private sector organizations working on green innovation and technology transfer.

HEPIA/EcaVert Vertical Green Biobed for treating agricultural effluents

- Environmental challenge: Reduce contamination of water from pesticides.
- Technology solution: Treat effluents, diluted with water, by cycling them through a vertical "biobed" with mixture of soil, organic materials, and plants.
- Regional technology dissemination: VG BiobedTM technology and associated know-how
- Transactions: Licensing, sales, joint research and development.
- The technology "Vertical Green Biobed for the efficient degradation of pesticides" is accessible at www.wipo.int/green

Source: https://webaccess.wipo.int/green/

Innovative Environmental Technologies Verification – the ETV scheme of the EC

Environmental Technology Verification (ETV) is a new tool to help innovative environmental technologies reach the market. The problem at the moment is that many clever new ideas that can benefit environment and health are not taken up simply because they are new and untried. Under ETV, claims about innovative environmental technologies can be verified – if the "owner" of the technology so wishes – by qualified third parties called "Verification Bodies". The "Statement of Verification" delivered at the end of the ETV process can be used as evidence that the claims made about the innovation are both credible and scientifically sound.

The EU Environmental Technology Verification pilot programme is trying out ETV on a large scale with volunteer organisations and Member States. The ETV pilot programme is open to all technologies ready for the market and presenting a potential for innovation and environmental benefit. One of the specific areas of coverage of this scheme is water treatment and monitoring (monitoring of water quality, treatment of drinking water and of wastewater).

Source: http://iet.jrc.ec.europa.eu/etv/

Smart wastewater management must be **socially and culturally appropriate**, economically and environmentally viable into the future.

The **sanitation ladder** is useful to assess the local status of sanitation in a community, municipality or region, pointing to optimal wastewater management strategies.

In the agricultural sector, the development of **tools and optimizing agricultural practices** can help reduce diffuse pollution, which is a major problem worldwide. Opportunities for using wastewater, and improving fertilization and animal production should continue to be explored.

Cleaner production and sustainability aid the transition toward zero effluent discharges. Industries should convert wastewater streams into useful inputs for other processes and industries. **Improved management of chemicals** to prevent spills and leakages.

Opportunities in cities

- Establishing **sustainable drainage systems** (SUDS) in high density cities are key (>15,000 people per km^2).
- **Nanotechnology** for urban water produce contributes to pollution reduction and accelerates filtration, making water re-use possible and affordable.
- **Greywater re-use**, along with simple water conservation technologies for urban applications (i.e. more efficient toilets and showers and in-house grey water recycling) can make water conservation more affordable. It can reduce the opportunity cost of selecting "ecological" options at individual and community scale. This means more efficient options for urban planning and more green building design.

3. Capacity development

Communication, education, training and awareness must be central in wastewater management and in reducing overall volumes and harmful content of wastewater.

This should be addressed at **multiple levels**, including the development of professional skills for improved inter-sectoral collaboration and multi-year financial planning, providing **access to solutions and culturally specific aspects**.

Water quality and agriculture

Guidelines on the Safe Use of Wastewater, Excreta and Greywater in Agriculture and Aquaculture

The capacity to apply the Guidelines on the Safe Use of Wastewater, Excreta and Greywater in Agriculture and Aquaculture and best practice recommendations needs substantial strengthening.

Wastewater as a managed resource for irrigation and food production

Through the FAO's Farmer Field Schools in developing countries, training in risk-reduction and safe food production and crop selection have been implemented from International Guidelines to simple and adoptable "farm-to-fork" techniques.

Source: UNEP and UN-Habitat (2010)

4. Water governance

Planning and management

- **Integrated water and wastewater planning and management at national and municipal levels** is needed. It is critical that wastewater management becomes an integral part of urban planning and integrated watershed and coastal management.

- Countries must urgently adopt a **multi-sectoral approach** to wastewater management, incorporating principles of **ecosystem-based management** from the watersheds into the sea, connecting sectors that will reap benefits from better wastewater management.

- **Maintaining ecosystem integrity and functions need to be an objective of planning processes**: The ecosystem is "natural infrastructure", an asset to be managed to meet human needs by using it to supply water more sustainably and to deal with water quality problems; wetland management is critical to sustaining the water cycle and dealing with nutrients and pollution.

Recommendations by UN-Water

- Stimulate action in countries to ensure collection and treatment of used water and related pollutants from domestic water users and from "point sources" of industry and agriculture to protect human health, the environment and ecosystems.
- Countries increase the amounts of used water that are re-used or recycled for beneficial purposes, thus maintaining sustainability.
- Countries introduce policies and regulations that lead to prevention of pollution and a reduction in the negative impacts of diffuse pollution, starting with, but not limited to the priority to reduce nitrogen and phosphorous pollution.

Source: UN-Water (2014)

- In light of rapid global change, communities should plan wastewater **management against future scenarios**, not current situations.

- Planning and management of wastewater in the **urban context** must be adapted, to the size and the economic development and governance capacity of the area.

- Joint management of cross-border basins and aquifers and integrated quality monitoring programmes are key (surface and groundwater).

Information monitoring systems are essential for efficient management of water resources, allowing for quick and easy access to data and providing data quality control.

For more information: http://www.wssinfo.org/introduction/

Water uses

- **Agriculture**. Intervention is needed for **non-point source** activities such as agriculture to limit the use of nutrients and change production processes. Interest in sustainable farming is growing, including **conservation agriculture, integrated plant protection and plant nutrition management**.

- **Sustainable forest management** can provide ecosystem services including waste treatment/water purification.

- **Industry**. The most cost-effective **industry** solutions focus on **preventing** contaminants from ever entering the wastewater stream or developing a **closed system** of water use. Industry can benefit from access to cleaner water resources, as impurities can add costs to the production processes.

- **Information**. Effective water management, water policy and biodiversity policy can benefit from the **collection and systematisation of information on water quantity and quality**, and their relationship to biodiversity. Natural capital accounts can provide an important contribution to this objective.

- **National and international commitments and experimentation will be important to develop natural capital and water quality accounts**, in order to clarify the information they can provide and how they can support decision-making processes.

Incentives

- Many incentives are based on **voluntary measures**, but governments and the public sector must play a central role in monitoring, regulating and implementing policy to reduce toxic waste.

How can industry clean up?

In many countries the responsibility for industrial wastewater treatment falls on ordinary taxpayers. In the absence of a "user pays" system for pollution control, large volumes of contaminated industrial wastewater end up in municipal sewage treatment plants, which are expensive to construct, operate and maintain.

Source: UNEP and UN-Habitat (2010)

Regulations, Guidelines and Standards

- **Regulation and enforcement of agreed standards** are essential to overall quality of water bodies over time. This requires (i) setting water quality criteria, (ii) monitoring these, (iii) monitoring who is causing infringements, and (iv) influencing behaviour through regulation and enforcement.

- **Establish and enforce well-defined emission rights**. Emission rights help ensure optimal resource use, including water quality. When resources are free to private participants it can encourage overexploitation.

- Effective measures for **groundwater quality** protection require **water and land use regulations** be considered together.

- Sound **drinking water guidelines, water safety plans and information monitoring systems** can also be instrumental for robust and transparent water information and governance.

Guidelines on the Safe Use of Wastewater, Excreta and Greywater in Agriculture and Aquaculture

- Establishing health-based targets which allow local authorities to set risk levels that can be handled under the local socio-economic conditions.

- Applying quantitative microbial risk assessment (for pathogenic viruses and bacteria) as a cost-effective way of assessing health risks.

- Identifying risk points along the chain of events from the origin of the wastewater to the consumption of the produce.

- Designing health risk management measures, to be applied along the same chain of events, to ensure health protection as a result of risk reduction.

- Monitoring all stages to ensure effective application and desired impacts on health.

Source: WHO/FAO (2006)

Water safety plans, as developed by the World Health Organisation, are one example of an approach to risk assessment necessary to ensure access to safe water and sanitation:

Drinking Water Safety Plans (WSP)

Managing drinking-water quality from catchment to consumer.

What are Water Safety Plans (WSP)?

A WSP is the most effective means of consistently ensuring the safety of a drinking-water supply through a comprehensive risk assessment and risk management approach that encompasses all steps in water supply from catchment to consumer.

Why are WSPs needed?

The WSP are designed to…

- Minimize direct contamination in source waters.
- Reduce or remove contamination by treatment.
- Prevent contamination during storage, distribution and handling.

For more information: http://www.who.int/water_sanitation_health/dwq/4safetyplans.pdf

Drinking water guidelines

The quality of drinking water is an environmental determinant of health. Drinking-water quality management has been key for over 150 years and it continues to be the foundation of prevention and control of waterborne diseases.

How are water quality guidelines useful?

The WHO's Guidelines for Drinking water provide a state-of-the art perspective on issues of water quality and health and on effective approaches to water safety management.

Objectives of water quality guidelines

- Guidelines should support development and implementation of risk management strategies to ensure safety of drinking-water supplies through control of hazardous constituents in water.
- Guidelines can help water quality managers define water quality management objectives and measures required to protect environmental values/uses.
- Water quality guidelines are an important source document used by state authorities, consultants and water resources management practitioners to guide water management decision-making.

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