A WELL FACTSHEET

On-site sanitation in areas with a high groundwater table

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Edited and produced as a PDF document: May 2020

In areas that experience a seasonally high groundwater table or that are prone to flooding, constructing affordable on-site sanitation facilities can be very problematic. It is a challenge that affects many countries worldwide. This technical brief provides practical guidance on some sanitation options in such conditions. More details on each option outlined can be found in the references in the further reading section.

A preventative approach includes land-use planning, to avoid building homes in areas with a high ground-water table and examining the causes of the high groundwater table and flooding, which may be due to poor drainage provision. As this is not always possible, other options may need to be considered.

Raised latrines

Where there is a seasonally high water table, a raised latrine may be the most appropriate option for on-site sanitation. The pit should be dug at the end of the dry season, to maximise the available depth of unsaturated soil that can be excavated. In areas with a recurring high groundwater table, this may be as little as 1 to 3 metres. It is worth trying to dig the pit below the water table if possible: firstly this increases the available volume and secondly there is evidence that wet pits take longer to fill, since the digestion processes in wet pits described by Mara and Sinnatamby (1986) are more efficient.

The pit should be lined with appropriate, locally available materials such as fired clay bricks, blockwork, porous concrete, large stones or pieces of rock, pre-cast concrete rings or ferrocement. It is also possible to use a 200 litre oil drum as a lining if these are readily available; this however makes a pit with a very low volume and therefore a short life. The lining is extended above ground level to provide the required pit volume, as shown in Figure 1. Excavated material can be used to build up a mound or embankment around the latrine.

This mound can be used for liquid infiltration from the pit if it is:

a) formed with permeable soil

b) well compacted with a stable side slope of 1:1.5, and

c) thick enough to ensure that filtrate does not seep out of the sides of the mound

The slab should be constructed at least half a metre above the highest water level.

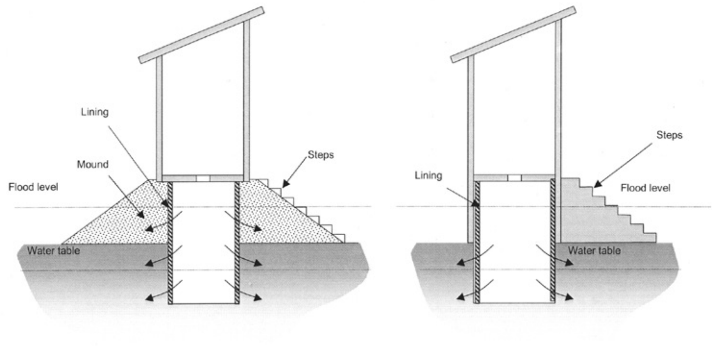

Figure 1. Types of raised pit latrine

The Latrine Project in Mozambique (Brandberg, 1985) promoted the use of wide diameter elevated pit latrines in areas of high groundwater table, as shown in Figure 2. The lining was made with soil-cement blocks with the joints mortared above ground level. The pits were covered by a 1.5 metre diameter re-usable unreinforced dome slab.

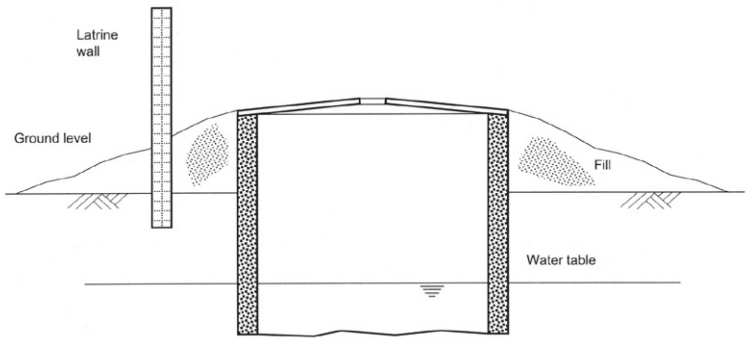

Figure 2. A wide diameter elevated pit latrine

Social impact of raised latrines

Raised latrines may not be socially acceptable if people feel 'exposed' and uncomfortable about being seen going in and out of the super-structure. They may also restrict access for disabled people, the elderly, pregnant women and others.

Short life or disposable pits

If space permits, a household may choose to dig a shallow, unlined pit latrine above the water table that will have a short life. When this pit becomes full, the household can simply abandon it and dig a new one. For this approach to be cost-effective, the slab and superstructure must be designed to be reusable and moveable.

The Arbour-loo

Some households in Zimbabwe use a shallow pit for about one month, after which time the slab and super-structure are moved to a freshly dug pit and a tree is planted in the used pit (see Morgan, 2004). Fruits like papaya thrive in this way. Although this sounds like a simple and easy technical solution, there are many social and health implications associated with this type of system. For example, people may be reluctant or unable to move the slab and superstructure so frequently or there may be resistance to eating fruit grown from a tree fertilized by human excreta. Such issues must be given serious consideration, as the approach will only be appropriate in certain environments and situations.

Pour-flush latrines

The simplest form of pour-flush latrine is the installation of a pan with a water-seal in the defecating hole over a pit. Pour-flush latrines are most appropriate for people who use water for anal cleansing and squat to defecate. Where the use of solid cleansing materials is common there may be a risk of blockage; however, pour-flush latrines with seats have also been used successfully in the Caribbean, where water is not normally used for anal cleansing.

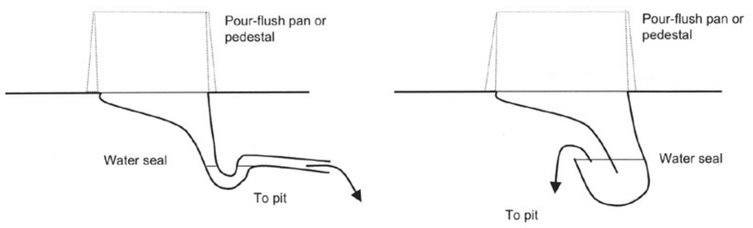

Figure 3. Varieties of pour flush latrines

In areas with a high groundwater table, an offset pour-flush latrine can be constructed where the pit is set away from the latrine. The pan and the pit are connected by a short length of small-diameter pipe. The benefit of this arrangement is that the latrine superstructure can be permanent, but the discharge pipe can be moved so that when the pit is full another one can be dug and connected by redirecting the pipe as shown in figure 4.

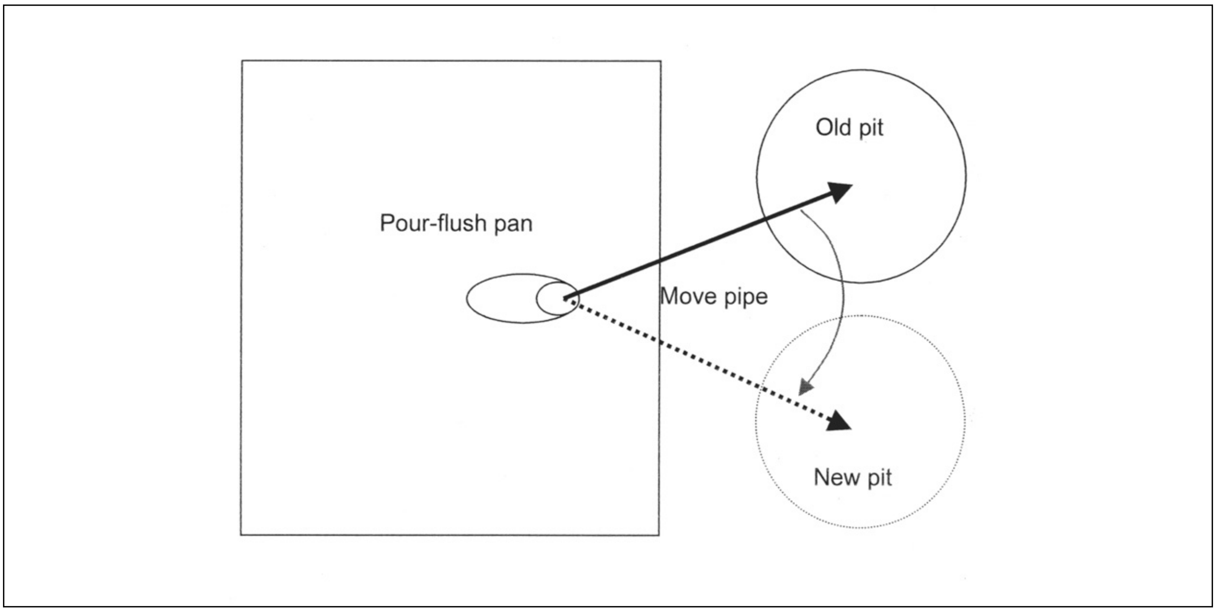

Figure 4. Offset pour-flush latrine with two external pits

Figure 5. A raised latrine constructed on stilts

Low-cost, offset pour-flush latrines have been successfully used in marshy areas of rural Myanmar. The pour-flush latrines (as shown in the photograph in Figure 5) are built a metre above ground level on bamboo stilts with plastic pour-flush pans set into wooden floors. The pits, offset from the superstructure with the pipe sloping at 45 degrees, are covered only with a simple bamboo trellis and matting. This makes the pit cheap enough to be abandoned if it fills or becomes silted up. In this case a new pit can be dug and the pipe moved to connect to a new pit.

Composting latrines

Composting latrines consist of a single or double vault construction, usually with a system to ensure that urine is kept separate from faeces. The urine is an effective fertiliser (when diluted with 3-6 parts water), while the faeces contains most of the disease-causing micro-organisms. Faeces collect in the vault and are regularly mixed with earth, wood ash or other organic waste material to deodorize it and control the moisture content. The accumulated waste must be left for at least a year, to ensure that all pathogenic organisms have died off, before it is applied to land or disposed of safely

The collecting vault is often constructed above ground, as this improves access for removing the composted waste (it can, however, make the construction more costly). In theory then, the system is suitable for regions with a high groundwater water.

Composting latrines continue to raise much debate among international sanitation experts, with strong arguments both for and against using the system. The health risks associated with poorly managed composting latrines must be considered, together with the low level of user acceptance in many countries and cultures.

Composting latrines should only be constructed where there is a proven track record of operation and acceptance in the region and the existing practice of re-using human excreta for agricultural purposes. An extensive hygiene education programme should precede and accompany the introduction of composting latrines.

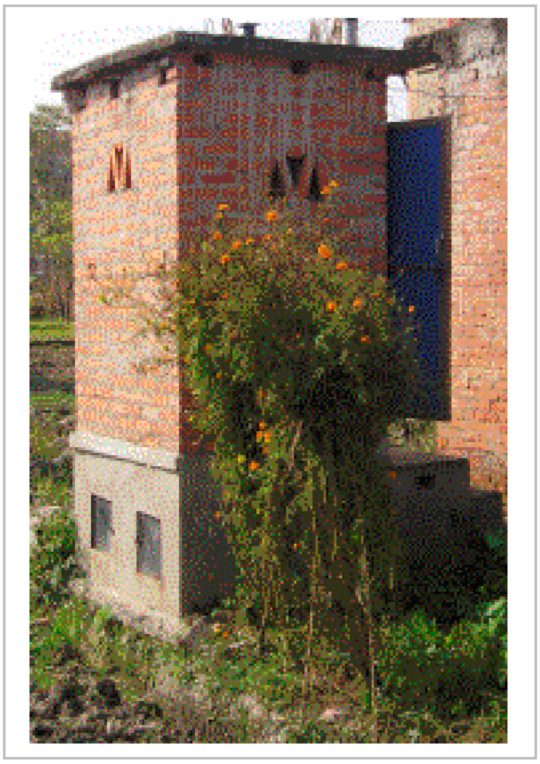

Figure 6. A raised composting latrine

Contamination of drinking water supplies

Where the source of drinking water is an aquifer with a high groundwater table, the risk of contamination from pit latrines needs to be considered.

As a general rule, abstraction of groundwater should be at least 10 metres from the latrine (WELL, 1998).

The risk of pollution through sub-surface movement of bacteria and viruses depends on a number of factors, such as: soil composition, hydraulic gradient, the soil's pH and organic content, and rainfall. Therefore the risk of pollution needs to be assessed for each individual case.

It has been found that the linear travel of pollution is governed primarily by the groundwater flow velocity and the viability of the organisms (Lewis et al, 1980). A useful and widely accepted guideline based on this research is that the maximum distance faecal pathogens will move through unfissured soil (including sand) is as far as the groundwater moves in ten days. In low-lying flat areas, with a high groundwater table, the groundwater flow is almost certain to be less than one metre/day, so a distance of 10 metres from latrine to source is adequate.

If there is considered to be a real risk of pollution of groundwater from a pit latrine, the risk can be reduced by constructing an artificial sand barrier around the pit to create a filter effect. This is an expensive solution and it may often be more practical to develop alternative drinking water sources, at a safe distance from the on-site sanitation facilities.

In densely populated urban areas with very high groundwater tables, the groundwater quality is likely to be poor. The provision of off-site water (water piped in from elsewhere) is likely to be a lot cheaper than the provision of off-site sanitation facilities such as sewerage.

See Cave and Kolsky (1999), for further information.

Cess pits

Shallow cess pits (an enclosed single tank with no outlet) could be considered, if protecting drinking water supplies from pollution is critical. If cess pits are used, a reliable means of emptying them is essential to their functioning and sustainability. At the planning stage, a supply of tankers for emptying must be both reliably available and affordable to users (especially once any external funding and support is removed).

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