MANAGING EVERYDAY SHIT USING THE 'MIRACULOUS' TIGER TOILET: A Technological Solution for Sanitation Challenges in Uganda

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Introduction

The tiger toilet is a type of ecological sanitation that uses earthworms to breakdown faecal sludge into vermicompost; manure rich for crop production (Appelhof, 1997). Like other ecological sanitation toilets, the tiger toilet has a shallow pit of 1m deep to ease emptying. The depth of the pit promotes protection of the underground aquifer. The toilet is constructed as a permanent facility, which is emptied when full and reused. It is designed in such a way that the superstructure is not tampered with during emptying. The toilet is ranked at the top of the sanitation ladder because it provides a high quality sustainable sanitation solution that eliminates problems associated with traditional pit latrines i.e., filling up, replacement, smell, costly emptying and challenges of excreta management (Furlong, 2014). Earthworms control sludge build up in the toilet chamber, ensuring prolonged usage. By design, the toilet Tiger Toilet allows for filtering of liquid influent and facilitates infiltration of safe effluent into the soil as well as production of high quality manure (ibid, 2014).

Uganda is faced with many sanitation challenges one of which is lack of appropriate technological options especially for people in areas with high water table and rocky grounds (Kakuru & Batega, 2010). In such places, pit latrines cannot provide an adequate sanitation solution because they either collapse or the rocky ground makes it very hard and expensive to excavate pits (ATC, 2011). The national sewer system caters for only 6.4% of the urban population (MWE, 2013). Amidst, the wave of urbanization has led to people living in small plots of land where they cannot afford to construct a latrine twice. They therefore construct harmful hanging toilets, which are often opened and release untreated sludge in the environment. Other undignified sanitation options commonly used include 'flying toilets' and open defecation (Isabel et al, 2011). Access to safe sanitation is a human right and therefore, people need toilet solutions that provide safety, comfort and protect the environment.

Ecological sanitation has for over a decade been promoted in Uganda to bridge the technological gap. The tiger Toilet is an addition to the ecological sanitation menu. The Appropriate Technology Centre for Water and Sanitation, Water for People, Oxfam International, PriMove India under the overall coordination of Bear Valley Ventures Limited UK are undertaking research to profile the viability of the Tiger Toilet as a safe and sustainable sanitation solution. This research is concurrently carried out in Uganda, India and Mymnar. The Tiger Toilet experiments in Uganda were set up in February 2014; with demonstrations constructed in three villages i.e., Buguju, Ngandu and Kigombya all in Mukono district. These facilities have been operational for a period of 6 months and evidently, the toilet chamber still looks empty. These facilities are under

close monitoring with monthly analysis of influent and effluent samples. This exercise will go on for at least one year however; pit filling and emptying may take more than 2 years.

Earthworms and their Survival in the Toilet

There are over 1800 species of earthworms worldwide. However, not all worms can be effectively used for composting. The Tiger Worms (Eisenia foetida), Red Tiger Worms (Eisenia andrei), the Indian Blue Worm (Perionyx excavatus), the African Night Crawler (Eudrilus euginae), and the Red Worm (Lum- bricus rubellus) are the only species with the ability to stabilize faecal sludge into vermicompost (Sinha et al 2009). Worms are bi-sexual animals, they eat twice their weight daily and if well fed can double in population monthly (Chicago Conservation Corps, 2012).

The survival of earthworms in the toilet chamber is threatened by ammonia present in urine. Earthworms are fragile to ammonia and in case of direct contact the worms die. Similarly, relatively high temperatures i.e. above 35^0C kill the worms (Aldadi et al, 2005). For this study, we are using the tiger worms and African Red Crawler that are installed in a specially designed toilet with bedding layer. The threat of ammonia plenty in urine is minimized by use of water. The toilet is constructed in such a way that urine is diluted with water and allowed to percolate through the system into the ground, leaving the worms to feed on solid faeces. Use of water also helps to regulate the temperatures in the composting chamber thereby maintaining a moist environment needed by the worms.

Operation and Maintenance of the Tiger Toilet

Operation and maintenance of the tiger toilet is very simple. Being a low volume pour flush, the toilet requires only 2litres of water to flush the waste into the composting chamber. It functions well without an offensive odor, maggots, flies and rodents as long as the user does not use/clean the toilet with detergents such as JIK bleach, Vim, herpic and powdered soap, does not throw in synthetic materials, sanitary pads, condoms and glasses which might block the system (Chicago Conservation Corps, 2012).

People generally have a fear of handling the compost from ecological sanitation toilet options because it is associated with human faeces (Kassa, 2009). One thing to note is that there is no scientific evidence to justify fears but just attitude characterized by

phobia and ignorance about the safety and potential of effluent compost. Research by Jenkins et al (2007) indicated that vermicompost is safe and a resource to sustain the ecosystem. As ecological sanitation technologies become common, there is a business opportunity created i.e., one can invest in emptying of Ecosan toilets and selling the manure, which can be used in lawns and gardens. However, the person in charge of emptying has to always have adequate protective gears.

How Eco-friendly are Earthworm-based Toilets?

The eco-strength of an earthworm-based toilet (Tiger Toilet) is the aptitude to uphold the ecosystem by minimizing pollution through recycling of waste. Its shallow depth is an advantage for protecting ground water even in areas with high water table. It is also easy to excavate the pit by people in rocky areas. According to Smet & Sugden (2006), the ability to provide a technological solution for people in geographically challenging areas is the outstanding selling point of all ecological sanitation technologies.

The tiger toilet promotes onsite sludge treatment thereby discouraging disposal of destructive sludge in the environment. Faecal sludge contains hazardous bi-products such as heavy metal, salmonella spp, Shigella spp, E. coli and protozoa cysts (Sinha et al, 2009 & Jemenez, 2009). Earthworms destroy these harmful pathogens, maximize solids digestion and stabilize sludge into safe compost through the process of vermicomposting (Jenkins et al, 2007).

Earthworms feed on faecal sludge and the castings produced through secretion; are rich in plant nutrients such as Nitrogen, Phosphorous, Nitrite, Carbon and Potassium (Jemenez, 2009., Nagavallemma et al, 2006 & Alidadi et al, 2005). In brief, the vermicompost produced contains all those minerals needed by plants during the growing period.

A random sample testing for Total Suspended Solids (TSS), faecal coliforms and BOD on the influent and effluent positioned the tiger toilet as a promising technology that can substantively protect the environment (table 1 below) however, conclusive results are pending completion of the going research.

Table 1: Sample analysis carried out on 14-07-2004

	Units	Household 4		Household 8		National Standards for effluent discharge
		Influent	Effluent	Influent	Effluent	
Total Suspended Solids (TSS)	mg/L	1536	70	326	33	100
Chemical Oxygen demand (COD)	mg/L	960	129	315	47	100
Faecal Coliforms	CFU/100mL	120×10^6	**1.5×10^6**	**127×10^6**	**1.58×10^4**	5×10^3

Conclusion

In sludge management, earthworms demonstrate two important processes i.e., the biodegradation and soil production process (Alidadi et al, 2005). They therefore play a key role in conservation, rejuvenation of the environment and provide cost free nutrients, which can be used in agriculture to enhance food security.

The national sewer is limited to a minority urban population, septic tank based toilets are quite expensive and pit latrines are environmentally degrading. The tiger toilet technology comes in as an efficient and compact on-site sanitation option ideal for most parts of Uganda. It is a sanitation solution that is easy to operate and maintain.

References

ATC (2011). *Report on Water and Sanitation technologies Study*. The Appropriate Technology Centre for Water and Sanitation: Mukono

Alidadi, H., Paruaresh, A. R., Shahmansouri, M. R., & Pourmoghadas, H (2005). *Combined Compost and Vermicomposting Process in the Treatment and Bioconversion of Sludge.* Iran.J.Environ.Health.Sci.Eng, Vol.2.4 pp251-254. Accessed at: www.bioline.org.br/pdf?se05036

Appelhof, M. (1997) *Worms Eat My Garbage*. (2nd edition). Flower Press, Kalamazoo, Michigan, US

Chicago Conservation Corps (2012). *Worm Composting Myth Busters*. University of Illinois Extension, Compost. Accessed at www.urbanext.illinois.edu/homecomposting/worm.htm/.

Furlong, Claire (2014). *Proving the worth of tiger toilets in real world.* On-going study coordinated by Water for People, Appropriate Technology Centre for Water and Sanitation, Uganda, PriMove India, Oxfam International, Bear Valley Venture Limited, UK.

Isabel, Günther., Alexandra, Horst. , Christoph, Lüthi., Hans-Joachim, Mosler., Niwagaba, B. Charles &Tumwebaze K., Innocent (2011). *Where do Kampala's poor "go"? Urban sanitation conditions in Kampala's low-income areas.* 1_Research_for_policy_2011.pdf Accessed at: http://www.nadel.ethz.ch/publikationen/1_Research_for_policy_...

Jenkins, Suzanne. R., Armstrong, Carl W & Monti, Michele. M (2007). Health effects of biosolids applied to land: available scientific evidence. Accessed at http://www.vdh.state.va.us/epidemiology/dee/documents/biosolids.pdf

Jiménez, B. (2009). *Helminth ova control in wastewater and sludge for agricultural reuse.* Water reuse new paradigm towards integrated water resources management. In W.O.K.

Jiménez, Blanca., Navarro, Inés and Maya, Catalina (No year). *Pathogens in dry sanitation systems and risk of using sludge produced in agriculture*. Accessed at http://www.sswm.info/sites/default/files/reference_attachments/JIMENEZ%20Pathogens%20in%20dry%20sanitation%20systems.pdf

Kakuru. Doris M & Batega, Dauda Waiswa (2010). *Addressing sanitation challenges in poor urban areas through sustainable technologies, gender integration and supportive policy framework.*IDRC

Kassa, Kinfe (2009). *Challenges and Opportunities of resource oriented sanitation toilets in Arba Minch, Ethiopia*. Water, Sanitation and Hygiene: Sustainable Development and Multisectoral Approaches. 34th WEDC International Conference, Addis Ababa, Ethiopia. Accessed at; www.gtz.de/Dokumente/oe44/ecosan/en-challenges-opportunities-of-resource-oriented-sanitation-toilets-2009.pdf

MWE (2013). *Uganda Water and Environment Sector Performance Report 2013*. Ministry of Water and Environment: Kampala.

Nagavallemma, K.P., Wani, S.P., lacroix, S., Padmaja, V.V., Vineela, C., Babu, R.M & Sahrawat, K.L (2006). Vermicomposting: Recyling Wastes into Valuable Organic Fertilizer. Open Society Journal Published by ICRISAT. SAT eJournal.icrisat.org. Accessed at: www.practicalprepping.net/index_htm_files/v2i1vermi.pdf

Sinha, Rajiv K., Heart, Sunil, Bharambe, Gokul, & Brahambhatt, Ashish (2009). *Vermistabilization of sewage sludge (biosolids) by earth*worms: converting a potential biohazard destined for landfill disposal into a pathogen-free, nutritive and safe biofertilizer for farms. http://wmr.sagepub.com

Smet, Jo & Sugden, Steve (2006). *Ecological Sanitation: A Concept*. Technical Brief. Practical Action: The Centre for Technology and Development. UK. Accessed at; www.engineeringforchange.org/static/content/Sanitation/s00036/Ecological%20Sanitation%Technical20Brief.pdf