Technical Committee (TEC)

Managing the other side of the water cycle:
Making wastewater an asset

It can save public funds, conserve water and nutrients, and protect human and environmental health. Managing the other side of the water cycle – municipal and industrial wastewater and storm drainage – offers many opportunities. And in a world in which cities are growing and climate change threatens to increase water scarcity in many areas,[1] it should be an integral part of water resources management and water supply and sanitation strategies.

Traditionally, water supply, sanitation and water resources management investments are planned, designed and managed separately. To make wastewater an asset requires taking an integrated approach that encompasses the whole water cycle – the water resources available and water supply, treatment, and reuse options. This brief outlines some of the institutional, economic and policy aspects of such an approach – topics that are covered in more detail in GWP-TEC Background Paper 13, *Managing the Other Side of the Water Cycle: Making Wastewater an Asset*.

Box 1. Seven key recommendations

1. **Consider wastewater as a potential resource** in the overall water budget.
2. **Adopt an integrated framework** to manage water supply, stormwater, wastewater, nonpoint source pollution and water reuse.
3. **Incorporate wastewater reclamation and reuse into sustainable development, climate change adaptation and integrated water resources management strategies.**
4. **Consider the various reuse options from the outset in the design of treatment plants, as well as in their operation, and define corresponding standards.**
5. **Ensure that guidelines and policies encourage communities to determine the most appropriate and cost-effective wastewater treatment solutions based on local capacities and reuse options** – rather than imposing solutions or severely limiting them through overly strict regulations.
6. **Involve all stakeholders** from the start in water reuse plans and ensure multi-stakeholder platforms to facilitate dialogue, participatory technology development, innovation uptake and social learning.
7. Ensure financial stability and sustainability by:
   - **Linking waste management with other economic sectors** for faster cost-recovery, risk reduction and sustainable implementation.
   - **Developing mixed public/private, public/public sector solutions for investment, service delivery, and operation and maintenance.**
   - **Considering social equity when defining cost-recovery mechanisms.**

[1] See GWP-TEC Background Paper 14: *Water Management, Water Security and Climate Change Adaptation: Early Impacts and Essential Responses*, 2009.

The sanitation challenge

Currently 90% of the world's cities do not have proper sanitation. Their rapid and unplanned growth continues to outpace improvements in sanitation infrastructure.

In India, only 24% of wastewater from households and industry is treated; in Pakistan, it is only 2%. And in Africa, it is only 1%. Even in cities with treatment facilities, the water discharged into rivers, lakes and seas is often not of adequate quality to protect the environment and human health – due to low financial, technical and/or managerial capacities (see Box 2).

According to a recent OECD report: 'Municipal water utilities have now become the main polluters of surface waters in many East European, Caucasus and Central Asian countries. Up to 90% of nitrogen and phosphorus discharges into the Black and Caspian Seas originate from riverine inputs, which mostly transport municipal wastewaters'.[2]

Box 2: Why sanitation systems fail

The International Water Association's (IWA) Task Force on Sanitation has identified several common reasons for the failure of sanitation systems:

- **System choice inappropriate to the context.**
- **Badly planned, badly implemented, and/or poorly managed.**
- **Incentives of utilities/municipalities conflict with interests of households they are meant to serve.**
- **Lack of resources and institutional capacities.**
- **Lack of focus on long-term operation.**
- **No planned provisions for maintenance requirements.**

Source: IWA, 2006, *Sanitation 21: Simple Approaches to Complex Sanitation – A Draft Framework for Analysis.*

Wastewater – a resource too valuable to waste

With increased urbanization and climate change, there is a need for a shift in thinking – from seeing waste as a drain on resources to seeing it as an economic and environmental opportunity. Sewage, household grey water and wastewater contain potential sources of fertilizer and energy. Treated effluent can replenish water courses or be reused directly for many purposes. Better management of wastewater would contribute to a solution to water *scarcity* as well as water *pollution*.

This shift in thinking could also help close the financing gap for sanitation. In some areas, industries are willing to pay for treated wastewater to use in their processes. For example, in South Africa, mining companies have invested in municipal sewerage works in order to ensure a reliable source of water for their operations. Even *sludge,* the irreducible end product of wastewater treatment plants, has potential value in construction, in biogas production and as a soil amendment in agriculture.

Box 3: Reuse cuts down sewage treatment costs in Melbourne

The public water company, Melbourne Water, manages 54% of its wastewater in 11,000 ha of ponds, wetlands and grazing fields – that is 500,000m^3 of wastewater per day. Cattle and sheep graze on 3,700 ha of pastures irrigated with raw or sedimented sewage and 3,500 ha non-irrigated pastures. The livestock yields a substantial return of about 3 million Australian dollars per year, which significantly reduces the cost of sewage treatment for the city.

Source: Melbourne Water, 2001, www.melbournewater.com.au.

[2] OECD EAP Task Force, 2007, 'Financing water supply and sanitation in EEC CA countries and progress in achieving the water-related MDGs'.

Water reclamation and reuse

Compared to desalination, water reuse is a cost-effective and energy saving option to increase water supplies and mitigate the impact of climate variability and climate change. There are different reuse opportunities with different social, economic and environmental values:

- agricultural irrigation,
- aquaculture,
- non-potable urban uses and landscape irrigation,
- drinking water augmentation,
- aquifer recharge,
- restoration of water bodies and wetlands, and
- industry (e.g., cooling, boiler-feed or process water).

Water reuse is already a widespread and accepted practice in many countries. It may however have negative cultural associations. In the US and Australia, there have been protests against the use of recycled water for domestic purposes.

There are only a few developing countries with experience in planned reuse and a record of wastewater treatment plants producing a safe effluent. In Africa, Namibia, South Africa and Tunisia (see Box 5) have policies and strategies in place that cover wastewater treatment – through a range of conventional and non-conventional systems – and national guidelines and regulations for reuse.

Wastewater irrigation as an environmental service?

By far the most common use of wastewater is for irrigation. The majority of this use is unregulated. Many of the 200 million farmers who specialize in market gardening rely on raw or diluted wastewater. Practices range from the use of polluted surface water, to raw wastewater, to the piped distribution of secondary or tertiary treated wastewater. Global estimates of the extent of wastewater irrigation range from 4 to 20 million ha.

Use of wastewater for irrigation can be a way of 'outsourcing' part of sanitation services, maximising water use efficiency, as well as closing the water and nutrient loops to sustain and promote food production. When wastewater irrigation is well regulated, the agricultural sector in effect provides the urban sector with a valuable environmental service. In addition, the urban and peri-urban agriculture enabled by a reliable supply of nutrient-rich water provides food to urban areas. In fact, many cities in the developing world owe a large percentage of their fresh fruit and vegetables to wastewater. It should be stressed, however, that, particularly in the absence of effective treatment and regulation, there are considerable risks associated with this practice (see Table 1). These risks should be addressed in the general context of poor water supply and sanitation and not in isolation.

Table 1. Trade-offs between the benefits and risks of wastewater use in agriculture

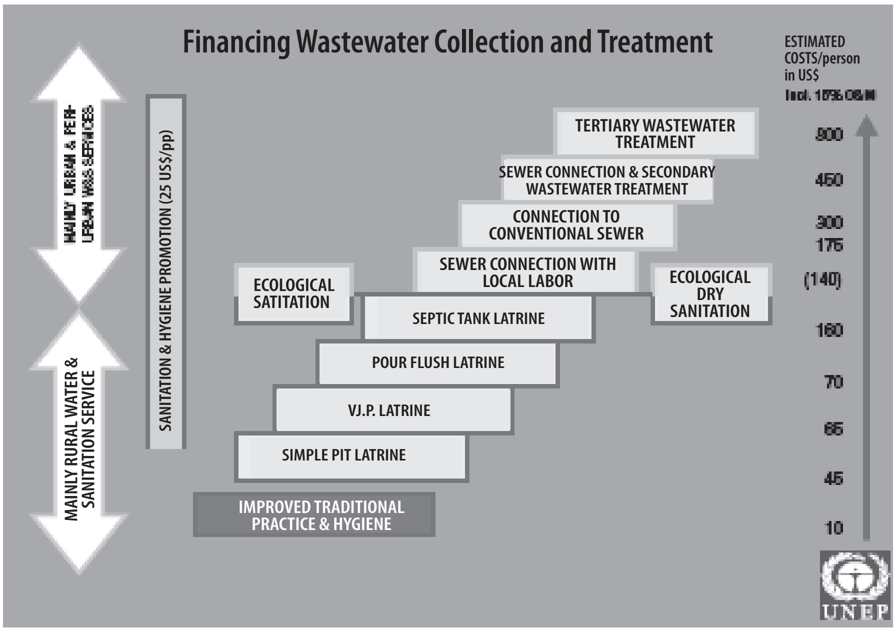
Economic, social and environmental benefits	Environmental & public health risks
• Conserves water and reduces freshwater demand • Provides a reliable water supply to farmers • Can act, depending on the degree of treatment, as a low-cost method for disposal of municipal wastewater • Reduces pollution of rivers, canals and other surface waters • Recycles organic matter and nutrients to soils, thereby reducing the need for chemical fertilizers • Increases crop yields and farmer incomes	• Health risks for irrigators and communities in contact with wastewater (increased incidence of diarrheal diseases) • Health risks for the consumers of vegetables irrigated with wastewater • Pathogens in wastewater can cause health problems for cattle • Contamination of groundwater (nitrates, trace organics, pathogens, etc.) • Build-up of chemical pollutants in the soil (salts, heavy metals, etc.) • Creation of habitats for disease vectors (mosquitoes) in peri-urban areas

Closing the financing gap

Although *household sanitation* costs are of a lower order and can be spread out in various ways, *public infrastructure* for sewage collection, wastewater treatment and re-use can be very costly. According to the World Panel on Financing Water Infrastructure, a high proportion of the additional US $100 billion required annually is needed for wastewater services.

Many cities have realized the advantages of making progress towards advanced wastewater treatment in several affordable steps, rather than immediate adoption of the most sophisticated option. Each of these steps on the 'sanitation ladder' entails a quantum leap in unit costs (Figure 1), and the incremental benefits obtained may not justify the extra outlays in every situation.[3] An integrated approach to wastewater use may mean some of these expensive investments can be avoided.

Figure 1. Costs of various services on the 'sanitation ladder'



Source: UNEP. Water Supply and Sanitation for All, 4WWF, 2006.

Looking at wastewater as a potential resource also makes it possible to draw on unconventional sources of enterprise and funding (see Box 4).

Box 4: An innovative public-private partnership provides social, economic and environmental benefits

Durban Water Recycling is a Durban Metro–Vivendi Water public private partnership that provides a 20-year build-own-operate and transfer service to Durban Metro. The project, which started operation in May 2001, includes treating and recycling 47,500 m^3/day of reclaimed water. The project treats 7% of the wastewater being discharged to the sea and guarantees a lower cost, high quality water supply to be sold to industries in the Durban South Industrial Basin (the Mondi Paper mill, Sapref Refinery and Sasol textile factory).

This innovative approach to wastewater provides the following benefits:

- Community partnership that enables affordable water supplies in poor informal settlements.
- Additional 8% potable water made available for the community.
- Lower water costs guaranteed to industry.
- Reduced flow to overloaded long-sea outfall.

[3] See TEC Background Paper 11: *Urban Water and Sanitation Services; An IWRM Approach.*

Shifting the paradigm

In addition to seeing wastewater as an asset, change is needed in a number of key areas for effective management of the other side of the water cycle:

Consider the full range of sanitation options: A well articulated portfolio of sanitation alternatives would help both communities and planners choose the most viable option. Different kinds of sanitation facilities are needed to suit technical, economic, environmental, and institutional conditions. The choice should take into account local capacities for operation and maintenance and downstream uses. Decentralized systems may better protect watersheds and water resources and avoid wastewater transfers over long distances.

Manage water, wastewater, pollution control and water reuse in an integrated way: Wastewater treatment units should be linked with the city economic development agenda. The location of large (centralized) or small (decentralized) treatment should be planned close to the reuse sites, such as peri-urban farmers or industrial users. Wastewater disposal must be seen as part of overall water quality management. Attention should however be given to risks of build up of difficult to remove pollutants.

Define appropriate and cost-effective treatment levels to correspond to each reuse option: The approach to wastewater treatment generally adopted is based on producing an effluent in compliance with water quality discharge requirements. Instead, defining performance criteria based on desired effects on human health (reduced exposure to pathogens), environment (ecosystems to be protected), and reuse options (e.g., irrigation) can be a more cost-effective approach. Considering reuse from the outset in the design of treatment plants as well as in their operation will yield the best results.

Shift from an end-of-pipe to a source approach: The most common approach to urban sanitation is centralised sewerage and treatment. This end-of-pipe approach has successfully helped reduce problems such as waterborne diseases and eutrophication. However, many industrial pollutants should be removed at the source. Removing them after they have been introduced into municipal sewer systems is much more difficult and in many cases technically or economically infeasible. Where possible, pollutants should be retained in closed-loops and reused within the industry – a win-win opportunity.

Consider the place of agriculture in the wastewater treatment cycle: Agriculture may be integrated, as a land treatment system, into the treatment cycle and considered as the nutrient recycling part of the loop. If reclaimed water is going to be used to irrigate fodder crops, field crops (cereals, industrial crops) or forest trees, a secondary treated effluent should be of sufficient quality. For vegetables eaten raw, additional wastewater treatment steps are required for public health protection. A combination of treatment and environmental and health protection measures, such as safer irrigation techniques and appropriate washing of crops to be eaten raw, should be adopted to reduce risks.

Box 5: Tunisia's national water reuse program

In Tunisia's national water reuse program, which was launched in the early 1980s, treatment and reuse needs are combined and considered at the planning stage. Reclaimed water is being used for industrial purposes, groundwater recharge, irrigation of forests and green areas along highways, and for wetlands development. By 2020, the annual volume of reclaimed water is expected to reach 290 million m^3, and it is planned to extend the area irrigated with reclaimed water up to 20,000–30,000 ha, i.e., 7–10% of the overall irrigated area.

Inter-departmental coordination and follow-up commissions with representatives from the different ministries and their respective departments or agencies, the municipalities, and representatives of the users (Water Users' Associations) have been set up at national and regional levels to bridge the gaps between the needs of different parties, ensure the achievement of development objectives, and preserve the human and natural environment.

Policies and institutions to support reuse

Strengthen political will: To make a strong economic case for sanitation and water reuse, the benefits (internal and external) need to be quantified, for example environmental services. The impacts on water-dependant sectors of economy – e.g., tourism, trade, agriculture – and on poverty reduction should also be determined and widely communicated.

Define rights to wastewater: Many poor farmers have been using wastewater without formal water rights. Improving water management practices in upper portions of a watershed or urban area to reduce wastewater volume will also reduce a portion of the irrigation supply for downstream farmers. Improvements in wastewater treatment can also reduce water supply if the treated wastewater is transferred from its original point of use. Legislation may therefore be required to define the users' access rights and the powers of those entitled to allocate rights. To ensure safe reuse, it is important to make access dependant on farmer compliance with guidelines for reuse. In Mexico, the authorities' power to withhold water from farmers who do not comply with crop restrictions is a major factor in their success.

Implement economic incentives: Incentives for reusing treated wastewater are helpful where water users can choose among different water sources. Lower water prices and subsidies for purchasing new equipment can speed the pace at which farmers and industrial users begin using wastewater. Incentives can be combined with monitoring to ensure compliance with incentive programs and safe use. Financing for in-plant recycling and pre-treatment of industrial effluent can be a key part of future water supply strategies, in addition to providing environmental benefits.

Bridge sectoral and administrative divides: Effective management of wastewater requires cooperation among agencies and sectors, such as health, municipal wastewater treatment, irrigation water distribution, etc. For example, to ensure efficient agricultural water reuse, cross-sectoral collaboration is required at the national and local levels. But skills and administrative responsibilities are also often spread over different governmental offices. A complete wastewater discharge, treatment and reuse system requires an integrated view and adapted legislation and institutional structures.

Define 'implementable' guidelines: Guidelines for wastewater treatment and use of reclaimed water should be: (1) realistic in relation to local conditions (epidemiological, socio-cultural and environmental factors); (2) affordable; and (3) enforceable. To gain public understanding and acceptance, water reuse regulations should be part of a set of consistent water regulations applying to drinking water, bathing water, irrigation water, discharge, etc.

Promote public awareness, education, and transparency: Public outreach and education programs, including school curricula, are an essential component in water reuse programs. Transparency, information sharing and involvement of water (re)users and local communities in the decision making process will also ensure greater acceptance of reuse projects. In the case of water reuse in agriculture, farmers need to be educated on safe irrigation and post-harvest practices, and consumers need to be informed about the safety of agricultural products irrigated with well-managed reclaimed water. Water quality data must be widely available and freely shared with customers for the water and the general public.

Encourage stakeholder participation: In addition to public understanding, water reuse requires systems adapted to users' needs and often behaviour change, thus stakeholder participation is crucial to success. Communities need to be able to express their needs and suggestions in open multi-stakeholder platforms.

The future of water management

So what does effective management of the other side of the water cycle look like? Water reuse defines the required degree of treatment, technical solutions match capacities, and urban source treatment is implemented along a multiple-barrier approach, combining treatment and different environmental and health protection measures. What will it take to make this a reality? To take advantage of water and nutrient recycling opportunities, agriculture will need to be incorporated into urban sanitation concepts.

Long-term strategies for step-by-step action and new local business models are also needed. But most of all, local capacities have to be built for more integrated management of the water cycle – management based on realistic standards and local solutions.

This brief is based on GWP-TEC Background Paper 13: *Managing the Other Side of the Water Cycle: Making Wastewater an Asset* by Akiça Bahri. It is available for download at www.gwpforum.org.

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