Looking up the pipe and down the drain!

Positioning sanitation within Integrated Water Resources Management

A WELL study produced under Task A.3
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Smits, S.J. (2005) *Looking up the pipe and down the drain? Positioning sanitation within Integrated Water Resources Management*

WELL.

Contents amendment record

This report has been issued and amended as follows:

Revision	Description	Date	Signed
1	Draft 1	07-07-2005	J. Smet and P. Moriarty
2	Draft 2	06-09-2005	J. Smet
3	Draft 3	21-09-2005	S. Sugden

Designed and produced at WEDC/LSHTM/IRC

Task Management by Jo Smet (IRC)

Quality Assurance by Jo Smet (IRC), Patrick Moriarty (IRC) and Steven Sugden (LSHTM)

Summary

Sanitation aims to reduce pathogen transmission risks originating from human waste. Much of the effort therefore goes into providing people with safe and private sanitation facilities at the household level. However, little attention is given to what happens with the waste afterwards, as it goes down the drain, such as pollution through seepage from pit latrines or disposal of wastewater. Nor are many people concerned with the impacts and requirements sanitation may pose upon water resources, for example the need to flush. With the realisation that sanitation has impacts on the water cycle, and hence on the availability of water as a resource for other (competing) uses, water resources managers are increasingly being pre-occupied with sanitation, especially in the context of Integrated Water Resources Management (IWRM). Water supply and sanitation professionals therefore need to start considering the position of sanitation in the water resource cycle.

This paper elaborates the various linkages between different sanitation options and water resources. In addition, it drafts two principal ways in which the management of these linkages can be carried out. Firstly, the authorities responsible for sanitation (often local governments) need to engage with water resource management institutions which are currently being established in many countries. Secondly, principles of IWRM can be more consistently applied in the sanitation sector. A number of organisations have turned IWRM principles into more practical guidelines which can be applied to sanitation. These approaches are not mutually exclusive; in fact they need to reinforce each other in order to position sanitation more effectively into IWRM initiatives.

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Abbreviations and acronyms

EC	European Commission
HCES	Household Centred Environmental Sanitation
IRC	International Water and Sanitation Centre
IWRM	Integrated Water Resource Management
JMP	Joint Monitoring Programme
lpcd	litres per capita per day
MDG	Millennium Development Goal
ODA	Overseas Development Assistance
UN	United Nations
VIP latrine	Ventilated Improved Pit latrine
WFD	Water Framework Directive
WHO	World Health Organisation

1. Introduction: why sanitation needs to be positioned in the water cycle

1.1 Sanitation

There are various definitions of sanitation but most commonly, sanitation services are understood to be those which aim to remove and dispose of human waste (excreta and urine) and wastewater (including grey water) in such a way that it creates convenience and privacy for the users, and creates a hygienic environment which reduces the risks of pathogen transmission from human waste. As the definition of the Joint Monitoring Programme (JMP) of WHO/UNICEF states: “*excreta disposal systems are considered adequate if they are* ***private*** *and if they* ***separate*** *human excreta from human contact”* (JMP, 2005). Others include in the definition the removal and disposal of stormwater, hospital waste, industrial waste and solid waste. This report mainly focuses on human waste.

Preventing excreta from entering into the environment is a key barrier to pathogen transmission. A first step in this is having a safe and adequate disposal and evacuation facility for faecal matter at the household level. But, that is often not the end-point of faecal matter, as it may enter the water and soil system. Safe sanitation services must consider the entire chain of evacuation, collection, transport, treatment, disposal and reuse of human waste and wastewater, where they are relevant.

1.2 Water resources

Sanitation cannot be developed without considering water supply and water resources. Impacts on health can best be achieved through the combination of safe drinking water, sanitation and hygiene behaviour (Van Wijk, 1998).

Sanitation is an integral part of the water cycle. Therefore, the traditional approach has been to develop water and sanitation as an integrated process of abstraction, treatment, distribution, use, evacuation, collection, transport, treatment and disposal (see Figure 1).

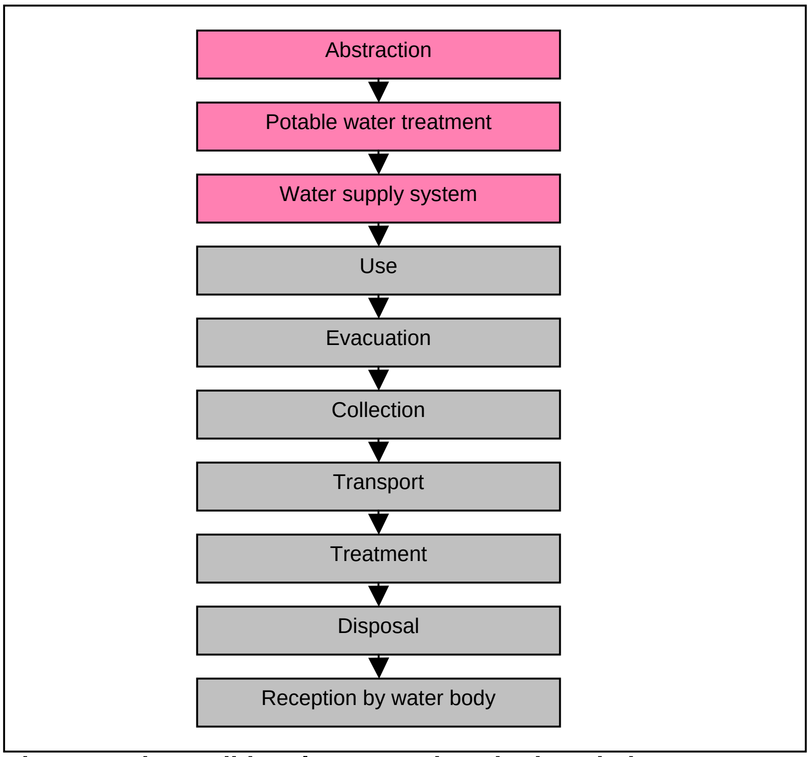

Figure 1: The traditional water and sanitation chain

With increasing population pressure, growing urban areas, poor functioning of sanitation services and competition over scarce water resources, this conventional practice is being questioned. Many people consider that using large amounts of potable quality water to transport human waste is inefficient and ineffective (Moriarty *et al.*, 2004). These water resources could moreover have been used for other beneficial uses. Using water for sanitation has a substantial opportunity cost, as well as a financial cost, especially when drinking water is used to flush away faeces.

Due to the impacts of sanitation on water use and quality, the water and sanitation sector needs to broaden its focus to consider the water resources it is using and polluting. This requires both looking up the pipe and down the drain.

1.3 Integrated Water Resource Management

The Integrated Water Resource Management (IWRM) paradigm has emerged over the last decade as a response to the global water crisis. It is based upon the understanding that water, as a finite resource, moves though its natural cycles and the various anthropogenic cycles of abstraction, use and disposal, in which it has competing values. Despite the fact that many definitions of IWRM exist, they are characterised by a number of common principles:

- Equity – to promote more equitable access to water and the benefits derived from it
- Efficiency – to ensure that water is used efficiently and for the greatest benefit to the largest number of people
- Sustainability – to achieve sustainable use of water, including that for the environment.

There are various interpretations of what IWRM means in practice. It is often understood as the establishment of policies, regulations and institutions for water resource management. This is what Moriarty *et al.* (2004) would call the “full” or institutional-based approach to IWRM. At the same time, it can be argued that it is also about applying the principles of equity, efficiency and sustainability in one’s own work and mandate, often at a lower level like a village or within a municipality. This is what Moriarty *et al.* (2004) call the “light” or principle-based approach to IWRM. Both are equally important and necessary to achieve the aim of IWRM.

1.4 Sanitation in IWRM

A number of national water resource policies directly or indirectly consider sanitation and more specifically the pollution it causes. For example, the European Commission (EC) in its Water Framework Directive (WFD) puts pollution management central to water resource management (EC, 2000). In other countries, similar policies are being put in place, e.g. in South Africa where the National Water Resources Strategy states that pollution effects should be considered in the design of facilities (DWAF, 2004). It is expected that IWRM policies will be developed in more countries, dealing explicitly with the externalities caused by sanitation.

However, so far, the water and sanitation sector has not engaged sufficiently with IWRM (Moriarty *et al.*, 2004) and the linkages between sanitation and water resource management are often not made explicit. This applies at both policy and operational levels. Even the Millennium Development Goal (MDG) aimed at reducing the number of people without access to sanitation focuses on the collection, treatment and disposal of human excreta and the drainage and disposal of household wastewater (UN Millennium Project, 2005). Sewage effluent management is specifically not part of the MDGs (UN Millennium Development Project, 2005), although, in the critical review of the monitoring of the MDGs, a call is made to include a consideration of the management of waste when looking at access to sanitation (UN Millennium Development Project, 2005).

Box 1: National Sanitation Strategy of Bangladesh
This recent strategy puts environmental integrity forward as one of the 15 guiding principles for sanitation development. It states that “*sanitation services that have*

unacceptable impacts on the environment, particularly pollution of water resources, will not be considered adequate" (Ministry of Local Government, Rural Development and Cooperatives, 2005). However, no clear guidance is given on what this environmental integrity means in practice, or how it can be planned and managed.

2. The water and sanitation chain in the water cycle

The water and sanitation chain links with the water resource cycle at two points: the point of abstraction and the point of disposal (see Figure 2).

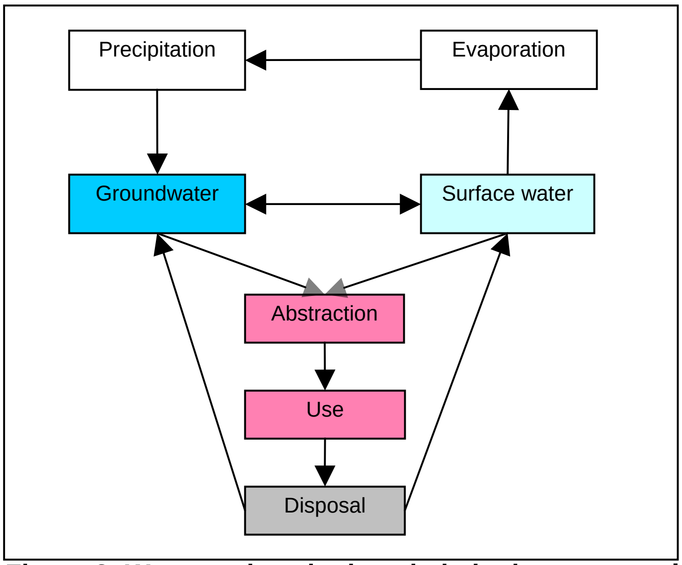

Figure 2: Water and sanitation chain in the water cycle

However, the specific linkages differ from case to case. These, to a large extent, depend on the type of sanitation in question, especially whether it is dry or waterborne (i.e. whether water is needed to flush away human excreta) and whether it is on-site or off-site (i.e. whether human excreta is transported away from the household).

The following main interfaces between the water cycle and the water and sanitation chain can be distinguished:

Water demand

- Water demand in relation to different sanitation options
- Water supply for sanitation from various resources, including rainwater and grey water

Pollution

- Groundwater contamination
- Sewers and their management
- Treatment options and impact on water resources
- Reuse of wastewater and grey water

2.1 Water demand and use in sanitation

Water demand for sanitation depends to a large extent on the type of sanitation technology used. There are also differences between models of toilets used in different countries. The table below shows some indications of the amounts used per flush in water-borne sanitation:

Table 1: Water required per flush for different sanitation options

Sanitation option	Amount of water required per flush
Urine diversion toilet	No water required

VIP latrine	No water required
Pour flush toilet with septic tank	2-5 litres (Brikké and Bredero, 2003)
Dual flush system	4.5 - 6 litres for normal flush and 3- 4.5 litres for a reduced flush (Cummings, 2001)
Low-flush toilets	6 litres in the USA (WaterWise, 2005)
Full-flush toilets	13,3 litres in the USA (WaterWise, 2005) 9 litres in Germany (Zifu, *et al.*, 2002)

These figures need to be put into perspective compared to other water demands. The Design Manual for Water Supply in India suggests 18 lpcd (litres per capita per day) as a guideline for sanitation using pour flush toilets, accounting for about 20% of water consumption (Smet and Van Wijk, 2002). In Australia, until the introduction of low flush toilets, sanitation accounted for about 30% of household water consumption (Cummings, 2001). An average of 35 lpcd, (29% of total water consumption) is used in the Netherlands (VEWIN, 2005). It can be concluded that at household level, water use for sanitation is relatively significant.

At a global level, the amounts required for sanitation initially seem to be low. Domestic uses of water account for about 10-20% of total water uses globally, whereas agriculture accounts for 60-80%. If all households had flush toilets, total sanitation demand could rise to 2-6% of total global water use. However, as many households have “dry” sanitation facilities or no facilities at all, total water use for sanitation is probably less than 1% of total global water use. However, at the local level, the demand for sanitation may still be significant. Sanitation technologies which require the most water (i.e. full-flush toilets) are particularly found in large cities. Some mega-cities already put a huge strain on water resources in the regions where they are located. Here, sanitation demand makes up a relatively large proportion of local demand for water, affecting other users of water. In addition, it should not be forgotten that every litre of water abstracted for use in sanitation will in turn become a litre of wastewater.

Even when water resources are in abundance, it does not necessarily mean that these should be used to flush toilets. An increasing number of people and organisations are advocating dry sanitation, to reduce the demands on water resources (Moriarty *et al.*, 2004), although this is far from a mainstream approach. If wet sanitation is already in place, or is the preferred solution by users, emphasis can be put on demand management, e.g. use of water saving technologies such as low flush toilets. In Australia and Singapore for example, low flush technologies have become mandatory (Cumming, 2001) resulting in a reduction in water use for flushing. In many places, the amounts of water provided are based on actual requirements for sewers to operate. Small-bore sewers require less water, as they do not transport the solid parts of human waste. Installing small-bore sewers can reduce water demands for sanitation.

Box 2: Rainwater for school sanitation

In Chacón Nuevo, a village on the Colombian Pacific coast there is no water supply system. Few houses have toilets, but those that do have flush toilets, including the toilets at the school. This is made possible by connecting rainwater tanks to the flush toilets. With over 3,000 mm of rain per year, water resource availability does not pose a problem.

Source: Vanin and Smits, 2002

Water for sanitation does not necessarily have to come from the (piped) domestic water supply system. Trials have been carried out using alternative sources of water, especially rainwater, and to a lesser extent, grey water which reduce the demands on water supply systems. Moreover, flushing toilets do not require potable water quality. For an example of using these “alternative” sources, see Box 2.

2.2 Pollution

When looking at pollution generated by sanitation, the following parameters are of importance:

- Microbiological contamination – this is what sanitation is all about: reducing faecal-oral transmission of pathogens.
- Organic matter – the main issue here is that organic matter will become oxidized, hence extracting oxygen from water. Reduced oxygen concentrations in water have a negative affect on aquatic life.
- Chemical matter - especially nutrients such as nitrogen, phosphorus and heavy metals. Increased nutrient levels may lead to eutrophication. Heavy metals and other chemicals can be highly toxic for aquatic life and humans.

2.2.1 Groundwater pollution from on-site sanitation

The risks of aquifer pollution are affected by groundwater hydrology although pathogens only travel at the same rate and distance as the water in which they are suspended. In the unsaturated zone, water travels very slowly along the surface of the soil particles, whereas it flows rapidly through the soil pores in the saturated zone. On-site sanitation systems rely on the capacity of the effluent to be purified in the unsaturated zone.

The key factor that affects the removal and elimination of bacteria and viruses from groundwater is therefore the maximum effluent residence time between the source of contamination and the point of water abstraction. The low velocities of unsaturated flow mean that the unsaturated zone is the most important line of defence against faecal pollution of aquifers. Commonly used guidelines in many soil conditions keep the bottom of the pit at least 2m above the water table, and at least 15m from any well used for drinking purposes. Where these conditions cannot be ensured, the choice of sanitation technology should take into account the risks posed by the available alternatives (adapted from Cave and Kolsky 1999).

2.2.2 Sludge and urine

Another issue is the management of the sludge when pits get full, for which there are a number of options: closing it off and building a new one, emptying it by hand, or emptying it by a small mechanical device or tanker (Brikké and Bredero, 2003; Pickford and Shaw, 2002). When it is emptied by hand, there are obvious high risks of faecal-oral transmission to the workers, which are reduced by using a vacuum tanker or mechanical device. The second issue to consider is what to do with the contents of the pit, and the risks associated with the method of final disposal. Different categories of disposal can be distinguished, based on Brikké and Bredero (2003) and Pickford and Shaw (2002):

- Disposal on land. This can only be done when left untouched for about 2 years. However, there are risks associated with this, especially when in contact with water, which may transport the pathogens. A variation to this theme is the ArborLoo. Once the pit is full it can be covered and a tree planted on top of it (Morgan, 2004).
- Treatment and disposal. Contents of latrines may be added to wastewater treatment works.
- Composting and biogas. Urine diversion toilets and composting toilets lend themselves well to producing dry faecal matter which can be turned into compost for use in agriculture. For VIP latrines this may not be directly possible because of the high humidity of the content. By adding vegetable waste, compost may be made.

Box 2: Bribes for sludge
In Tamale (Ghana) often tanker drivers are bribed by farmers to dump sludge on their lands. Farmers believe that this enhances the soil properties and adds organic matter to their land. However, the untreated sludge poses health risks for those farmers and the consumers of their produce. So far, no detailed data exists on these health impacts. Some suggest that this may be a safe practice when it is done at the beginning of the dry season. In the dry climate the sludge can dry and pathogens may get killed. No research has been done in Tamale to test this hypothesis.

Once dried and adequately stored (depending on storage conditions, it may be more than 12 months), human waste can be applied to the soil to improve soil characteristics by adding nutrients and organic matter. A number of organisations are involved in research on ecological sanitation, with various results suggesting positive impacts on soil characteristics, e.g. GTZ (2005).

Urine can be separated from excreta in urine diversion toilets. Various experiments are being carried out with the use of urine in agriculture. Although urine contains nutrients and does not contain pathogens, still, this practice is not common.

A major consideration when planning these such sanitation systems is whether there is any land and farmers available who are willing to take part in this. In urban areas, land availability and therefore disposal of the contents of urine diversion systems could be a problem

For water resources, the main risk is from microbiological contamination of groundwater (and open water bodies) when sludge is not properly disposed of. The contamination process and its impacts are similar to those described above for the pits themselves.

2.2.3 Septic tanks and other forms of waterborne on-site sanitation

Many of the issues relating to contamination from “dry” sanitation also apply to water-borne on-site sanitation options. In many cases the risks for water resources are even higher, because larger amounts of water are involved. In addition, septic tanks are usually connected to a soak-away or drainage field. This means that the chances are higher that contaminated water reaches the saturated zones. In some cases in the Middle East, people make their septic tanks leak, reducing the frequency of emptying and hence the associated costs. Obviously, this contaminates groundwater flows and the extent to which this poses a problem for other water users again depends on the distance to points where groundwater is extracted for other uses and the site specific soil properties.

For emptying septic tanks (which needs to occur every 5 years) a vacuum tanker takes the sludge for either treatment or disposal. Similar management options exist for the sludge of septic tanks as for latrine contents, but the risks are greater, because sludge is concentrated at one single point. Often, sludge from septic tanks is dumped illegally in open sewers, on open land or in wastewater treatment systems, all having associated risks for downstream users.

Where many septic tanks exist or are being planned, careful attention needs to be paid to their emptying, including the availability of a sufficient tankers, suitable treatment and/or disposal sites, and the potential downstream impacts of those sites.

2.2.4 Sewers

Sewers are often not a main source of pollution. They are just the conduit to bring faecal matter back into the water cycle. The only potential direct pollution which may be caused by sewers is through leakage. Again, similar mechanisms apply as those for groundwater contamination from latrines. Leaking sewers may cause microbiological contamination of groundwater abstraction sites. Cross-contamination of piped water supply systems operating under inadequate pressure from sewer systems is also a common risk. Local conditions, such as soil characteristics, the volume of leakage and the concentration of pathogens will determine the extent of the problem.

More important is the fact that sewerage systems usually collect all types of waste and water. Household wastewater may be combined with industrial and hospital waste. Stormwater may come into the sewerage network, collecting other waste on its way. Finally, solid waste and illegally dumped sludge from septic tanks may also end up in the same sewers. This may lead to sewage with a wide variety of pollutants, including microbiological contamination, solid waste, heavy metals and other toxins and biologically hazardous waste from hospitals. In Kumasi (Ghana) for example, the city's sewer system brings together the effluent of households through conventional sewers, the untreated effluent of breweries through drains, stormwater, faecal material from open defecation and all kinds of other waste via open drains (Agodzo *et al.*, 2003).

A general rule of thumb is that waste flows should be as concentrated and homogenous as possible for effective and efficient treatment. If stormwater is collected and disposed off separately from wastewater, for example, it means that the stormwater can be discharged directly into water bodies or used for recharging groundwater, and that only small amounts of wastewater need to be treated. In the European Union, much attention is therefore paid now to the separation of stormwater and wastewater sewers. For example, in Belgium, guidelines are being established for municipalities to start separating the two flows (van Gils and Hanegreefs, 2003). Equally, it will be easier to separately treat the relatively small amounts of hospital and industrial waste instead of combining it first with household waste, and then treating it together. Not separating waste flows may lead to plants functioning sub-optimally or even breaking down, with increased operational costs.

So, the way sewerage systems are designed and used will determine the characteristics (quantity, quality parameters, fluctuations, etc) of the effluent, and hence the management options of this effluent. If a reduction of pollution on downstream water resources is planned, this should not only be found at the source, but also in the way different waste flows are managed. This is again an area where the sanitation sector can contribute to improved quality of the water resources.

2.2.5 Treatment and disposal

Once wastewaters are produced and collected in sewerage systems, then treatment and disposal becomes a necessity. The objectives of treatment are many but typically include one or more of the following:

- the removal of microbiological contamination, preventing human waste coming into contact with humans via open water bodies;
- the improvement of the health of open water bodies, as nutrients and organic matter in wastewater will affect the quality of river water if not treated sufficiently; and
- the removal of other hazardous substances such as heavy metals or hospital waste.

In wastewater treatment design, three levels of treatment are distinguished (Metcalf and Eddy, 1991):

- primary treatment: removal of floating and settleable solids;
- secondary treatment: removal of organic matter; and
- tertiary treatment: removal of other constituents that are not sufficiently removed by secondary treatment, such as nitrogen or phosphorus.

There is a wide range of technologies available for these different processes, leading to different types of effluent in terms of water quality parameters (organic matter, microbiological contamination, heavy metals, etc). The level to which the removal of these substances is needed depends on the characteristics of the wastewater, the bio-remediation and dilution capacity of the receiving water body and the uses and users downstream. In reality, objectives of treatment are often set without considering the downstream uses.

Despite the fact that different technologies exist, still in most parts of the world, wastewater treatment occurs only to a very limited extent, with impacts on the environment, human, health and downstream livelihoods. As there are no completely reliable data on sewerage volumes generated and their fate (Scott *et al.*, 2004), water supply coverage rates are often used as a proxy to predict amounts of wastewater generated. The table below gives the best data there is on wastewater treatment:

Table 2: Treatment of wastewater

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

Source: Scott *et al.*, 2004

2.2.6 Reuse of wastewater

The main interest in sanitation by water resource managers relates to pollution prevention and the minimization of treatment costs. Reuse of wastewater is emerging as an important issue because it relates to both these concerns. In addition, reuse of wastewater may reduce the need to develop other fresh water resources for agriculture and this has therefore become an area of study in itself (Scott *et al.* 2004).

Van der Hoek (2004) gives a short typology of wastewater use:

- *Direct use of untreated wastewater*: the application to land of wastewater directly from a sewerage system or other purpose-built wastewater conveyance system.
- *Direct use of treated wastewater*: control exists over the conveyance of wastewater from the treatment works to a controlled area where it is used for irrigation.
- *Indirect use of wastewater:* irrigation from a water body that receives wastewater flows which may be treated or not, but is partially diluted in the receiving water body.

Further to this typology are a number of other key points to assist in analysis of wastewater reuse practices. These include (based on Scott *et al.*, 2004):

- *Livelihoods*: Most of the wastewater irrigation is market oriented (cash income), growing relatively high value crops such as vegetables. Besides, it is quite labour intensive, and for example, in Ghana, much of the labour is female (Keraita and Drechsel, 2004). In addition, indirect employment as a consequence of wastewater irrigation is significant.
- *Availability of other sources of water*: In many places farmers use wastewater because it is the only source of water available.
- *Reliability of wastewater flows*: Even where other sources of water are available, wastewater flows have the advantage of being more or less constant and reliable throughout the year, whereas “natural” water sources may be variable due to the weather regime.
- *Nutrients in wastewater*: Although it is often stated that farmers choose to use wastewater because of its nutrient content, it appears to be a secondary driver for choosing this source of water (Scott *et al.*, 2004).

Wastewater agriculture also poses risks to several groups in society:

- *Health risks for farmers and their families*: The exact health impacts may be difficult to assess, but when farmers are in contact with untreated or partially treated wastewater they are more likely to become exposed to pathogens (e.g. Agodzo, 2003). The World Health Organisation (1989) drew up guidelines for safe use in agriculture which are now being reviewed. As wastewater treatment is unlikely to be widely available in the foreseeable future, new guidelines need to offer practical and feasible solutions to minimize health threats. For a discussion on those, see Carr *et al.* (2004).

- *Health risks for consumers*: When crops that have been irrigated with polluted water are consumed raw they may expose consumers to bacterial and biological infections (Blumenthal et al., 2000).
- *Environmental risks*: These are likely to be posed not by the reuse of wastewater, but rather through the disposal of untreated wastewater. Agriculture may “absorb” part of this pollution and hence even reduce the environmental impact of wastewater disposal. At the same time, using wastewater for irrigation, may affect local soil properties, especially when the wastewater has a high salinity.

Reuse of wastewater poses a number of trade-offs which have to be carefully managed. Specific guidelines are for example given in the Hyderabad Declaration on Wastewater Use in Agriculture (IWMI-IDRC, 2002) or in (OPS, 2005)

2.3 Externalities and opportunities

Different elements of the sanitation chain create different externalities or impacts. At the same time, some sanitation options may create opportunities for others, e.g. through the reuse of wastewater or the use of sludge in agriculture. The extent to which these happen can be summarised as follows for the different sanitation options:

Table 3
: Externalities and opportunities of different sanitation options

	Urine diversion latrine	**Pit latrine**	**Pour-flush and septic tank**	**Full-flush with sewer**
Externalities				
Water use	-	-	+	++
Groundwater contamination	-	+	++	(++)
Contamination by sludge	-	+	++	(++)
Combination of waste flows	-	-	+	++
Pollution by wastewater flows	-	-	+	++
Opportunities				
Use of solid and liquid human waste	++	-	+	-
Reuse of wastewater	-	-	-	++

() = non-local

3. Managing the linkages

It has been shown that the way in which sanitation is planned and managed creates externalities which affect water resources. At the same time, sanitation is dependent to a large extent on this resource base, which makes the water and sanitation sector stakeholders in water resource management. The question is how can they play this role and engage with those entities responsible for water resource management? How can stakeholders negotiate the amounts of water available for sanitation, or discuss pollution control measures? But also, how can entities responsible for water resource management enforce pollution control? There are also various interventions that can be applied within the sector for a more integrated approach to sanitation. Both the above approaches are important but the emphasis between positioning sanitation better in the water resource platforms, or in applying an integrated approach within sanitation development, depends on the specific case.

3.1 Sanitation in water resource management platforms

Planning and managing sanitation services are usually the responsibility of local authorities. Local government takes a regulatory role while working together on water resource management with other stakeholders at local level, such as NGOs and the local private sector who may implement and even manage services.

For water resource management, a range of institutional models is present in different countries (Jouravlev, 2003; Smits and Butterworth, 2005 forthcoming). These are typically based at a catchment or regional level and may bring together different water using sectors, which coordinate water resource management among them. National government (sometimes in a deconcentrated form) normally retains final decision-making authority.

Looking at the role of local authorities in these different models, a number of critical lessons emerge in relation to sanitation (Smits and Butterworth, 2005 forthcoming):

- Local authorities often do not see the need for water resource management, as the water and sanitation chain is based on the idea of "the end of the pipeline" where waste is no longer the responsibility of the local authority. Water resource management entities, tasked with pollution control, may be more interested in getting local authorities on board than the other way around.
- In many countries, it is difficult for the government body responsible for water resource management to enforce control on another government body (e.g. local authority). Therefore the discharge of untreated wastewater may be forbidden but hardly ever enforced. Although there is pressure to highlight the pollution impacts of sanitation in water resource management, institutional and governance arrangements may hamper an integrated approach to this.
- Even if it is possible for one government entity to enforce rules and regulations from another body, politicization may hamper its effectiveness. Within catchment platforms, local government may be a powerful player, overriding the interests of less powerful downstream users.
- The different roles played by local government may give rise to internal conflicts and difficulties in negotiating them as a "package" with water resource management entities. The drive to increase sanitation coverage in the context of the MDGs may be contradictory to the need to reduce externalities caused by sanitation and it will therefore be difficult to reconcile these two roles within water resource management platforms.

3.2 Applying an integrated approach within sanitation

Because of the limitations of engaging with water resource management, an alternative can be to apply an integrated approach within the sanitation sector. Basically, this comes down to applying the 3 key principles of IWRM within the sanitation sector's own mandate: equity, efficiency and sustainability.

The principle-based approaches by the EC (EC 1998) provide a check-list of questions and answers for different phases in the project cycle, helping to analyse and formulate issues around impacts created by sanitation, and water requirements for sanitation.

Visscher et al. (1999) formulated working principles for integrating IWRM into water and sanitation projects (see Box 3).

Box 3: Working principles for IWRM and water and sanitation (Visscher et al., 1999)

1. Catchment management and source protection are essential to ensuring sustainability of supply
2. Water use efficiency and demand management must be addressed to minimise the need for new

source development
3. Multiple uses of water should be acknowledged and encouraged
4. All stakeholders should be involved in decision making, but particular emphasis should be put on the active participation of users
5. Gender and equity issues must be addressed throughout the project cycle
6. Water provision should be priced so as to discourage wasteful use, while ensuring the right to access of a necessary minimum for all.

The Bellagio principles (SANDEC/WSSCC, 2000) (See Box 4) change current approaches to sanitation into a more integrated approach.

Box 4: Bellagio principles (SANDEC/WSSCC, 2000)
1. Human dignity, quality of life and environmental security should be at the centre of the new approach, which should be responsive and accountable to needs and demands in the local setting.
2. In line with good governance principles, decision-making should involve participation of all stakeholders, especially the consumers and providers of services.
3. Waste should be considered a resource, and its management should be holistic and form part of integrated water resources, nutrient flows and waste management processes.
4. The domain in which environmental sanitation problems are resolved should be kept to the minimum practicable size (household, community, town, district, catchment, city) and wastes diluted as little as possible.

These principles have been taken a step further in the Household Centred Environmental Sanitation approach (HCES) (Kalbermatten *et al.*, 1999) in which waste management should be holistic and form part of integrated water resources, nutrient flows and waste management processes. It is argued that the HCES approach and the application of IWRM principles contributes significantly to a reduction in externalities caused by sanitation.

Taking into account these different approaches, the following set of guiding principles for the sanitation sector in relation to IWRM is proposed:

1. Planning sanitation services must take into account sustainable access to water resources and water supply services that are to be used for sanitation services
2. Water use, efficiency and impact on water resources must be considered in planning sanitation services
3. Multiple (alternative) sources of water for sanitation services should be considered
4. Possible pollution from sanitation and subsequent waste management should be assessed and reduced
5. Reuse of desiccated waste products should be acknowledged and appropriately managed
6. Waste flows should be separated and concentrated as much as possible.
7. Current and future downstream water uses, and self-purifying capacity of receiving water bodies should be reflected in the objectives and operational planning of treatment facilities
8. Reuse of wastewater should be acknowledged, and steps taken towards its management, in agreement with the Hyderabad declaration
9. All stakeholders should be involved in decision making, with particular emphasis on the active participation of users, and the establishment of linkages with other stakeholders involved in water resource management
10. Gender and equity issues must be addressed throughout the project cycle

Conclusions

The sanitation sector is busy scaling up the delivery of sanitation services. However, the tendency is to focus only on household level, facilities and less so on the subsequent management of waste. In rural and low-income urban areas this is also where the current priority is, in line with the HCES approach. However, as urbanisation grows, so water-borne sanitation becomes increasingly important. Where dry sanitation or urine-diversion is promoted, there are issues of human waste management and its impact on the water cycle.

The main interfaces between sanitation and water are the demands that water-borne sanitation put on water resources and water supply services, and the pollution caused by managing human waste. Specific attention is given to the reuse of wastewater.

Managing the linkages between sanitation and water resource management can be done through two different but complementary strategies. The first one is to position the sanitation sector more clearly in water resource management platforms, requiring local government to engage more actively with water resource management entities. Secondly, within the sanitation sector, a number of principles can be followed that can guide a more integrated approach to sanitation.

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Annex 1: water and sanitation in the water resources cycle

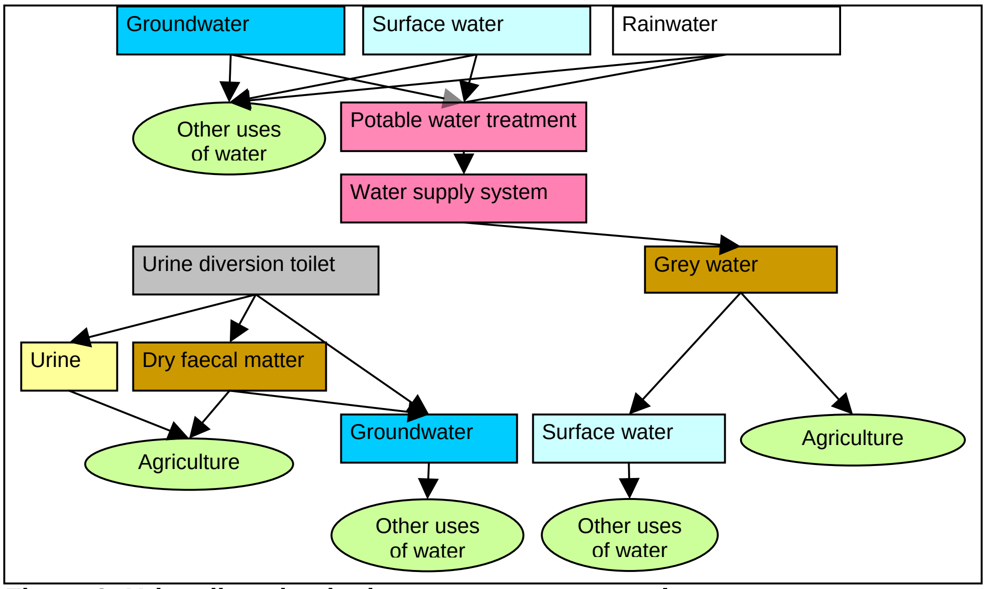

Figure 3: Urine diversion in the water resources cycle

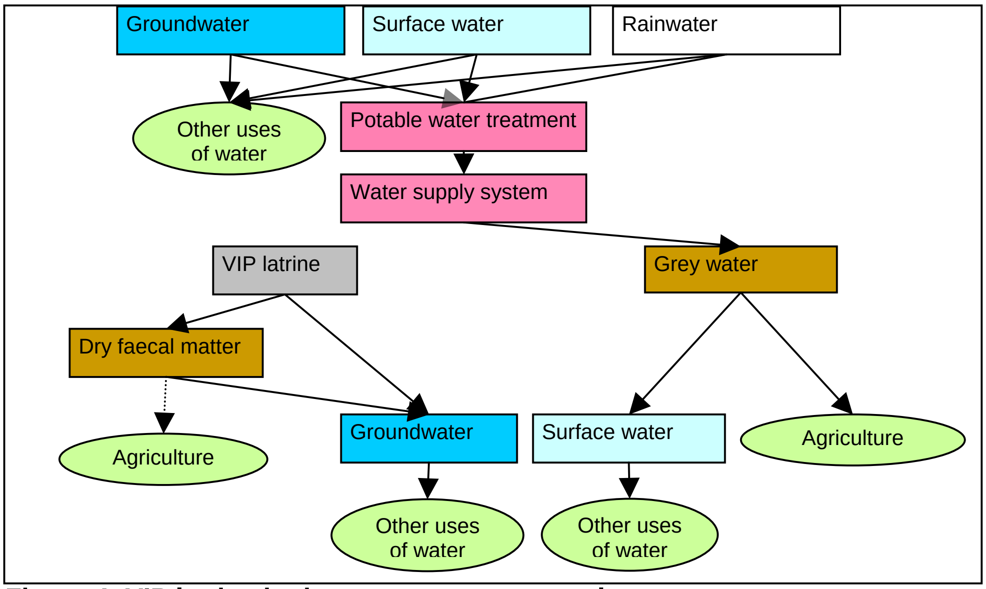

Figure 4: VIP latrine in the water resources cycle

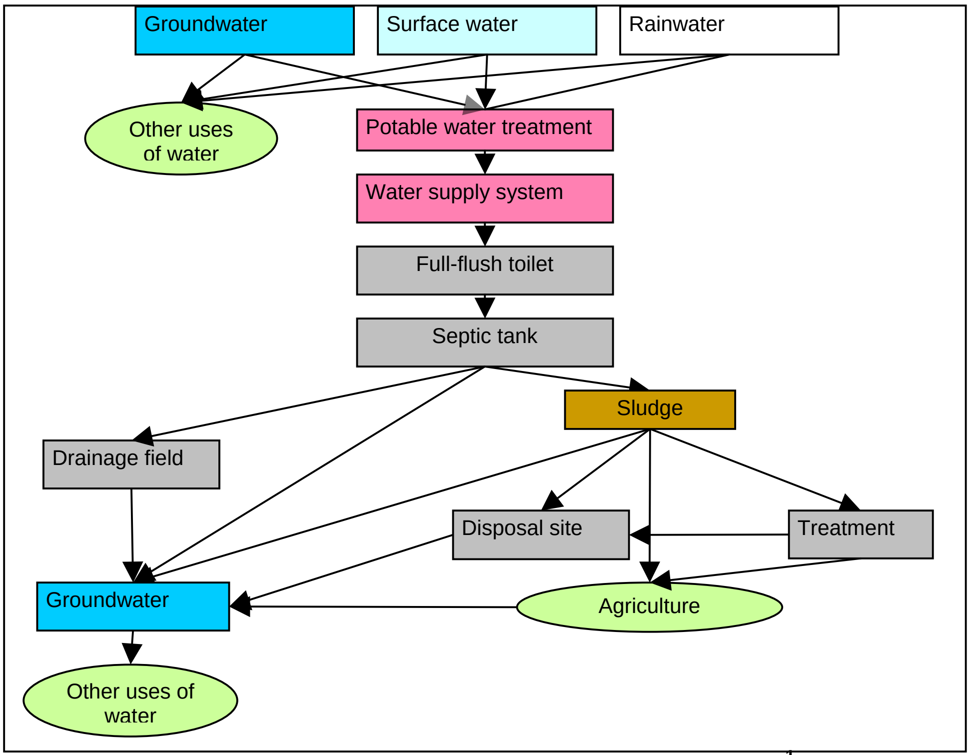

Figure 5: full-flush toilet with septic tank and on-site drainage[1]

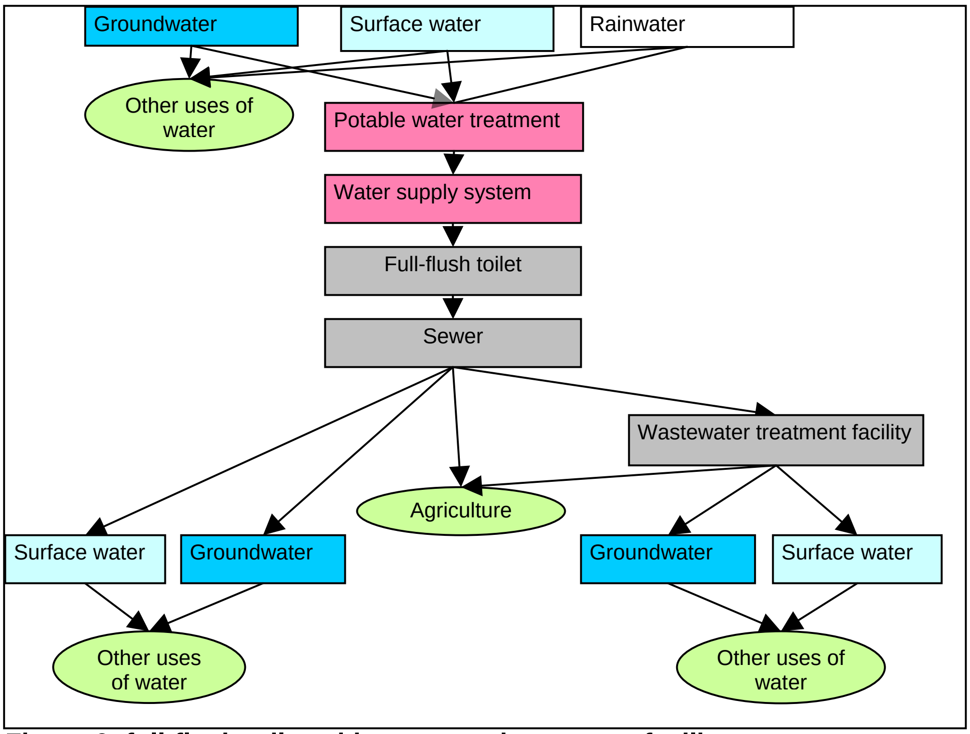

Figure 6: full-flush toilet with sewer and treatment facility

[1] The chain for grey water has been elaborated in the first two figures and is not repeated here.