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SUSTAINABILITY OF WATER AND SANITATION SYSTEMS

Pit latrine emptying using motorised equipment

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IN ZIMBABWE, THE provision of sanitation and water supplies has resulted in major health and social changes for many communities, particularly where the intended users are involved in setting goals and defining project objectives. The challenge to researchers, scientists, and environmental health officers is the continuity of the technologies implemented.

Zimbabwe's public health policy is based on the principles of primary health care and, environmental hygiene is viewed as a fundamental principle of public health policy. In applying these principles, appropriate technologies for the safe disposal of excreta, in the form of an improved ventilated pit latrine, have been designed and implemented in most rural areas of Zimbabwe. The Blair latrine was developed and first implemented in the early 1980's. Thus, many of the early proto-type models have been in operation for almost fifteen years.

The latrine was originally designed to last for approximately fifteen years when serving an average family size of 7-10 people (Morgan, 1990). Therefore, many of the early constructions are full and, the usual practice under such circumstances has been to seal the full pit and build a new latrine. This practice, however, has become prohibitively expensive. Moreover, in peri-urban areas and rural growth points, where rapid population growth is being experienced, available land is decreasing in proportion to population expansion. The net result of these factors coupled with fiscal constraints on the provision of reticulated sewage systems for rapidly expanding peri-urban populations means that desludging already existing pit latrines may be the only option for sustaining a viable excreta disposal system in the short and medium term.

To examine the feasibility and cost effectiveness of desludging pit latrines, a small motorised vacuum tanker was procured and tested in 2 distinct areas; a large scale holding camp for translocating populations and a large, well established, peri-urban area.

The research programme was conducted to examine two broad objectives:

i) to assess the feasibility of pit emptying using the micravac vehicle and,

ii) to estimate the unit cost of emptying a latrine pit and identfying possible areas of environmantal impact associated with the procedure.

Study areas

The first phase of the study was conducted at Porta farm, a temporary holding camp for 7000-10000 people awaiting resettlement. The camp is serviced with 74 communal pit latrines. All the latrines in the camp are unlined versions of the standard VIP latrine, which were not originally intended for long term use. In contrast, the second phase of the study was conducted in Epworth, a large (N·60000) and well established peri-urban settlement which has been provided with fully lined latrine pits connected to soakaway tanks. These latrines were designed to last for roughly 15 years with the option of being upgraded into flushable units.

Materials and methods

The vehicle employed was specially constructed for operation in peri-urban areas which have little or no planning regarding the spatial arrangement and distribution of households. The vehicle is compact for easy movement between households and thus is fitted with a 1000 litre capacity tank and a compressor capable of creating a negative or positive pressure (approx. 20 Kpsi) used for filling or emptying the tank respectively.

Before emptying the latrines in the study areas, the distance between the latrine floor and the surface of the sludge was measured and recorded. The latrines at the Porta farm site were not lined and were not recommended for use as bathrooms and thus, the sludge was relatively solid. Therefore, water was added to the pit contents to increase the fluidity of the sludge for ease of extraction. Following dilution the contents of the pits were agitated using ancillary equipment to remove non-faecal solids such as pieces of blankets, sacks and sticks. The pits were then emptied and the distance between the latrine floor and the surface of the sludge again measured. In all, 44 pits were desludged at the Porta farm site. The sludge removed from the pits was disposed of into 8 specially constructed disposal pits measuring 4 x 2.4 m^2 in area and 3 m deep with a spatial distribution shown in Figure 1. Sludge was deposited into pits 1, 4, 5, and 8 and the remaining pits were left empty in order to collect effluent from the sludge pits. A disposal pit was considered full when the distance between the ground level and the sludge level was 1 m. The pit would not be used again until the contents subsided substantially below the 1 m mark. The pits were treated with chloride of lime each time sludge was discharged into them and on a daily

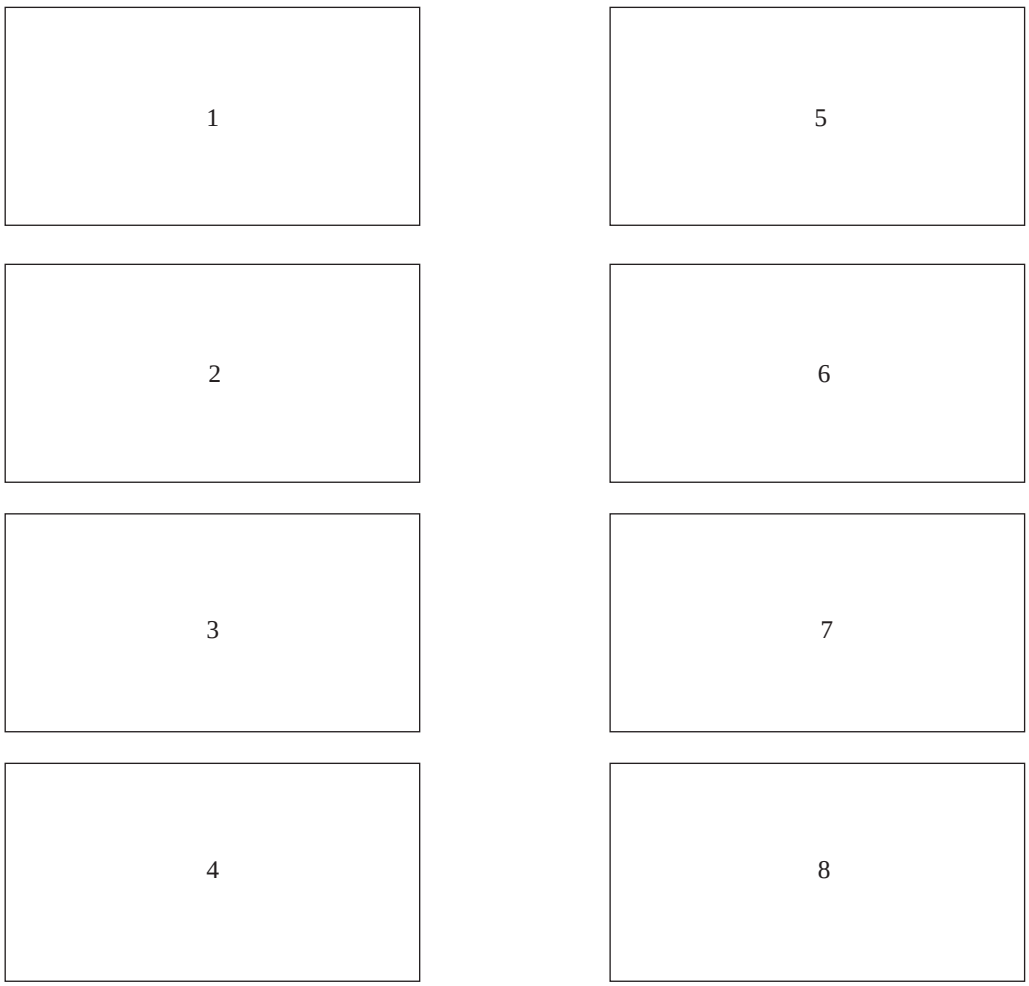

Figure 1. The spatial layout of pits at the disposal site.

basis (mornings only) for filled up pits. Treatment was intended to discourage breeding of flies and to reduce bad odours. Pits which had drained and had semi-solid contents were covered with soil. A similar procedure was adopted for the disposal of sludge at the Epworth site.

Results and discussion

On inspection, most (70%) of the latrines at the Porta farm site were full; pit latrines in Zimbabwe are considered full when the sludge level is between 30 and 50 cm below the level of the latrine floor. Pit depths following the desludging procedure are shown in Table 1. Originally, the pits were constructed with depth of 3 m, however after emptying, all the pits had a depth of less than 3 m and 36.4% had a depth of less than 1.5 m. The reduction in pit depth is mainly due to an accumulation of soil, resulting from the erosion of the unlined sides of the pit. This erosion process was exacerbated by the desludging process, and on 7 occasions, the desludging process resulted in the complete collapse of the latrine. Whilst desludging unlined pits will extend their life span by an average of 1.5 years, it is recommended that the micravac should not be used for these temporary constructions because of the danger of serious erosion of the pits.

The second phase of the study was conducted in Epworth, a peri-urban area on the outskirts of the capital City, Harare. Data were collected during a typical desludging exercise and analyzed to provide an indication of the financial savings which can be achieved through the desludging process.

The great majority of pit latrines constructed in Epworth have fully lined and plastered pits, which are connected to soak-away tanks. The latrines were constructed in this manner to facilitate desludging and upgrading to flushable units.

On average, it took about 1 hour to desludge 1.0 m^3 of pit contents. This duration includes time spent on fluidi-

Table 1. Depth of unlined latrines after desludging and the proportion of latrines within each depth range.

Depth Range (x) in metres	Proportion (%)
x > 3	0
2.5 < x < 3	20.5
2.0 < x < 2.5	18.1
1.5 < x < 2.0	25.0
x < 1.5	36.4

sation, agitation, stoppage time during the emptying of the pit due to blockages and discharging the contents of the micravac into disposal pits. Because the vehicle has a capacity of only $1m^3$, the exercise has to be repeated to gain an effective $2m^3$ of empty pit space. During a typical exercise of this nature, 2 litres of diesel fuel worth Z$ 2.34/litre are used, and the vehicle is hired at an additional cost of Z$3.00 per hour. Therefore, the total cost of removing 2 m^3 of sludge equates to Z$ 10.68.

The average per capita sludge accumulation rate is roughly 0.04 m^3 per person per year (Morgan, 1990). Therefore, it will take a family of 7 persons around 7 years to refill the 2 m^3 of pit space gained during the desludging exercise. The bonus life span of the latrine will, of course, increase with decreasing family size. The Z$ 10.68 (US$ 1.17)[1] cost of providing a 7-year bonus life span for a latrine is significantly less than the Z$ 1000.00 (US$ 116.84) which would have to be spent to build a new Blair latrine. Desludging not only provides an increased life span for pit latrines, but also reduces markedly the environmental impact of building new latrines, since additional ground space is not required. Neither are additional bricks, which would have to be fired using ever increasingly scarce fuel wood, required.

In conclusion, the small-scale motorised tanker used during this programme proved to be easy to use and efficient in its intended application. We suggest limited use of the vehicle in areas where pit latrines are unlined, to reduce the potential for latrine collapse. On the other hand, we strongly advocate for the use of such vehicles in peri-urban and other areas where latrine pits are adequately lined. Desludging of lined pits results in a very significant extension to the life span of the latrine and a minimal cost to the latrine owners. Furthermore, desludging is accompanied by minimal environmental degradation compared to what would be experienced if full latrines were replaced by new units.

Reference

Morgan, P. 1990. Rural Water Supplies and Sanitation. MacMillan Education L.t.d. London and Basingstoke. 358pp.

[1] Current conversion ratio Z$ to US$=8.59 as of 26/05/95