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## **Enhancing waterborne toilets to reduce water usage in schools: experience from Kampala, Uganda**

Jude Zziwa BYANSI<sup>\*</sup>, Richard MUTABAZI, Joel BUWAGUZIBWA and  
Najib Bateganya LUKOOYA

*Kampala Capital City Authority, Kampala, Uganda.*

*\*Correspondence author, E-mail: [byansijude@gmail.com](mailto:byansijude@gmail.com)*

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### **ABSTRACT**

Over 620 million children worldwide lacked a basic sanitation service at their school and 12% of schools have facilities that are not usable. In Kampala's public primary school, the pupil to stance area stands at 57:1 as compared to the required 40:1 by the public health regulation of 2000. A number of waterborne toilets have been constructed in schools to change the pupil to stance ratio from 118:1 to 57:1 in the period 2012- 2018. However, the administrators of schools have denied 07% of the toilets in schools to be accessed by pupils in an effort to control water bills. Administrators prefer pupils to use pit latrines to waterborne toilets because they use less water. This exacerbates the inadequacy of access to sanitation in schools in Kampala. The objective of this work was to develop a waterborne sanitation facility that meets the school administrators' preferences features of VIP latrine with water usage of less than 10 liters of water to flush the toilet. Kampala Capital City Authority (KCCA) has constructed water based toilets referred to as 'channel flush' toilets in public schools to reduce water usage. The channel flush toilet uses a channel as a receiving chamber for faecal matter which is flushed intermittently to the septic tank or bio-digester. Each toilet block is flushed four times a day with each flushing time using 60 liters of water. With the channel flush toilet, schools use about 4 liters per child per day on flushing toilets leading to a 90% water usage reduction. Emptying has been reduced from 30 cubic meters to 5 cubic meters per year. The toilet is recommended to be used in schools and public places such as markets and taxi parks.

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**Keywords:** Waterborne toilets, VIP latrine, ventilated pit latrine, schools, Kampala Capital City Authority, Uganda.

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### **INTRODUCTION**

Goal six of the Sustainable Development Goals (SDGs) requires the world to achieve universal access to adequate and equitable sanitation and hygiene for all by the year 2030 (UN, 2018). This can be realized through putting up infrastructure, operating and maintaining them across both the waste

water and the faecal sludge management chains. To date, 892 million people still practise open defecation and 4.5 billion people do not access safely managed sanitation services where excreta is safely disposed of *in situ* or treated offsite (UN, 2018). Currently, over 620 million children worldwide lacked a basic sanitation service at their school and 12%

of schools have facilities that are not usable (WHO/UNICEF, 2018). Poor water, sanitation and hygiene (WASH) conditions have been reported to reduce educational outcomes in school going children by contributing to absenteeism and impaired cognitive abilities (Cronk et al., 2015). Worldwide over 440 million school days are missed annually by children due to WASH-related illnesses (Hullalli et al., 2017).

In Kampala, the Capital City of Uganda, schools are required by law to only use waterborne toilet (MLHUD, 2011). About 20% of the toilet facilities in Kampala public schools meet this requirement (KCCA and WAU, 2018) with the ventilated improved Pit (VIP) latrines being the most popular and preferred technology covering 57% of all toilet in public schools (Kimbugwe et al., 2018). Kampala Capital City Authority, the entity managing the city for the central government, has invested in waterborne toilets in primary schools shifting the pupil to stance ratio from 118:1 in 2012 to the current 57:1 (Kimbugwe et al., 2018). However, children are denied access to 7% of the waterborne toilet stances in school. This exacerbates the inadequacy of access to sanitation in schools in Kampala. The objective was to innovatively modify the waterborne toilet to have features of a ventilated pit latrine and minimize water usage. The ventilated pit latrine is preferred over the waterborne toilet because of low operations costs and low water usage.

## **MATERIALS AND METHODS**

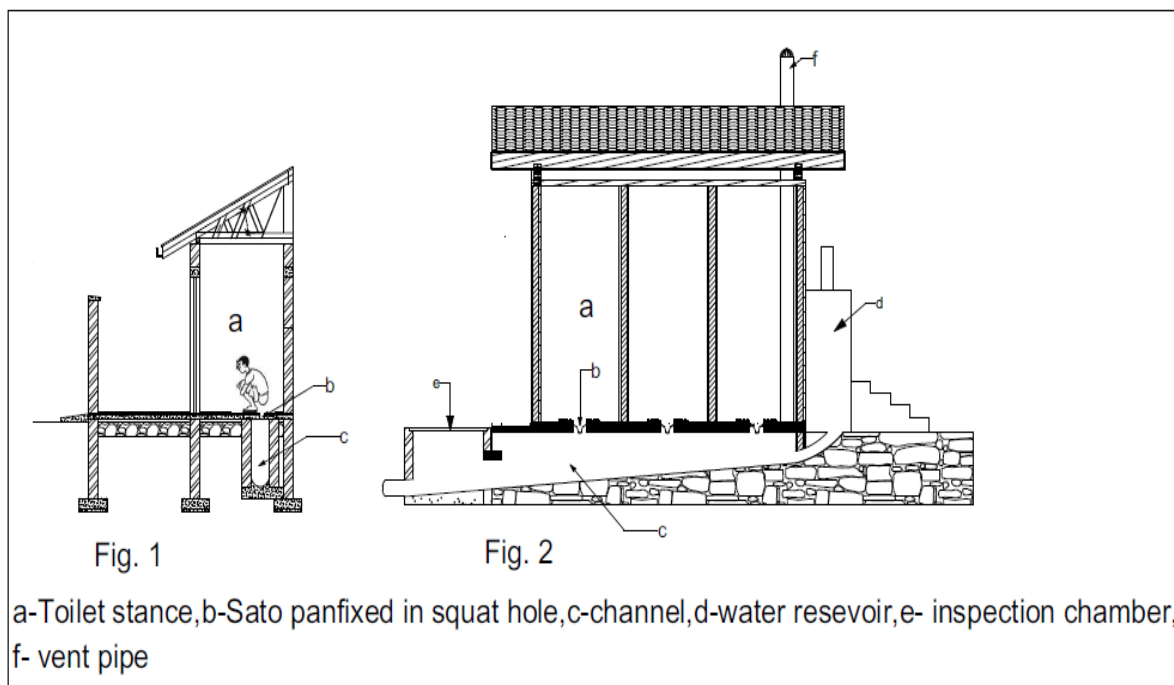
### **Enhancement of waterborne toilet to channel flush toilet**

The features of the VIP latrines and those of waterborne toilets were compared and contrasted in line with the problem of water usage. Common features were maintained and the differences considered for modification. All features of the superstructure of the VIP

latrine were maintained in the new design which led to elimination of cisterns for the case of waterborne toilets. The substructure of the VIP latrine was adjusted by incorporating a channel in the substructure instead of having a pit. The drop hole for the case of VIP latrine and toilet bowls for the case of waterborne toilets were replaced by a sato-pan. A sato-pan is a plastic mold that fits into a concrete base over a squat hole with a self-sealing trap door that shuts out flies and unpleasant smell. The sato-pan, direct the feces in the channel which is directly below them as shown on Figure 1. The channel is constructed using concrete with a slope of 12% to 15% and the surfaces finished smooth with cement sand mortar. The channel depth is 1.5 m above floor level with bifurcations at each point that is directly below the squat hole. Bifurcations are put in the channel to retain some water that keeps the channel wet always. The channel connects to a reservoir at the upper end and to the inspection chamber at the lower end. The inspection chamber then connects to the septic tank as shown on the Figure 2. The modified waterborne toilet is referred to as 'channel flush toilet'. In Kampala, the cost of constructing a channel flush toilet is equivalent to that of a waterborne toilet.

### **Using the channel flush toilet**

The channel flush toilet is used as a pour flush waterborne toilet with a flushing quantity of one liter to clean the sato-pan. The sato-pan opens upon receiving the weight of the feces and closes the flap upon releasing it into the channel underneath the floor slab. After three hours of use, 60 liter of water are flushed from the reservoir running through the channel down to the inspection chamber. The flowing water cleans the channel of all feces taking it into the septic tank or the digester. The foul stench escaped through the vent pipe inserted on the channel.



**Figures 1 and 2:** Samples of toilets.

## RESULTS AND DISCUSSION

### Using a ‘channel flush’ toilet in Kampala

KCCA has constructed 12 toilet blocks each with 14 stances that uses this technology. These toilet blocks are used by public schools having an average population of 1000 pupils with an estimated water usage on waterborne toilets of about 30 liters per child per day. With the channel flush toilet, schools use about 4 liters per child per day on flushing toilets leading to a 90% water usage reduction.

Sato-pans prevent flies to harbor in the toilets by closing the drop hole with a flap after solid have fallen in the channel. There is no foul stench due to the fact that vents pipes are connected to the channel to suck out the bad odor. Secondly, the waste is not given long time to sit in the channel while rotting. Flushing is always done every after 3 to 4 hours. The challenge of the channel surface drying when the toilet is not in use for a long period is solved by wetting the channel with soapy water. This is normally experienced on resumption of schools after holidays.

The toilet are as clean as waterborne toilets with very low maintenance costs. The technology is recommended for public and institution sanitation where bid numbers of user are common. Such institutions include schools, markets and taxi parks. These institutions require a lot of water for flushing. It is common in Kampala to find soak away pits of such institutions failing due to the high volumes of water received per day which cannot be accommodated by the soils through infiltration. This technology also reduces on the emptying frequency for the toilets.

### Conclusion

The public schools where channel flush toilets have been constructed, fecal sludge emptying has been reduced by 80% (from 30 Cubic meter to 5 cubic meters per year). The toilet is recommended to be used in schools and public places such as markets and taxi parks. More research needs to be done to optimize water usage and channel flow properties.

### COMPETING INTERESTS

The authors declare that they have no competing interests.

### AUTHORS' CONTRIBUTIONS

All the authors participated in this work and contributed to the writing of the final manuscript.

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