Looking up the pipe and down the drain

Positioning sanitation within Integrated Water Resource Management

Sanitation aims to reduce the risks of pathogen transmission from human waste. Lots of effort therefore goes into providing people with safe and convenient sanitation facilities in their homes. However, often in sanitation planning, little attention is given to what happens with the waste afterwards. This can lead to pollution through seepage from pit latrines or through disposal of wastewater into receiving water bodies. This means that pathogen transmission can still take place, but further 'down the drain'. A related issue concerns demands made upon water resources, for example, due to flushing toilets.

Water resource managers are becoming increasingly aware of these issues and are turning their attention to sanitation, especially as part of an Integrated Water Resources Management (IWRM) approach.

This briefing note discusses the linkages between sanitation development and water resource management, and the ways in which concerns for both can be effectively integrated and managed.

Headline facts

- At a global level, the quantity of water used for sanitation is relatively minor compared with productive use in agriculture. At a local level, it may be much more significant due to specific technologies, such as flush toilets in urban centres.
- From an IWRM perspective, the provision of sanitation should consider the potential risks of polluting water resources and, where possible, reuse of waste and wastewater.
- Complementary management strategies exist for ensuring both sufficient water resources and adequate pollution control: firstly, for local authorities to engage with water resource management institutions and secondly, to apply an integrated approach within the sanitation sector.

IWRM, Sanitation and the Water Cycle

The various definitions of IWRM are all based on the principles of equity (access and benefits), efficiency (supply to the greatest number of people) and sustainability of use.

The Joint Monitoring Programme (JMP) of WHO/UNICEF states that excreta disposal systems are adequate if they are private and if they separate human excreta from human contact. One of the main methods of preventing pathogen transmission therefore, is an effective disposal and removal facility for faecal matter in the home. As sanitation is an integral part of the water supply chain, safe sanitation services traditionally consider all the elements in Figure 1.

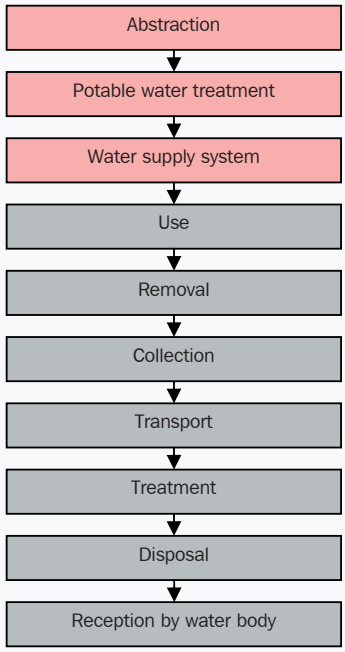

Figure 1. The traditional water and sanitation chain

With increasingly scarce water resources, using potable water to transport human waste is inefficient and wasteful. At the same time, seeing sanitation as only the removal of waste, has led to pollution of water resources.

The impacts of sanitation should be key to IWRM, as part of a broader focus on the water resources it is using and polluting. This requires the water and sanitation sector to look both 'up the pipe and down the drain'.

Putting Water Use for Sanitation into Perspective

The water demand for sanitation depends on the type of technology used:

Table 1. Water required per flush for sanitation options

Sanitation option	Amount of water per flush
Urine diversion toilet	No water required
VIP latrine	No water required
Pour flush toilet pit	2-5 litres
Dual flush system	4.5-6 litres normal flush; 3-4.5 litres reduced flush
Low-flush toilets	6 litres in USA
Full-flush toilets	13.3 litres in USA 9 litres in Germany

At a global level, domestic water use accounts for only about 10-20% of total water use, with sanitation at less than 1%, compared to agriculture, which accounts for 60-80%. At the local level, however, the demand caused by sanitation can be an important part of total domestic water consumption, especially in large cities with full-flush toilets, which puts a huge strain on water resources in some regions.

Even when water resources are in abundance, there are still water-saving alternatives to flush toilets:

- Dry sanitation (although this is a far from mainstream approach).
- Water saving technologies (such as low-volume flush toilets) exist for wet sanitation.
- Small-bore sewers require less water, as they only transport settled sewage.
- Trials have been carried out using rainwater and grey water for toilet use.

Rainwater for school sanitation
In Chacón Nuevo, a village on the Colombian Pacific coast, there is no water supply system. Few premises have toilets, but those that do have flush toilets are connected to rainwater tanks. With over 3,000 mm of rain per year, water resource availability is not a problem.

Toilets included in irrigation scheme, Zimbabwe

Pollution from On-site Sanitation

The type and amount of water pollution depends on the sanitation option. There are three main problems that arise: the transmission of disease-causing organisms (pathogens); oxygen depletion of receiving waters (rivers and lakes); and eutrophication through excess nutrients in receiving waters.

Pit latrines

The main risk posed by pit latrines is microbiological contamination of groundwater. This mainly affects those who use water from boreholes or wells. Water resource management should cover risk assessment and alternative technologies for the specific site conditions.

Sludge disposal

Inappropriate sludge disposal can also pollute groundwater and open water bodies, making sludge management important. It can be disposed of on water or land (with risk of pathogen transmission), added to wastewater treatment works, or turned into agricultural compost and biogas.

Flush toilet to septic tank

Similar contamination issues apply. The various management options for emptying septic tanks pose risks, requiring careful planning of treatment and/or disposal sites and awareness of potential downstream impacts.

Sewers

The only direct pollution caused by sewers is if they leak, although cross contamination of piped water systems operating under inadequate pressure from sewer systems is also common. More importantly, sewerage systems collect all types of household, industrial, hospital and solid waste, resulting in a wide variety of pollutants. Wastewater treatment can be most effective when waste flows are separated and kept as homogeneous as possible.

Wastewater treatment and disposal

Wastewater treatment and effluent disposal is arguably the most obvious point where sanitation and water resource management meet. Treatment and disposal options are largely determined by earlier activities in the chain, but the main objective is to remove the risks from the three main types of contaminants. Despite this, wastewater treatment occurs only to a very limited extent, mainly due to the costs of construction, operation and maintenance.

Table 2. Treatment of wastewater

Region	Sewered wastewater (%) treated to secondary level
Africa	0
Asia	35
Latin America and Caribbean	14
Oceania	Not reported
N. America	90
Europe	66

Source: Scott et al., 2004.

Reuse of wastewater

Reuse of wastewater is emerging as an important issue relating to both pollution prevention and minimising treatment costs.

A typology of wastewater use:

- Direct use to land of untreated wastewater from a sewerage system or other purpose-built wastewater conveyance system.
- Direct use of treated wastewater to a controlled area for irrigation.
- Indirect use of wastewater which may be treated or not, but is partially diluted in the receiving water body.

Van der Hoek, in Scott et al,(2004).

Wastewater treatment technologies suitable for meeting microbiological guidelines for reuse of wastewater in agriculture, include the use of waste stabilisation ponds, wastewater storage and treatment reservoirs, or conventional treatment processes.

A range of health protection measures including crop restriction, irrigation techniques and human exposure control should all be considered in conjunction with partial wastewater treatment. In some cases, community interventions using health promotion programmes could be considered.

Using untreated wastewater, Ghana

Sanitation in Water Resource Management

The way in which sanitation is managed has an impact on water resources, while at the same time, sanitation is heavily dependent on them. The water and sanitation sector needs to manage this dual role and two strategies exist for this: to position sanitation more effectively on water resource platforms, and to apply an integrated approach within sanitation development. Both are important and their suitability depends on the case in question.

Sanitation in water resource management platforms

The known linkages between sanitation options and water resources require local authorities, who are responsible for sanitation, to engage with the water resource management institutions that are being established in many countries. Some cautionary lessons for these local authorities are:

- Local authorities may not see the need for water resource management, as the water and sanitation chain is based on the idea of "beyond the end of the pipeline", which is outside of their responsibility.
- The difficulties of one government body enforcing control over another can hinder the discharge of untreated wastewater. Political issues may also hamper its effectiveness.
- Internal conflicts may arise if increased sanitation coverage also increases the adverse impacts caused by sanitation.

An integrated approach to sanitation

An alternative can be to follow an integrated approach within the sanitation sector, maintaining the sector's own mandate of equity, efficiency and sustainability. Key guiding principles should include:

- sustainable access to water resources for sanitation;
- water use, efficiency and impact on water resources;
- multiple and alternative water sources for sanitation;
- reduced pollution and waste management;
- reuse and management of wastewater and desiccated waste products;
- separation and concentration of waste flows;
- downstream water uses and the self-purifying capacity of receiving water bodies;
- stakeholder and user involvement in active decision making;
- linkages with stakeholders involved in IWRM; and
- gender and equity issues.

Conclusions

As delivery of both rural and urban sanitation services is scaled up, there is a tendency to focus only on the household level, ignoring the subsequent stages of waste management. Where there is water-borne sanitation in the growing urban centres, there is a significant impact on water resources. These linkages require those responsible to implement processes by which they can be strategically managed and any potential problems overcome.

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This note was funded by the UK Department for International Development (DFID). The views expressed, however, are not necessarily those of DFID.

Published by WEDC on behalf of WELL

This briefing note discusses the linkages between sanitation options and water resources and the ways in which concerns for both can be effectively integrated and managed.

Key references

- Cave, B. and P. Kolsky, (1999). *Groundwater, latrines and health*. WELL Task 163. www.lboro.ac.uk/well/resources/well-studies/summaries-htm/task0163.htm
- Kalbermatten, J. M., Middleton, R. and R. Schertenleib, (1999). *Household-Centred Environmental Sanitation*. WSSCC Working Group Environmental Sanitation, Switzerland. http://www.sandec.ch/EnvironmentalSanitation/Documents/Paper_Description_HCES_July99.pdf
- Moriarty, P. Butterworth, J. and C. Batchelor, (2004). *Integrated Water Resources Management and the domestic water and sanitation sub-sector*. Thematic Overview Paper. IRC International Water and Sanitation Centre, the Netherlands. http://www.irc.nl/page/10431
- Scott, C.A., Faruqui, N.I. and L. Raschid-Sally, (2004). *Wastewater use in irrigated agriculture: confronting the livelihood and environmental realities*. CABI Publications, United Kingdom
- Blumenthal, U. J. et al., (2000). *Guidelines for wastewater reuse in agriculture and aquaculture: recommended revisions based on new research evidence*. WELL Task 68 Part 1. http://www.lboro.ac.uk/well/resources/well-studies/full-reports-pdf/task0068i.pdf

Briefing Note source material by Stef Smits (IRC, The Netherlands). The full report is available at: at www.Lboro.ac.uk/well

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