

Sanitation in Developing Countries: Innovative Solutions in a Value Chain Framework

Meine Pieter van Dijk
UNESCO-IHE Institute for Water Education
DA Delft
The Netherlands

1. Introduction

There are a number of new ways to look to sanitation issues in developing countries, which will be discussed in this paper:

1. *Look as shit as an asset, the beginning of a whole sanitation value chain*
2. *Emphasize the role of the private sector in sanitation, in particular small scale private enterprises*
3. *Pay attention to the economics of investing in sanitation*
4. *Increase the efficiency of the sanitation value chain*
5. *Look at advantages of small scale decentralized versus large scale centralized waste water treatment (WWT) plants*
6. *Considering sanitation as a multi-governance challenge*
7. *Consider the economics of different technological options for sanitation*
8. *Incorporating informality in the sanitation sector*
9. *Tap alternative sources of finance for sanitation*
10. *Be aware of the politics of sanitation*

2. Faeces as an asset, the beginning of a whole value chain

We suggest looking at sanitation as a possibility to make money and will study a number of cases where this is actually happening. In scientific terms this may be called: “resource oriented decentralized sanitation”.

In order to achieve the Millennium Development Goals with respect to drinking water and the Johannesburg Plan of Implementation with respect to sanitation, a different approach to these problems is required, including a role for innovations and the private sector, in particular for financing a different approach to sanitation and to provide an alternative for inefficient public schemes. The drinking water and sanitation situation in African slums depends to a large extent on the socio-economic characteristics of the population, such as their income level.

Drinking water issues receive generally much more attention than sanitation issues. The fact that the number of people with no access to toilet facilities is twice the number of people having no access to safe water is the proof that sanitation is very much neglected.¹ Several reasons can be mentioned why not enough attention is paid to sanitation. In the first place most people consider drinking water a priority but they don't always see the need for proper sanitation. Similarly people are willing to pay for drinking water, but are much more reluctant to invest in proper sanitation and pay for using toilets. Connection fees for sanitation also tend to be higher than for drinking water, if only because it is more difficult to recover the investments later, which is certainly easier in the case of drinking water.² In the third place drinking water supply is more often characterized as a natural monopoly and hence considered the responsibility of the government. However, if we look at shit as a resource that can be exploited, more investments will come forward.

There are different definitions of sanitation (table 1) and there are many different types of toilets. In table 2 we list criteria for the classification of these toilets, without being exhaustive. To keep it simple we don't mention the management structure, the cost recovery approach or the scale of the facility. Sanitation is defined as safe collection, storage, treatment and disposing in a hygienic way of waste, including human excreta (faeces and urine), household waste water and rubbish at an affordable rate in a sustainable manner. We will deal mainly with the disposal of human excreta (improved sanitation) and leave out what is sometimes included in the wider definition of sanitation (see table 1).

Elements of sanitation	Proposed solutions	Covered by Johannesburg plan of implementation	Covered by Joint monitoring program of UNICEF-WHO
1. Human excreta	Provide access to toilets	Yes	Called Improved sanitation
2. Household waste water	Remove used water from within households	Yes, together with human excreta called Basic sanitation	No
3. Storm water	Collect and transport	No	No
4. Other sewage effluents to be treated	Reclaim used and dirty water by removing pollution	No	No

Table 1. Different definitions of sanitation

Later on we will distinguish seven types of toilets, but there are of course combinations of the different types listed different varieties exist, like simple pit latrines, or dry urine diversion toilets. The bottom line is that there is enough scope for unbundling in the sanitation value chain and competition and that we have to find the optimal solution for a specific situation.

¹ Water and sanitation are linked because contaminated water may result in water borne diseases, such as viral hepatitis, typhoid, cholera, dysentery and other diseases that cause diarrhea. Without adequate quantities of water for personal hygiene, also skin and eye infections, particularly trachoma, spread easily. Finally, drinking water can contain high amounts of harmful chemicals, such as arsenic and nitrates, which can lead to diseases.

² In the Buenos Aires concession a water connection would cost the equivalent of 500 US\$, while a sanitation connection would cost twice as much.

Three different stages in the case of sanitation can be distinguished, before the product (the raw material) can be 'harvested and manufactured'. They should be separated in the sanitation value chain (figure 1):

1. Building toilets, going for individual or collective solutions (see table 2)
2. Operation and maintenance can be outsourced to small enterprises and also emptying and transport can be done by small private operators
3. Recycling can be done by separate actors, preferably also local enterprises

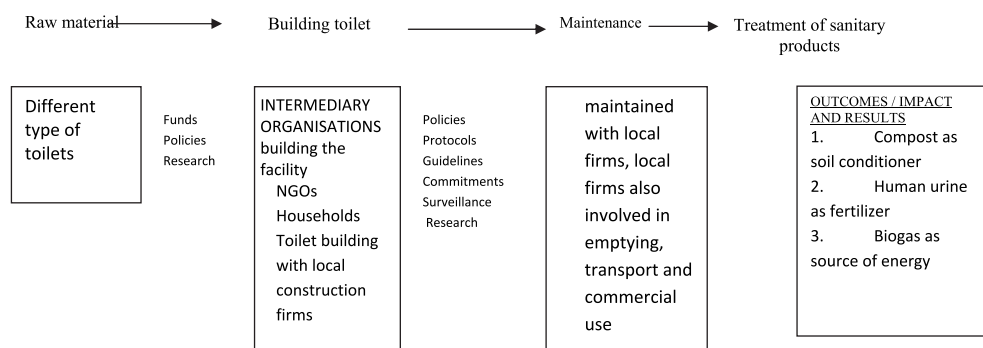


Fig. 1. Three levels for unbundling in the sanitation value chain

Figure 1 shows that at each level different operators can be effective and encouraged. Pit latrines need to be built, maintained and emptied. The product can be used for composting, biogas or as fuel, but rarely the activity is considered as a value chain, where each stage built on the previous one and the advantages need to be distributed over the chain in case the chain is upgraded. Upgrading means stimulating the local construction of certain types of toilets, facilitating emptying services and promoting the processing of sanitary products. There are places in the world where there is a whole economy around sanitation, creating employment and income opportunities.

Criteria	Drinking water	Sanitation
Connected to piped system	Individual drinking water connection	Individual sewer connection
Individual or collective	On site or no on site solution	On site or no on site solution
Dry or using water	No pressure, no ground water	Flushing, pour or dry toilet, using chemicals, charcoal or nothing. Also water less urinals to separate phosphor and nitrate
Urine diversion or not	Does not apply	Sophisticated solution
Simple or improved	Well or borehole	Bucket, pit latrine (often inadequate) versus basic VIP latrines
Storage	Yes or no tanks	Septic tank

Table 2. Different criteria to classify technologies in drinking water and sanitation

What is interesting is that each option can be considered a different value chain, with its own operators, technology and distribution channel. Facilitating the supply of finance would be important for the users as well as the providers of these technological options. For that reason we will present alternative ways of financing for water and sanitation before drawing some conclusions from this study at the end of this contribution.

The importance of alternative technological options should be underlined. They provide an alternative to a full fledged sewerage system, which if installed in every African city would contribute to an even higher debt in foreign currency in many African country, given that steel and cement often need to be imported. Finally capacity building is extremely important, to allow local organizations and local small firms to carry out most of the work and to assure the necessary investments will have a maximum effect on the local economy and that they will also be maintained locally.

In sanitation we can distinguish the following technological options:

1. Ordinary or unimproved pit latrines, which is basically a pit with a seat in a shelter. They can be constructed by the people themselves, but may be poorly built and have problems with flies and stench. Small enterprises may do a better job
2. Bucket sanitation systems have the same problems and the buckets may fill rapidly and need to be emptied somewhere by someone
3. VIP or Ventilated pit latrines, where the pit is reinforced with concrete cover and a seat, where the air can circulate, while anti-mosquito screens keep out the flies. A high groundwater table would cause problems, just like a rocky soil.
4. Aqua-privy with on site disposal or simplified network to evacuate the liquid effluent which otherwise needs to soak away. The digester requires periodic emptying and some water is needed for flushing
5. Septic tank is similar to the aqua-privy with on-site disposal, but uses a full flush system. The system is expensive and requires emptying and sludge disposal
6. Intermediate (using less water) and full flush toilets where all waste goes to a sewer. These are expensive systems to construct, using a lot of water.
7. Eco-sanitation, for example composting and composting/urine diversion toilets

3. The role of the private sector in sanitation

Different arguments can be used to explain why private sector involvement (PSI) is better possible and more frequent in sanitation than in drinking water (Van Dijk, 2003). On theoretical and practical grounds it will be argued that there is even less of a natural monopoly in the sanitation sector than in drinking water. Besides the natural monopoly argument it is often said that water and sanitation are public goods, if only because of the negative external effects. Certainly a number of positive and negative external effects of drinking water and sanitation can be mentioned (see table 4). They differ for a chemical toilet or a pit latrine and vary from an open soak away pit to a septic tank. These external effects need to be taken into consideration when considering the choice of a technology.

Hence in many developing countries more can be left to private innovative solutions, often involving the small-scale local private sector. One reason why sanitation problems are often left to individual households, instead of expecting the solution to be supplied by the

government, is because many countries have adopted a strategy of decentralization and devolution for water supply and sanitation. The national government puts the responsibility for sanitation at the municipal level, but without providing the necessary means to lower levels of government for this purpose. This means not much is happening since we know that the investments in the construction, or rehabilitation of new water and sanitation systems is many times higher than what is required to extend or upgrade an existing system.

There are many examples of Private Sector Involvement (PSI) in sanitation. In Indonesia Public Private Partnerships (PPPs) in this sector started for example in the 1990s. The Indonesian president even promulgated a presidential decree to promote them (No. 7/1998) and the Asian Development Bank (ADB, 2004) provided technical assistance and loans for this purpose. Even in China in large cities like Chengdu (10.6 million) only about 80 percent of the inhabitants in the centre of the city are served by a piped centralized sewer system. On top of that, only 60 percent of the sewer produced finds its way through the system, because not all buildings are connected. Typically the situation in the periphery of Chengdu is the opposite. There only 20 percent of the area benefits from a networked sewerage system, while the other inhabitants and businesses have to find private solutions. China has a number of Build Operate and Transfer (BOT) contracts in the water and sanitation sector, many with local companies or investors, because this is a municipal responsibility (Tu Shan, 2006). In the case of wastewater treatment the Ministry of Construction has the lead and usually also manages to mobilize the partners and the necessary finance, also from the private sector.

Sanitation was defined and the challenges are listed in table 3. The problems have been classified as institutional, technical, social and financial (ADB 2007).³ They explain to a large extent the poor performance of many public authorities (table 3). A different approach,

<p>Institutional challenges</p> <ol style="list-style-type: none"> 1. No regulation to encourage proper sanitation practices 2. Weak institutional framework 3. Lack of clarity of institutional roles and responsibilities 4. Lack of focus on sanitation and waste water
<p>Technical challenges</p> <ol style="list-style-type: none"> 1. Water resource pollution 2. Deteriorating infrastructure 3. Low sanitation coverage
<p>Social challenges</p> <ol style="list-style-type: none"> 1. Unsustainable project outcomes 2. Community resistance 3. Low hygiene awareness
<p>Financial challenges</p> <ol style="list-style-type: none"> 1. Inadequate resources 2. Low or non-existent tariffs 3. Lack of financial sustainability

Source: ADB (2007).

Table 3. Main challenges in the sanitation sector in developing countries

³ One could add operational, commercial, human, and environmental problems.

stressing the ecological aspects of water and sanitation and trying to integrate the urban water cycle is desirable. It is important to consider how Small-scale independent providers (SSIPs) could help in fixing some of the problems mentioned in the table. As will be shown this may require a change in the institutional arrangements, a different look at the technical and social challenges and assistance to deal with the financial challenges in a very different way.

Now the role for the private sector in sanitation can be assessed. Subsequently data on the importance of small-scale independent providers (SSIPs) in the drinking water and sanitation sector will be reviewed. Then the issue how to improve efficiency in sanitation will be raised by looking at the possibility to unbundle this activity, to use technological innovations and to bring in more competition. Finally some dilemmas will be discussed related to the Millennium Development Goals (MDGs) and the role of the private sector in sanitation. If the MDG will not be achieved easily in the sanitation sector it is time for smart sanitation provision for slums and informal settlements.

Sometimes drinking water and sanitation activities are taken up simultaneously in private sector involvement projects. However, the drinking water component usually receives much more publicity (as was the case for the Buenos Aires concession for example). In other cases there is a management contract for sanitation, which doesn't draw as much attention as a concession contract for drinking water, because people do not really know who takes care of the wastewater and the contract period tends to be shorter. For example it is hardly known that the French water company Suez runs a number of wastewater systems in the United States (Mathews, 2003). The relative good performance of these systems is rarely mentioned in the critical discussions about the role of the private sector in water and sanitation.

The Global Water Initiative (GWI; www.globalwaterintel.com) concludes in its March 2005 issue that to date limited progress has been made towards the achievement of financing these MDGs. Only the Eastern Asian countries are ahead of the targets set in 2000, while Sub-Saharan Africa is falling far behind.⁴ Lack of clean water and sanitation is the second most important risk factor for people in developing countries, after malnutrition. Problems with public sector supply of water and sanitation services have led to the increasing awareness that more participation of the non state sector is needed in the provision of these services.

4. The economics of sanitation

Who bears the cost of sanitation? What investments are required for different options, ranging from piped systems to collective facilities? Is cost recovery taking place and are the funds used to improve the current system? Small amounts can support small systems.

Sanitation is not really a public good, since people can be (and are) excluded and the system is rivalled, meaning if some households use it the capacity may not be enough for

⁴ Several programs are active to help African countries to achieve these MDGs. For example the Water and Sanitation Program (WSP, based in Nairobi) with support from the Netherlands and other donors has studied in a number of African countries where they are and what still needs to be done (WSP, 2004).

everybody. One reason for the government to get involved would be the negative and positive external effects (see table 4). However, as such positive or negative external effects are not a strong reason to supply the services by the government. In fact the activity can be outsourced to the private sector and regulated by the government in such a way that these external factors are taken into account. In case of important externalities, there is the need to assure investments in the sector, over and above what private operators are doing because the socioeconomic benefits are larger than the financial benefits resulting from a private cost benefit analysis. Externalities may lead to formulating clear aims for sanitary systems, such as being attractive and hygienic. The challenge is then to make them also affordable to the population and easy to maintain.

Externality	Water	Sanitation
If piped system producing good quality is in place: positive effects	Better health Higher labour productivity	Improved health More dignity and security
If piped system is in place: negative effects	Chemicals in the environment	Such services require space and may smell
If no piped system in place: negative effects	May spread diseases Much time lost, often by women	Diseases can spread easily No dignity and security problems for women

Table 4. Positive and negative external effects of drinking water and sanitation

5. Increasing efficiency through unbundling, technological developments & competition

Increasing access to safe water and sanitation in peri-urban areas of large cities requires (a) increasing the efficiency of urban water supply systems and water demand management, and (b) developing and implementing new sustainable forms of sanitation, including eco-sanitation technologies. Although facilities for collection, treatment, and disposal of waterborne sewage also exhibit significant scale economies it is worth considering when decentralized systems and small-scale private sector providers can be used more. They usually involve other private actors and private capital, although sometimes the large-scale water treatment plants also attract private funding and management.⁵

Increased efficiency in sanitation can be achieved through involving the private sector, which through a combination of unbundling, technological developments and more competition can bring about lower tariffs. In other utility or network sectors these three factors have contributed to lower cost of service provision. For example all three factors have contributed to lower prices in the telecommunication and electricity supply sector and technological progress may currently change the drinking water sector, when desalination is really becoming competitive. The importance of these options in the sanitation sector will now be discussed.

⁵ Like for example a new wastewater plant in Harnas polder in the Netherlands, which is totally financed by private partners through a BOT formula

5.1 Unbundling

Increased efficiency in the utility sector is often a combination of unbundling, technological development and more competition (Van Dijk, 2003). All this is possible in the sanitation sector and makes the involvement of private sector operators more likely and more effective. They can be involved in small scale construction, or the maintenance and emptying of the sanitary facilities. Unbundling in the sanitation value chain is depicted in figure 1.

5.2 Technological progress

For sanitation, just like in the drinking water sector one can have at least ten technological options and continuing technological progress adds options to this list all the time. In the drinking water sector house connections and yard taps refer to different delivery modes (water vendors or public tanker trucks), wells (communal open or tube wells), tanks (in the yard or on the roof) and solutions outside the plot (water kiosks or communal standpipes). Each option has certain advantages and disadvantages and commands a price.

5.3 Competition

Economists argue that competition will improve the quality of a product or service and drive down the price. Competition in the sanitation sector is possible since in fact a dual system exists in the sanitation sector and different technological options are available. One finds at the same time on site sanitation and large scale centralized water treatment plants and hence there is competition. On site sanitation happens in the periphery of the big cities. The technologies range from pit latrines to the obligation to recycle grey water in each important urban project in the case of Beijing. This is done since piped sewerage system linked to waste water treatment plants are very costly.⁶ Because of the unbundling and the technological progress more competition is possible leading normally to lower prices and better services for customers.

6. Look at advantages of small scale decentralized versus large scale centralized WWT

Liang and Van Dijk (2010) have compared the economic cost and benefits of small scale decentralized versus large scale centralized WWT in Beijing and concludes that currently the decentralized systems cannot compete with the centralized because of subsidies and the low price of drinking water.

Big private international water companies are mainly interested in running large scale centralized water treatment systems, if they are combined with drinking water (making charging consumers easier), if they do not have to invest themselves (they do not consider themselves to be the bankers of the water sector any more), or if there is a possibility to recover the investments in another way (for example because a municipality pays for every

⁶ The duality in Beijing is emphasized by the obligation to reuse the grey water at the level of major construction projects (for example hotels or universities). It allows a comparison of centralized and decentralized water treatment options (Liang and Van Dijk, 2010).

litre of treated water). Attention has shifted from the big centralized systems to the potential of decentralized systems combined with small-scale sanitary improvements and in particular eco-san solutions. The latter allow people, enterprises, or neighbourhoods to take the initiative or participate in it.

To what extent do small-scale private individual providers or operators (SSIP) provide basic services like sanitation in developing countries (Collignon and Vezina, 2000)? Although there are usually economies of scale in networked systems, small-scale operators are tremendously important. The data presented in table 5 concern the role of SSIP in water services. The origin of the data is described in box 1.

The World Bank undertook a literature review of small-scale private operators of water supply and sanitation (Kariuki and Schwartz, 2005), defining small as less than 50,000 customers. The database (over 400 documents) is available under 222.rru.worldbank.org. The 400 documents reviewed provided evidence for about 50 countries and 100 different locations in these countries. In total some 10,000 water SSIP were identified, which maybe still only part of the total, given there are more countries and the SSIP sometimes are informal or illegal. Table 5 summarizes the findings.

Box 1. Data on small-scale private operators in water and sanitation

Both formal and informal small-scale independent private operators are considered, given that they are difficult to distinguish. In table 5 an estimate is provided of the number of people receiving services from SSIP and it is indicated in which regions this is most common. In both the drinking water and sanitation sector there are in fact dual systems and there are reasons to build on that reality, providing more space to the private providers and individual households.

Only 10 to 15 percent of the urban population in developing countries benefits from access to a sewer network according to WUP (2003). The rest depends on on-site or collective facilities. In case small-scale sanitation solutions are adopted, there doesn't have to be a private operator except may be in the construction phase, given the role of the community. When the alternative for a sewerage system is a septic tank or a closed pit latrine, the question of emptying those arises. This may be the responsibility of the household, of a private service provider, or a public operator. Unfortunately no detailed figures for SSIP in sanitation are available. Table 5 provides data for 33 cities concerning water SSIP. Per city the percentage of households being served by the SSIP is given. The huge variation between and even within countries strikes immediately, just like the importance of the SSIPs.

In Senegal, only 21 percent of the households in the capital Dakar are served by SSIP, while in Diourbel, a city more in the interior, it goes up to 90 percent! It usually varies between 0 and 30 percent. The role of SSIP in the water sector is most wide spread in Africa, while for South Asia SSIP are most prevalent in areas with low coverage levels and ineffective public utilities, in particular in India and Pakistan. Also they are important in remote areas. Kariuki and Schwartz (2005) have analyzed the features of these SSIP and classify them according to organizational form (cooperatives to private ventures), technology, staffing (usually less than ten employees), customer service and marketing, financing and pricing, sales and earnings. These activities tend to be outside the legal framework and production is usually

at a very small scale. However, a high proportion of local and often unskilled labour is involved and there are very low levels of initial investments. The conclusion is that SSIP are very diverse and often threatened by an extension if the coverage of the formal supply network is extended. The challenge is to consider SSIP as complementary and incorporate informality when formal supply of urban services is not adequate (Van Dijk, 2010). Part of the solution of the MDGs may come from these 'other sources' of supply.

Region and countries	Water SSIPs in	Households served by SSIP	Region and countries	Water SSIPs in	Households served by SSIP
Africa	City	Percentage	Latin	America &	Caribbean
Benin	Cotonou	69	Argentina	Cordoba	15 - 20
Burkina Fa	Ouagadougou	49	Bolivia	Santa Cruz	100
	Niangolo	68	Colombia	Barranquilla	20 - 25
	Bobo-Dioulasso	33	Guatemala	Guatemala	32
Ivory coast	Abidjan	35	Haiti	Portau-Prince	70
	Boundiali	50	Honduras	Tegucigalpa	30
Ghana	Kumasi	32	Paraguay	Asuncion	30
Guinea	Conakry	66	Peru	Lima	26 - 30
Kenya	Nairobi	60	East Asia	and Pacific	
Mali	Bamako	63	Cambodia	Ky Cham	50
Mauritania	Nouakchott	51	Indonesia	Jakarta	44
Niger	Guidan	40	Philippines	Manilla	30
Nigeria	Onitsha	95	Thailand	Sawee	10
	Ibi	40	Vietnam	Ho Chi Minh	19
Senegal	Dakar	21	South Asia		
	Diourbel	90	Mongolia	Ulaanbaatar	5
Sudan	Khartoum	80	Nepal	Kathmandu	5-7
Somolia	Ali Matan	10	Pakistan	Karachi	40 - 50
Tanzania	Dares Salaam	56	India	Delhi	6 -47
Uganda	Kampala	30	Bangladesh	Dhaka	14

Source: Kariuki and Schwartz (2005).

Table 5. Data for 33 cities concerning water SSIP

Poor people often pay a high price per litre because SSIP don't have access to subsidies and SSIP are unable to benefit from economies of scale. Nor can they assure the quality of their water. Externalities are not be taken into consideration by a private operator and hence the price is not reflecting the real cost. Price differences with the publicly supplied water range from 1.5 to 2.5 times the official public utility price, and may increase in times of scarcity. However, the key advantage of SSIP is that they deliver the water at home.

WUP (2003: 53) considers intermediate and independent service providers are filling the gap between the public suppliers and no supply. They suggest working with the local sub-network providers and water carriers and tankers to improve services. The small-scale

providers have the potential to become local private operators in small towns. Over time they can play a more important role in medium and large towns.

There are strong reasons to try to increase the role of the private sector operators as a percentage of total turnover in the water and sanitation sector and to encourage their development. The government could impose a specific status for these operators in the water and sanitation sector, giving them for example fiscal incentives and asking a certain quality of water in return. For quality and environmental reasons governments may not want to promote private operators and on site solutions in drinking water. However, given the size of the sanitation problem and the ambitious MDG in this respect, given the difficulty to recover the cost of sanitation and the huge amounts that need to be invested for onsite public solutions involving a network and centralized waste water treatment governments may still be inclined to promote the existing on site private sanitation solutions. Then it should provide more space to SSIP in the water and sanitation sector.

If drinking water resale initiatives and private sanitation solutions are encouraged it is important to raise the public awareness of health and hygiene issues and to clarify the respective roles of public and private players in the water and sanitation market. The OECD global forum on sustainable development also concluded that policies are necessary to enable the private sector to play a greater role in helping to achieve the MDGs.⁷

7. Multi-governance issues related to sanitation

Sanitation is embedded in governance structures and different countries have selected different solutions. Table 6 summarizes the major institutional arrangements. The question is: which structures work and why?

	Institutional arrangement	Drinking water	Sanitation
Solutions on the plot	Public	Piped connection	Sewerage network
	Private	Well or bore hole Home delivery	Not connected latrine, but f.ex. pit latrines
Not on site solutions	Public	Standpipes Public wells Uncontrolled sources	Government supported community toilets
	Private	Autonomous water kiosks	NGO supported community toilets Private paying toilets Uncontrolled

Table 6. Private versus public on site and collective solutions

How does the official municipal utility cooperate with the authorities dealing with the 'informal' solutions? As an example: in Uganda NWSC is responsible for piped sanitation, while the City council is involved in toilet projects with all kinds of NGOs. Is this working and what can we learn from such experiences?

⁷ 'Public-private partnerships in water supply and sanitation: trends and new opportunities' (www.oecd.org).

8. Consider the economics of different technological options for sanitation

Different toilets are available and different technologies have been suggested for waste water treatment. Which ones are doing better and why? Eco san solutions would also be considered. The different options in the water and sanitation sector are illustrated in table 2. Private sector involvement in sanitation has a double meaning. It means on the one hand that individual households need to find a solution for their sanitary problems. On the other hand the households may involve private firms for the construction or maintenance of the facilities. In the table we distinguish private versus public and on-site versus not on-site solutions. In the latter case these would be collective or community solutions (WSP, 1998).

For different reasons (see box 2) large-scale network sewerage solutions are too expensive to introduce on a large scale in developing countries. To achieve the relevant MDG a different approach will have to be taken.⁸ Since in a number of countries there is no separate institutional structure in place to manage sewer systems, it is often left to the drinking water companies to take care of this issue.⁹ In fact if the water companies can put a surcharge for sewerage on the water fee their financing problem will be partly solved (Pagiola and Platais, 2002). Otherwise we may have to rely more on small-scale independent providers in the case of sanitation.

1. The necessary steel and concrete often needs to be imported requiring foreign exchange and risking huge debts in foreign currency
2. The long term investments (50 to 100 years) are difficult to finance because no capital market for long term finance exists in most developing countries
3. It is more difficult to recover the cost in the case of sanitation than in the case of drinking water
4. Use need to be made of expensive consultants to design the system
5. Technicians tend to overdo the dimensions of the system to be able to deal with future extension and one time disasters
6. There is sometimes no sewerage system in place, or repairing the existing system would be very expensive because built under the ground fifty years ago
7. Network sewerage solutions need a lot of maintenance, which is often not budgeted for
8. There may be no institutional structure in place to manage sewer systems
9. The tendering system may not always be competitive and transparent
10. International contractors may be required given the scale of the projects

Box 2. Why large scale network sewerage solutions may be too expensive

⁸ In the framework of the European Water Initiative (EUWI) efforts have been made to start a dialogue in a number of African countries on how to achieve these MDGs with the involvement of all actors: local governments, non governmental organizations (NGOs) and the private sector. After organizing a dialogue, a road map, or sector plan would have to specify the minimum acceptable level of access to water supply and sanitation. Subsequently a Financing strategy is developed to indicate how these objectives can be achieved. The objective of such a Financing strategy is achieving MDGs through private sector involvement in water and sanitation, or by tapping as many sources of finance as possible.

⁹ Tunisia is an example of a separate National Sanitation Utility, which seems to work very well.

In sanitation competition also exists between informal and formal suppliers. The sanitation and drinking water sector in developing countries can be described at least as a dual system if 85 to 90 percent of the people in developing countries depend on private sanitary solutions and 65 percent on private water suppliers as is the case for example in urban Benin. Private water vendors play indeed an important role in supplying at the average 20 percent or more of the urban population in developing countries (World Bank, 1988). This implies that the role of the private sector is much more important than generally admitted. It competes with the relevant public utilities. The major mechanisms to achieve more efficiency in service delivery are the possibility of unbundling, technological progress and more competition. The factors influencing the choice of an appropriate sanitation solution are depicted in figure 2.

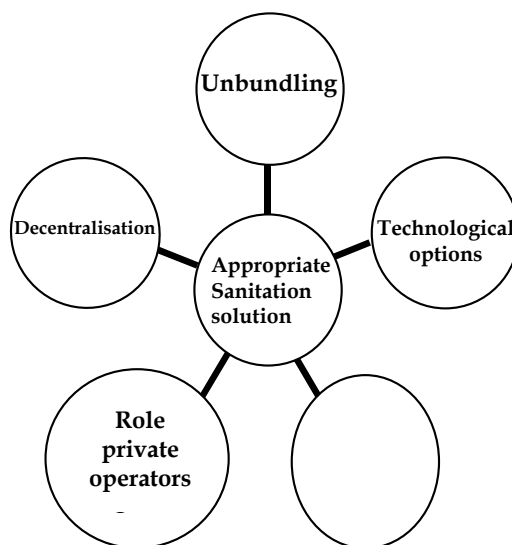


Fig. 2. Elements of an appropriate sanitation solution

9. Incorporating informality in the sanitation sector

Fransen et al. (eds. 2010) argue that if local governments cannot provide certain services they could facilitate other actors who do take up that challenge. The role of these non state providers is elaborated by Van Dijk (2008).

Liberalization is a process by which competition is introduced in situations or sectors hitherto characterized by exclusive or special rights, or monopoly, granted to historical operators. We argued that more competition is possible in sanitation and related activities than in the drinking water sector and hence different policies can be pursued. In fact competition is easier in sanitation than in drinking water and private solutions and PSI are more likely because there are no economies of scale, such as the ones existing in drinking water systems. Secondly, drinking water supply is more often characterized as a natural monopoly in the distribution system, which is not the case in sanitation, where there is a real dual system since often 85 to 90 percent of the urban population in developing countries

depends on private solutions. The natural monopoly can be overcome with common carriage¹⁰ and inset arrangements¹¹, which can create real competition and exists in several European countries (Van Dijk, 2003). In practice common carriage and inset arrangements make up only between 5 and 10 percent of the drinking water in countries like the Netherlands and England and Wales. However, through the possibility of inset arrangements regional monopolies do not work anymore. Even if currently its use is limited, the possibility to compete already limits monopolistic behaviour. The taste and quality of the water may be different in the case of sharing arrangements, and the responsibility for negative health consequences may become more diffuse in the case of inset arrangements. In drinking water it is not as easy as in for example the power sector to break natural monopolies by linking different networks.

10. Alternative ways of financing sanitation

The MDG for sanitation is to halve, by 2015, the proportion of people who have no access to basic sanitation. The estimated funding requirements range from US\$ 2.1 to 23 billion and when going beyond the more basic definition of urban service provision will cost even more. Already the Camdessus report in 2003 (Winpenny, 2005) had suggested an additional US\$ 32 billion a year and if a broader definition including treatment of all municipal and industrial wastewater and solid waste would be used US\$ 100 billion a year would be necessary. An overview of the progress with household sanitation in South Asia is provided by Sijbesma (2008).

Research should contribute to the development of an innovative approach to water and sanitation in African slums, which is not only cheaper, but also institutionally, environmentally and financially sustainable. It starts with identifying the institutional network for providing water and sanitation to the slums. What is the role of the government, of the private sector (small scale providers) and of NGOs? If their impact is limited, private solutions will dominate and the willingness to go for collective solutions needs to be studied.

We noted that large scale sanitation activities are difficult to finance, given the large amounts needed and the lack of cost recovery mechanisms. The private sector can get in if the projects are really conceived as economic investments with a return. This requires an emphasis on ways and means to finance sanitation services and recover the cost. Cost recovery is possible through:

1. Contributions from the people benefiting from the system, possibly in kind
2. Linking sanitation to drinking water
3. Charging connection fees
4. Asking small contributions to the necessary investments

¹⁰ The common carriage principle is also used for telephones and electricity, and tested for water in England and Wales. It means sharing the use of pipes (for raw water) and implies mixing different qualities of water.

¹¹ Inset appointments would allow in the UK under the original privatisation scheme, a new water or sewerage 'undertaker' to penetrate the area of an existing undertaker via this appointment (putting clean water in the network of another company).

5. Using private construction firms, and local small enterprises for building, O&M and for emptying and finally small enterprises for recycling the liquid waste products

Many alternative financial solutions have been suggested, ranging from cross subsidies to using micro loans to pay for connection fees (Winpenny, 2005). The bottom line is that some subsidy can be provided (for example cross subsidies for the poor) and the first 200 litres of drinking water can be provided for free (the life line approach), but if there is no money in the system, it will run dry. Sustainability involves not only environmental, but also institutional and financial sustainability. The issues of low household income, low social status of the customers and a limited degree of organization of poor people are linked with measurable consequences in terms of surface water pollution, poor health and a large number of children dying under such circumstances.

Decentralization requires more local revenues. However, the need for financial reform at the municipal level should be mentioned as a condition if municipalities want to qualify for loans to finance their infrastructure. Decentralization is the trend, but the financial means also need to be available at lower levels of government to carry out the tasks assigned to them. These means are often lacking.

More traditional sources of finance	More alternative sources of finance
Higher levels of government, financed out of tax revenues	Private sector involvement, for example through Public Private Partnerships & joint ventures
Project finance, with loans or bonds	Concessions, BOT (Build Operate Transfer), Design, Finance, Build and Operate (DFBO) and ROT (Rehabilitation Operate Transfer)
State Level Finance Institutions, or Municipal Infrastructure Development Funds: investment, capital funds, trust funds, or endowment funds	Microcredit to finance water and sewerage connections, or rotating savings and credit associations (ROSCAs) linking savings with credit
Hedging, using futures and options to cover risks	

Source: Van Dijk (2006).

Table 7. Innovative ways of financing infrastructure: water and sanitation

A solid and sound financial management system should comprise an improved municipal accounting system, but also a better budgeting system and budgetary control, improved internal control systems, internal audit systems and modern data processing facilities. A number of reforms at the municipal level are necessary for example to qualify for support in the framework of an urban infrastructure project in India

Different drinking water and sanitation options are available for the inhabitants, which can be introduced in other low-income neighbourhoods through NGOs or CBOs and local small scale private sector entrepreneurs. These 'private' solutions that people have chosen have their cost and need support from new sources of finance, such as the ones mentioned in table 7.

11. The politics of sanitation

For the improvement of sanitary services in developing countries different actors are important. Each one has its own specific interests and objectives which will try to achieve

them. The interests of the different actors: landlords, tenants, Ministries, NGOs, donors, international lending agencies, etc. They are likely to conflict and, as such, achieving these interests and objectives is subject to contestation. As different entities pursue their, possibly conflicting, interests the provision of sanitation services becomes an inherently political process. The dynamics of this political process underlying the provision of sanitation services, within a slum setting, has largely been ignored by researchers in this field. The sanitation crisis in slum areas has largely been perceived as either an issue of developing appropriate technologies or, in recent years, as an issue of creating demand for sanitation services. Once a sanitation coverage gap is established, efforts have to focus on raising resources to build appropriate facilities, coupled with sensitization and the job is done. This portrayal of slum areas is oversimplified and underestimates the inherent social complexities of providing sustainable sanitation services in slum areas. Very little is known about demographic and social processes within slum areas and how these may impact provision of sustainable sanitation services.

PSI can make a contribution to the achievement of the Millennium Development Goals (MDGs), giving the financial and skill bottlenecks for the fulfilment of the Millennium Development Goals in the water and sanitation sector in Africa, Latin America and Asia. There are some dilemmas concerning the role of the private sector in relation to the achieving the Millennium Development Goals. The role of the private sector can never be to take over the political responsibility of the government. They can also not take the decision to go for large scale centralized or for decentralized wastewater treatment. Once decisions like what will be solved collectively and what will be left to individuals are taken the private sector can execute the activities required and will probably become more efficient than the government in supplying these services.

12. Conclusions

Local governments and utilities share the responsibility for waste water. Too often they do not link the idea of collection, transport and treatment. It is expected that an integrated approach as practices in a limited number of Third world cities would produce better results. It would mean that different actors work with different technologies and alternative sources of finance to deal with sanitation in an integrated way. Using local enterprises more in the sanitation value chain will increase employment and contribute to local development.

Realistic prices for such services and involving the private sector where and when adequate is important. One way to achieve satisfactory results is to follow the methods suggested by the European Union Water Initiative (EUWI). It is suggested to involve as many parties as possible in the construction, operation and financing of the required facilities and to bring them together before actually starting to identify possible bottlenecks.

We have suggested different ways of financing water and sanitation to allow more poor people to gain access to these services. Subsidizing may make it unaffordable for most governments in the long run, hence designing appropriate schemes which would be self financing is much more the challenge. All kinds of statements have been made about sanitation. The Joint Africa-EU statement mainly repeats the commitment, but is very brief about the ways of financing a different approach to sanitation, which would really benefit the poor. Also NGO initiatives like the Sustainable sanitation alliance is brief on funding

(mentioning mainly to include sustainable sanitation issues in to existing funding instruments and initialising of new funding mechanisms in the sanitation sector), without being very specific. More experience need to be gained with the different options mentioned in table 2. Further research could then identify the conditions in which these approaches may work successfully.

Governments should recognize the importance of what we called 'private solutions'. They can be recognized and supported, for example by introducing adequate financing systems. This is what is called incorporating informality (Van Dijk, 2010) and would lead to a dynamic small scale private sector of service providers in the water and sanitation sector. We have shown that technological development, unbundling and competition, which are often looked for in the drinking water sector in fact exist in the sanitation sector. Their effectiveness can be enhanced through a different approach to sanitation, more support for it and appropriate financing mechanisms.

13. References

- ADB (2004) Small piped water networks, Helping local entrepreneurs to invest. Manila: Asian Development Bank.
- ADB (2007) Smarter sanitation, How to clean up your sanitation and waste water mess. Manila: Asian Development Bank.
- Collignon, B. and M. Vezina (2000) Independent water and sanitation providers in African cities, full report of a ten-country study. Washington: Water and Sanitation Program.
- Dijk, M.P. van (2003) Liberalization of drinking water in Europe and developing countries. Delft: UNESCO-IHE Institute for Water education.
- Dijk, M.P. van (2006) Incorporating informality. In: Shelter HSMI New Delhi, Vol. 9, No. 4, December, pp. 14-21.
- Dijk, M.P. van (2008) Role of small-scale private operators in water and sanitation in: International Journal of Water Vol. 4, No. 3/4, 2008, pp. 275-290.
- Dijk, M.P. van (2010) Incorporating informality: 35 years of research and policies on the urban informal sector. In: J. Fransen et al. (eds, 2010), pages 1-15.
- Fransen, J., S. Kassahun and M.P. van Dijk (eds., 2010) Formalization and informalization processes in urban Ethiopia: Incorporating informality, Maastricht: Shaker.
- Kariuki, M. and J. Schwartz (2005) Small-scale private service providers of water supply and electricity. Washington: World Bank.
- Liang, X. and Dijk, M.P. van (2010), Financial and economic feasibility of decentralized waste water reuse systems in Beijing. In: Water science and technology, 61(8) pp. 1965-1974.
- Mathew, N.B. (2003) Performance analysis of privately and publicly managed waste water utilities in Indiana and surrounding states. Delft: UNESCO-IHE, MSc thesis.
- Pagiola, S. and G. Platias (2002) Payments for environmental services. Environmental strategy notes, Washington: IBRD.
- Sijbesma, C. (2008) Sanitation and hygiene in South Asia: Progress and challenges. South Asian Sanitation and hygiene practitioners workshop in Dhaka: BRAC, WaterAid & IRC.

- Tu Shan (2006) The use of BOT contracts in the water sector in the People's Republic of China. UNESCO-IHE Institute for Water education, MSc thesis.
- Winpenny, J. (2005) Guaranteeing development? The impact of financial guarantees. OECD.
- World Bank (1988) The role of public finance, World development report. Washington: World Bank.
- WSP (1998) Community water supply and sanitation conference, Proceedings. Nairobi: Water and Sanitation Program.
- WSP (2004) Sanitation is a business, Approaches for demand-oriented policies. Nairobi: Water and Sanitation Program.
- WUP (2003) Better water and sanitation for the urban poor, Good practice from sub-Saharan Africa. Nairobi: Water Utility Partnership for Capacity Building (WUP) Africa.



Management of Technological Innovation in Developing and Developed Countries

Edited by Dr. HongYi Sun

ISBN 978-953-51-0365-3

Hard cover, 312 pages

Publisher InTech

Published online 21, March, 2012

Published in print edition March, 2012

It is widely accepted that technology is one of the forces driving economic growth. Although more and more new technologies have emerged, various evidence shows that their performances were not as high as expected. In both academia and practice, there are still many questions about what technologies to adopt and how to manage these technologies. The 15 articles in this book aim to look into these questions. There are quite many features in this book. Firstly, the articles are from both developed countries and developing countries in Asia, Africa and South and Middle America. Secondly, the articles cover a wide range of industries including telecommunication, sanitation, healthcare, entertainment, education, manufacturing, and financial. Thirdly, the analytical approaches are multi-disciplinary, ranging from mathematical, economic, analytical, empirical and strategic. Finally, the articles study both public and private organizations, including the service industry, manufacturing industry, and governmental organizations. Given its wide coverage and multi-disciplines, the book may be useful for both academic research and practical management.

How to reference

In order to correctly reference this scholarly work, feel free to copy and paste the following:

Meine Pieter van Dijk (2012). Sanitation in Developing Countries: Innovative Solutions in a Value Chain Framework, Management of Technological Innovation in Developing and Developed Countries, Dr. HongYi Sun (Ed.), ISBN: 978-953-51-0365-3, InTech, Available from: <http://www.intechopen.com/books/management-of-technological-innovation-in-developing-and-developed-countries/sanitation-in-developing-countries-innovative-solutions-in-a-value-chain-framework>

INTECH
open science | open minds

InTech Europe

University Campus STeP Ri
Slavka Krautzeka 83/A
51000 Rijeka, Croatia
Phone: +385 (51) 770 447
Fax: +385 (51) 686 166
www.intechopen.com

InTech China

Unit 405, Office Block, Hotel Equatorial Shanghai
No.65, Yan An Road (West), Shanghai, 200040, China
中国上海市延安西路65号上海国际贵都大饭店办公楼405单元
Phone: +86-21-62489820
Fax: +86-21-62489821

© 2012 The Author(s). Licensee IntechOpen. This is an open access article distributed under the terms of the [Creative Commons Attribution 3.0 License](#), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.