Sanitation: What's the Real Problem?

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Abstract The vast number of people without sanitation raises the question why this is so. It cannot be a lack of adequate sanitation technologies as these exist for all situations from dispersed rural communities to high-density low-income urban areas. Nor cannot it be money as development banks will readily fund a well-prepared sanitation proposal. The real sanitation problem must surely lie with those developing-country governments who have shown little commitment in practice to sanitation despite international sanitation advocacy since 1980. Their lack of commitment is clearly shown in the number of 'open defecators' in the world today. There are fortunately some countries that have done well: Malaysia, Thailand and Vietnam, for example, but they are a clear minority.

1 Introduction

In 2008, 2.6 billion people were without 'improved' sanitation (WHO/UNICEF 2010). 'Improved' sanitation includes access to a flush toilet, a piped sewer system, a septic tank, a pour flush latrine, a ventilated improved pit latrine, a pit latrine with slab, or a composting toilet (JMP 2011). The category 'pit latrine with slab' is problematic as there are very large numbers of these that are grossly unhygienic in practice and cannot really be considered an acceptable form of sanitation. If this category were to be excluded from 'improved' sanitation, no-one knows exactly how many more people would be lacking access to 'improved' sanitation – possibly in the order of at least 500 million.

UN-Habitat (2003) introduced the term 'adequate' sanitation which went beyond mere access to a particular type of sanitation system. 'Adequate' sanitation was defined as 'access to sanitation that is convenient for all household members, affordable, and that eliminates contact with human excreta and other wastewater in the home and neighbourhood'. In urban areas alone UN-Habitat estimated that around 850–1,130 million people lacked adequate sanitation vs 394 million lacking improved sanitation.

The latest development in defining sanitation is by Kvarnström *et al.* (2011) who proposed that access to sanitation be function-based (health functions and environmental functions), rather than, as done by JMP (WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation), simply technology-based (Table 1). There is thus some similarity between Kvarnström *et al.* (2011) and UN-Habitat (2003), at least at the level of health functions.

2 The real problem cannot be a lack of sanitation technologies

There are several good, well understood, and tried-and-tested sanitation technologies available for both rural and urban areas which can easily be implemented at large scale. These are:

a *Rural areas:* Arborloos (Morgan 2007; Simpson-Hébert 2007), single-pit ventilated improved pit (VIP) latrines (Mara 1984), single-pit pour-flush latrines (Mara 1985), 'eThekwini' latrines (urine-diverting alternating twin-vault ventilated improved vault latrines) (WIN-SA n.d.), and biogas latrines (Mara 2007); and

b *Urban areas:* simplified/condominial sewerage (Melo 2005; Mara *et al.* 2001), settled/solids-free sewerage (Otis and Mara 1985), low-cost combined sewerage (Guimarães and de Souza 2004), and community-managed sanitation blocks (Burra *et al.* 2003).

Two of these technologies are now briefly described: Arborloos (for low-density rural areas) and simplified sewerage (for high-density urban areas).

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Table 1 **Function-based sanitation ladder**

	Function	Indicators	Management needs
Environmental functions	7 Integrated resource management	Indicators will differ and depend on flow streams from the full environmental sanitation system (urine, faeces, greywater, faecal sludge, wastewater as below but also including water provision, stormwater management and solid waste management) and context	↑
	6 Eutrophication risk reduction	Indicators will differ and depend on flow stream from the sanitation system (urine, faeces, greywater, faecal sludge, wastewater)	
	5 Nutrient reuse	(i) X% of N (nitrogren), P (phosphorous), K (potassium) excreted is recycled for crop production; (ii) Y% of used water is recycled for productive use	
Health functions	4 Pathogen reduction in treatment	Indicators will differ and depend on flow stream from the sanitation system (urine, faeces, greywater, faecal sludge, wastewater) and also whether the flow stream will be used productively afterwards or not	
	3 Greywater management	(i) No stagnant water in the compound; (ii) no stagnant water in the street; (iii) no mosquitoes or other vectors	
	2 Safe access and availability	(i) 24-hour access to facility year-round; (ii) facility offering privacy, personal safety and shelter; (iii) facility is adapted to needs of the users of the facility	
	1 Excreta containment	(i) Clean facility in obvious use; (ii) no flies or other vectors; (iii) no faecal matter lingering in or around latrine; (iv) hand-washing facility in obvious use with soap; (v) lid; (vi) odour-free facility	

*Note that moving up the ladder means that the functions below have also been fulfilled!

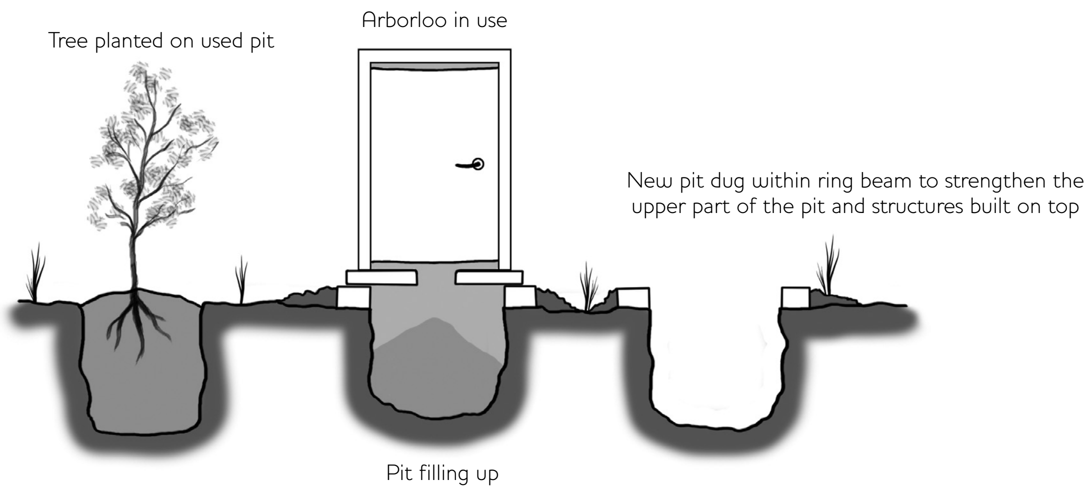
Source (Kvarnström *et al.* 2011).

2.1 Arborloos

Arborloos are short-life shallow pit latrines that function like this: a shallow pit (approx. 0.8m diameter and 1–1.5m deep) is dug and a coverslab and portable superstructure (made from local materials) placed over it (Figure 1). The arborloo latrine is used for 6–12 months, with soil, leaves and/or ash being regularly added to the pit to accelerate the composting process, after which time a new pit is dug nearby and the coverslab and superstructure placed over it. Soil is added to the full pit to just above ground level and a young high-value tree (a fruit tree or a medicinal tree) is then planted; its roots grow down into the composted excreta/soil/ leaves/ashes in the pit and, as a result, the tree grows quickly and soon provides an income for the household. This process is repeated until the household has an orchard of high-value trees. The family diet is improved and the excess produce is sold in the local market. Arborloos are thus a good combination of sanitation and agroforestry (see IFAD 2011): excreta in, money out.

Arborloos are especially suitable in dispersed rural areas where subsistence agriculture is practised. They have the advantages that the

Figure 1 Schematic diagram of an arborloo



Source Morgan (2007).

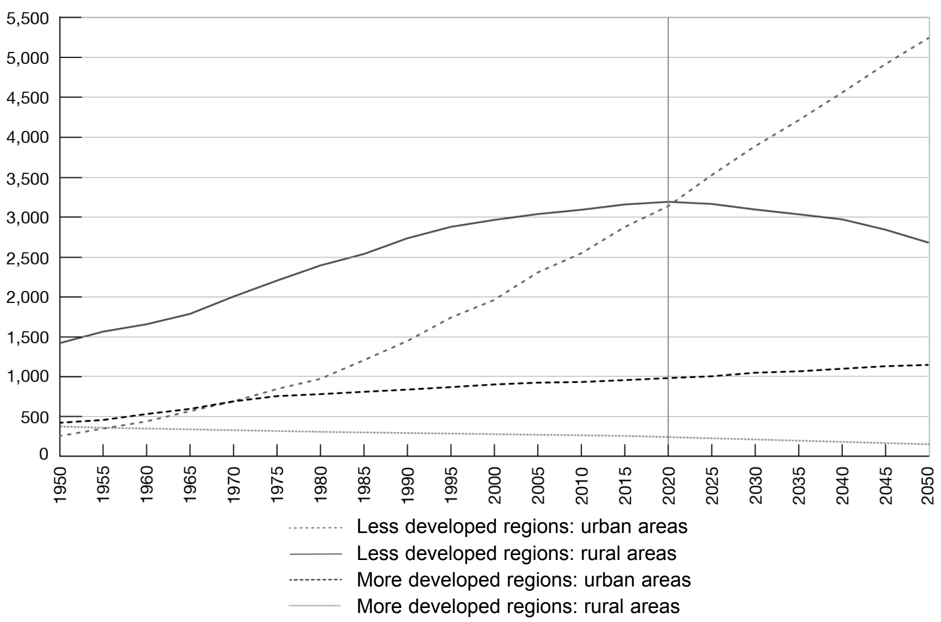
nutrients in the excreta are used productively without any human contact with the excreta, and that women (whose husbands are commonly away from the family home working elsewhere) are able to dig the shallow pits themselves.

Arborloos are very cheap: in Ethiopia, where there are approximately 12,000 units, the cost is around US$5–10.

2.2 *Simplified sewerage*

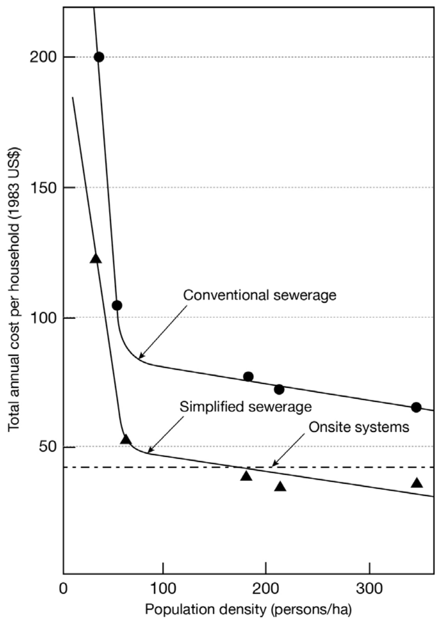
The world is urbanising rapidly, with almost all population growth in the next few decades expected to be in urban areas of developing countries (Figure 2). In high-density low-income urban areas often (and, in fact, more often than not) the most appropriate sanitation system is simplified (also called condominial) sewerage. The basic reason for this is cost: at quite low

Figure 2 World population from 1950 projected to 2050



Source UN DESA (2010).

Figure 3 Total annual costs of conventional sewerage, simplified sewerage and onsite sanitation systems vs population density in Natal, northeast Brazil, 1983



Note In this example simplified sewerage became cheaper than onsite sanitation at a population density of approximately 160 persons per ha.
Source Mara *et al.* (2001).

population densities (*ca.* 150–200 persons per ha) simplified sewerage becomes cheaper than onsite sanitation systems (Figure 3).

Simplified sewerage was developed in northeast Brazil in the early 1980s as a solution to the up-to-then intractable problem of sanitation in low-income urban areas. It takes all the household wastewater (toilet wastewater and greywater), but not stormwater. It is essentially conventional sewerage stripped down to its hydraulic basics; in fact it is more rigorously designed than conventional sewerage.

Costs are reduced as its layout is more flexible, simple inspection boxes are used in place of expensive manholes, and smaller diameter sewers are used and laid at shallower depths and flatter gradients. The hydraulic design of condominial sewerage is based on (a) a minimum sewer diameter of 10mm, (b) a minimum tractive tension of 1 N/m^2 (this is a better design criterion than a minimum self-cleansing velocity for wastewater flows in small-diameter sewers), and (c) a minimum peak wastewater flow of 1.5 l/s (which is approximately the peak flow induced in the sewer by flushing a toilet). This results in a minimum sewer gradient of only 1 in 200 (i.e. 5‰), and a 100mm diameter sewer being able to receive the wastewater from approximately 230 households of five people who have a water consumption of 100 litres per person per day (or of ten people who have a water consumption of 50 litres per person per day).

With conventional sewerage the sewers are laid deep in the centre of the road, so house connections are longer and more expensive. With simplified sewerage there are three basic options (Figure 4): 'back-yard' sewerage, which is the cheapest and thus generally used in low-income areas, and two options for less poor areas – 'front-yard' and 'sidewalk' (pavement) sewerage. In the back-yard version the length of the house connection is much shorter and the in-block sewers do not have to be designed to withstand traffic loading. Consequently, simplified sewerage costs are a third to a half those of conventional sewerage.

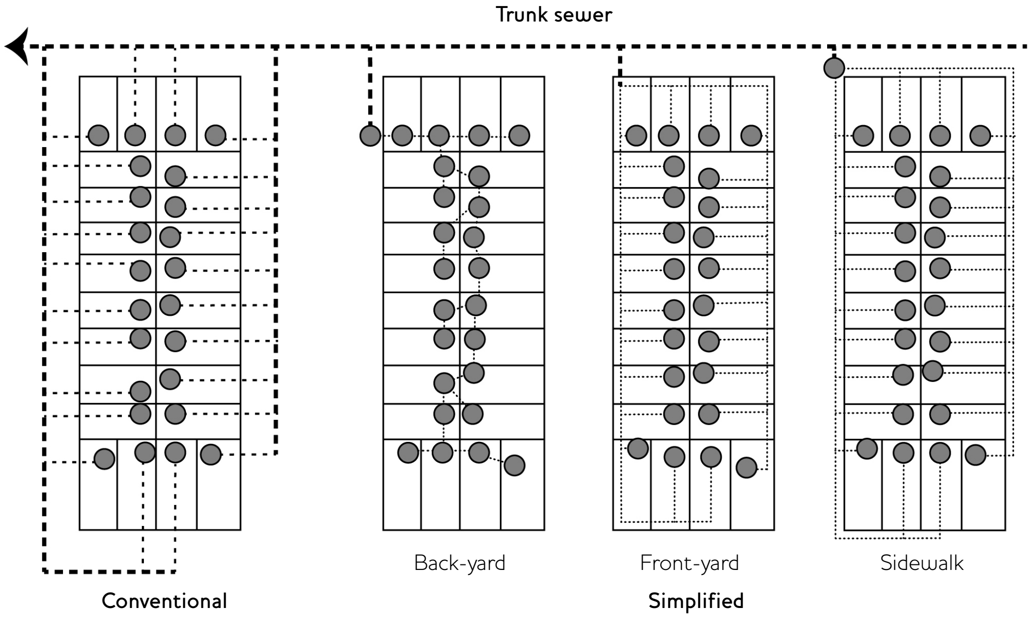
3 So what is the real sanitation problem?

If it is not the availability of good sanitation technologies, what is the real problem? It cannot be money, as any development bank will readily fund a well-prepared proposal to improve access by the urban or rural poor to adequate sanitation. Funds are also available to help governments prepare such projects.

My view is that the real sanitation problem lies with developing-country governments who have shown little commitment in practice to sanitation despite the International Drinking Water Supply and Sanitation Decade (1981–90), Safe Water 2000 (1991–2000) which despite its title did include sanitation, and the Millennium Development Goals (2001–15). I believe it is they, and they alone, who are to blame for the insanitary state of the world today, for the 3–4 billion not having 'adequate' sanitation, and for the 1.15 billion 'open defecators' (around a fifth of the developing-world population). There have been many fine words, of course – see, for example, the eThekwini Declaration (AMCOW 2008) – but little action, and certainly not at the scale required.

So what is preventing developing countries actually doing something useful? Some countries have done

Figure 4 The three typical sewer layouts used with simplified sewerage (right) and comparison with conventional sewerage (left)



Source Melo (2005).

really well with sanitation provision – for example, Malaysia (96 per cent improved sanitation and 4 per cent shared sanitation in urban areas, and 95 per cent improved sanitation, 4 per cent shared sanitation and 1 per cent open defecation in rural areas, in 2008) (WHO/UNICEF 2010), and Thailand (95 per cent improved sanitation and 5 per cent shared sanitation in urban areas, and 96 per cent improved sanitation and 4 per cent shared sanitation, in 2008) (WHO/UNICEF 2010). Have these two countries (and, of course, all the industrialised countries) done well because they 'think clean' and have 'invested in clean'?

Quite a few countries don't seem to be thinking clean – at least as evidenced by the numbers of their citizens who are open defecators ('ODers'). Table 2 lists the countries with over 20 per cent of their population who openly defecate. Some countries have tackled open defecation rather well – for example, in Vietnam in 2008 only 6 per cent of the population were ODers, compared with 42 per cent in 1990 (WHO/UNCIEF 2010).

What is stopping other countries doing as well as Malaysia and Thailand? Why do they not think clean? Is it the 'aid dependency' syndrome – 'we have to have your money as we have none of our own to do anything'? Maybe, but I think it's deeper than that. I think there are at least three interrelated problems: firstly, judging by their poor record of action, senior politicians and

Table 2 Countries with 20 per cent or more open defecators in 2008

Africa: Angola (23%), Benin (60%), Burkina Faso (64%), Cape Verde (42%), Central African Republic (20%), Chad (65%), Côte d'Ivoire (27%), Eritrea (85%), Ethiopia (60%), Ghana (20%), Guinea (22%), Guinea-Bissau (31%), Lesotho (40%), Liberia (49%), Madagascar (32%), Mauritania (53%), Mozambique (42%), Namibia (53%), Niger (79%), Nigeria (22%), São Tomé & Principe (55%), Senegal (19%), Sierra Leone (24%), Somalia (54%), Sudan (41%), Togo (55%), Zimbabwe (25%)

Asia: Cambodia (64%), India (54%), Indonesia (26%), Laos (38%), Nepal (52%), Pakistan (27%), Timor-Leste (43%), Yemen (25%)

Latin America and Caribbean: Bolivia (21%), Haiti (30%)

Source WHO/UNICEF (2010).

senior civil servants do not seem to think that thinking clean or investing in clean is that important (and there are no solutions without political solutions); secondly, the technical ignorance of local engineers who are paid too little to be motivated to correct this (and they devote their intellectual energy, such as it is, to their second job as they can be easily sacked from this) (Restrepo-Tarquino 2001); and thirdly, there's too much corruption in general and in the water sector in particular (Transparency International 2008).

Bilateral and multilateral aid agencies, and the development banks, are not, of course, wholly blameless. We certainly don't want to see more aid-funded activated sludge plants not connected to a sewer system – there's a city in the Nile Delta in Egypt with six of these which have been doing nothing (apart from deteriorating) for over ten years! Development aid in the water and sanitation sector should, in my opinion, concentrate on the provision of technical training, i.e. the knowledge dissemination referred to above and really good technical advice and loans for really well-prepared projects, so that we get more good pits and good pipes in the right places, and so far fewer ODers. Output-based aid (see Trémolet and Evans 2010) should be reserved for the poorest countries of those listed in Table 2, so that the world tackles the problems of the 'Bottom Billion' (see Collier 2007) first.

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