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THE FUTURE OF WATER, SANITATION AND HYGIENE:
INNOVATION, ADAPTATION AND ENGAGEMENT IN A CHANGING WORLD

Innovation in the school environment related to sanitation, hygiene and nutrient recycling

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This paper further reports on continued activities at the Chisungu Primary school, Epworth Harare. Zimbabwe, where children are taught the basics of ecological sanitation, toilet construction, hygiene and recycling of urine and toilet compost. A number of innovative ideas and concepts are being used in this school program. This paper briefly describes some of them. The school is perhaps the most ideal learning centre for introducing new ideas in the evolving world of sanitation, recycling and hygiene.

Introduction

Earlier work related to this project was reported at the WEDC conference held in Addis Ababa in 2009. The Chisungu Primary school was established in 1938 and has an enrolment of 2250 pupils. The pupils chosen for this project are taken from the uppermost two grades and the practical work is undertaken as extra – curricular activity. This project has been operational for almost three years and many innovative ideas have been used and tried. The pilot project is viewed by the authors, not only as centre for training, but also for research into new and innovative ideas related to sanitation, hygiene and recycling of excreta. The concepts described here have been taught to those operating school projects in both Uganda and Malawi, and the data has been placed on a CD of manuals and power points, but the concepts have so far not been replicated to other schools in Zimbabwe. Many ways of recycling excreta have been explored, by planting vegetables and maize in the school garden and accelerating their growth with diluted urine. Also by planting trees close to shallow ventilated pit toilets, thus tapping the nutrients formed underground into meaningful growth above ground. And not least to planting trees in the school woodlot and fertilising with diluted urine. All these concepts are practical and valuable, with the possibility of economic benefit. The pupils have also been taught how to build toilets in brick, both below ground and above. These various methods have also been used in an outreach program around the school.

Innovative ideas in toilet design and construction

The Government of Zimbabwe has set standards for the construction of toilets countrywide. For schools in the rural and many peri-urban settlements, these are based on multi-compartment VIP designs. The family owned VIP toilet is also set as a national standard for all rural and many peri-urban settlements. Most family owned VIP toilets in Zimbabwe are also used as wash rooms since the use of pedestals is rare, providing a floor surface suitable for bathing. The screened vent pipe controls flies and odours. This multi-purpose use of the toilet is popular and thought to prolong the life of the pit. Some VIP toilets built in the 1970’s are still in use. Many variants of the VIP toilet (known as the Blair Toilet) have been designed in Zimbabwe. Several use an ecological approach, where recycling of both hardware (bricks, slabs and roof etc) and organic materials (composted excreta) is possible. Ventilated versions of simple toilets like the *Arborloo* and *Fossa alterna* are also used. Also variants which use a tank in place of a pit have been used at the school and in Epworth for over 20 years.

In this school project, an experimental approach has been used in building single VIP toilets, which can also be copied and used as family units in the community. All new VIP toilets used in this project have shallower and wider pits than the current national standard. This makes them easier to line with bricks and also further distances the pit contents from the existing water table, whilst maintaining a practical pit volume, which can serve a family for over 10 years. Most family owned VIP toilets used in community projects in Zimbabwe have a pit filling time of 12 – 15 years and the multi-compartment school toilets of which there are many thousands in use, have a pit filling time of around 20 years. The long life and relative ease of maintenance of the door-less spiral design is well established in Zimbabwe – there are no moving parts. However special toilets fitted with doors have been built in this project, as these can be latched and are thought to be popular with the girl child.

Innovative ideas in superstructure designs - building techniques suitable for pupils

Special building techniques using templates or treated gum poles have been employed in the construction of both doored and spiral superstructures. In both cases a treated gum pole or wooden template is used to guide the young brick layers at both the ends of the brick wall of the superstructure. All structures are built using a rounded wall shape. Toilets built with a door are constructed in the shape of a horseshoe. In the spiral unit the construction is in the shape of a spiral. These rounded shapes give the structure strength, even if it not built perfectly. The mortar used is durable and economic being a mix of 20 parts pit sand and 1 part Portland cement. Over years of use, this weak and economic mortar has proved a durable mix. Traditional mortar using a mix of anthill soil and sandy soil is also used in the construction of the superstructure. It is a myth that the VIP toilet must be very dark within. It should be possible to read a book inside. In this schools project coloured glass bottles have been built into the upper walls of spiral toilets to allow light in. This method is decorative, arty and allows a diffuse light into the interior.

Substructures

The current standard VIP toilet in Zimbabwe has a pit depth of 3m and diameter of 1.1m. But pits built in this project are both shallower and wider. A maximum depth has been set at 2m with base internal diameter of 1.4m. Using a corbelling (stepped in) technique where the base has a wider diameter than the top, pit volume can be the same or even greater than existing VIPs, whilst allowing smaller and more economical 1.2m diameter slabs to be fitted on top. This change in pit shape has several interesting advantages. Some pit linings are made leaking with holes made in them to allow some penetration of the excreta sideways to feed trees planted around the structure. The shallow depth (2m rather than 3m) makes the pits easier to line. The bricks are placed around the rim of the pit, and can be picked up easily by the builder standing on the base of the pit and without the requirement of having to stand on a drum or support inside a deeper pit. Using a single 50kg bag of Portland cement it is possible to make a 1.2m diameter concrete slab and line a pit 2m deep with a base diameter of 1.4m. A mortar mix for brickwork using 20 parts of pit sand and 1 part of Portland cement has proved to be most durable. Such a pit may function for at least 12 to 15 years. A large range of superstructures can be built on top of this basic pit unit. These can follow an upgradeable sequence using the principle – start simple (pole and grass) and upgrade (brick) over time. In Epworth, a fully lined pit with covering slab can be built with up to 500 fired bricks (USD20) and a bag of Portland cement (USD12) with some 3mm reinforcing wires in the slab. Labour and construction amount to about USD20. This substructure unit can provide service for a family of about 6 for 12 to 15 years – about one USD per year per person. Structural parts and organics can be recycled – as described below. Economically - not a bad deal!

The door and hinge problem

Toilets fitted with doors, especially those used at schools, can become a headache – doors have a habit of falling off or being left open. In this project doors are made light, yet durable in treated wood. The hinges are made of heavy duty rubber or polyurethane. Polyurethane is the most durable. The hinges must be self closing to maintain the semi-darkness required in the VIP concept. VIPs fitted with doors which are left open cannot function properly as VIPs – fly control is lost. Doored VIPs which can be latched from inside are thought to be valuable for the girl child on menstruation. In this project, both doored and door-less units are being used and each pupil has the choice to use either. Girls on period thus cannot be identified by their use of a specialised toilet – they have a choice like all the other girls.

Garbage pits and pit life

One of the external problems of pit toilets including the VIP is that the pit eventually fills up. The pit must either be abandoned or emptied. Emptying is very difficult, partly because pits are used as dumping grounds for every form of garbage. This decreases pit life considerably. The habit of throwing garbage down toilet pits can be offset by building garbage pits close to the toilets. These are unlined pits protected by a ring beam at the surface and have a covering slab with lid. These have been used in both the school and in outreach projects. This single addition can extend the working life of the pit considerably. Also several toilets used at the school were built 20 years ago and employed a tank beneath the slab rather than a pit. During 2010 some of these tanks were emptied with a small suction tanker ("Honeysucker").

Modifying the existing boys urinal for urine collection

Multi-compartment Blair VIP toilets have one enlarged compartment which serves as a boys urinal. At Chisungu, a modified PVC pipe was attached to one of the urinal walls, with urine being led through the toilet wall into a brick tank built below ground level. The pupils built the tank. A shallow lift hand pump made entirely of plastic (modified Blair Pump) was used to pump the urine from the tank into buckets. Pupils usually wear rubber gloves when handling urine. This urine, diluted with water, is used to fertilise a variety of plants in the school premises, including vegetables, maize and trees.

Portable toilet units

There is merit in using a portable superstructure, even in the school environment, and this is being tried in Chisungu and the surrounding outreach areas. Many types of portable unit have been designed including steel frames fitted with doors where the walling material and even the roof can be covered with grass or reeds. Once put into use, these steel frame units can last for many decades with the roof and walling being replaced from time to time from traditionally available materials. They are portable and are useful for use as Arborloo, Fossa alterna or VIP superstructures where the pit may last from a single year up to 20 years.

Upgradeable sequence of toilets

The school also serves as a demonstration site for a variety of toilets designs from the simple Arborloo (tree toilet) to the VIP toilet. A new concept, known as the Upgradeable BVIP (Blair VIP), is currently being considered by the Government of Zimbabwe for future programs. This was pioneered in this schools project. In this concept the shallow corbelled pit capped by a concrete slab is made first, with the superstructure design being optional and upgradeable over time.

Building toilets in homesteads

The pupils have also been engaged in the construction of some toilets in the community especially of older "granny headed" households. In these cases a builder may be employed to build the substructure and slab, and the pupils assist by building the superstructure. The residents are able to witness the event which the pupils enjoy. It gives them a sense of lasting achievement and also benefits the family.

Innovative ideas in recycling

Human excreta (faeces and urine used either separately or in combination) contain valuable nutrients which can assist plant growth. The faeces must be composted until free of pathogenic bacteria and where worm eggs, if present, have lost their viability. Various ways are being used to recycle these nutrients. The urine is a valuable and plentiful source of nitrogen, and experiments carried out at the school have revealed much increased production of maize and a variety of green vegetables. Composted excreta derived from shallow composting pits can be very valuable. The alternating shallow pit compost toilet known as the *Fossa alterna* was designed for this purpose. Here, soil, ash and leaves are added to the filling pit, thus accelerating the rate of composting. The fully composted material is dug out after a year or more, making available a new empty pit. Details of these methods have been reported elsewhere.

Shallow pits and trees

Trees have also been planted near or around the shallow pit toilets to do the recycling. The tree roots are able to tap the nutrients in the excreta, whether they are composted or not. This is recycling at its simplest – out of site and out of mind! Many tree species can be used. Currently these include two species of gum tree, *Eucalyptus grandis* and *Eucalyptus tereticornis*, and the black mulberry *Morus nigra*. Earlier work in Zimbabwe revealed that a considerable range of both exotic and indigenous trees can benefit from pit compost. Remarkable growth of the profitable gum tree has been achieved around toilets which also draw out the liquors and nutrients from the soil around and beneath the pit. This "tree effect" may help to reduce the penetration of pathogenic bacteria held in excreta into the ground water and also reduce the entry of nitrogen into the water table. It is thought the combination of shallow pit technology (max 2m depth) in combination with nearby planting of suitable liquor drawing trees, such as gum, may reduce the potential for pit toilets to contaminate ground water. The toilets are always placed 30m or more from a working source of potable water, such as a well. In this project the pollution of the underground sources of water is highly unlikely. Money can also be made from the gum trees which can be coppiced many times and sold for firewood or building material. Linking toilets with trees makes very good sense.

Trees and urine

Diluted urine can accelerate the growth of many plants including trees. This is most noticeable in the gum tree and banana. In fact most trees respond positively to the weekly application of diluted urine. Urine collected at the school has been used to accelerate the growth of green vegetables and maize and this has been reported earlier. In later trials, urine derived from the boy’s urinal is diluted with water and applied to woodlots of gum trees once a week. This has led to a considerable acceleration of the growth rate of the trees. Mulberries also respond well to urine treatment and currently the “urine effect” is being studied on the multi-purpose, indigenous tree *Acacia albida*. This remarkable tree also fixes nitrogen in its leaves.

Innovative ideas in hygiene

Hand washing and personal hygiene are vital components in any sanitation promotion in which a health benefit is expected. The school hand pump delivers safe and potable water, but pathogenic bacteria can be carried in large numbers on the hands after toilet use. The pupils have been taught how to make simple hand washing devices from cans or plastic bottles. These may be more valuable in the homestead. The school pupils won a first prize for their demonstration of simple hand washing devices at a public event where many schools were represented. Once seen the method is easily copied.

Conclusions

This simple work reveals that innovation is still possible in this much studied area of development. Like all research projects, new ideas and revelations never seem to come to an end! Lectures and practical courses describing this work have already been given in countries like Uganda and Malawi, but have not yet been replicated in Zimbabwe. However there will be considerable scope for these innovations to be used more widely in future reconstruction programs when the country becomes more stable. What has been revealed is that the pupils are quite capable of constructing fully functional toilets as well as practicing many forms of recycling activity. And also, as it turns out, they have also participated in practical research and development work. Such innovative work, benefits not only the pupils and the schools of today, but also the many who will follow them in the years to come.

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