Habitat International 49 (2015) 529–537

Contents lists available at ScienceDirect

Habitat International

journal homepage: www.elsevier.com/locate/habitatint

Performance of pit latrines in urban poor areas: A case of Kampala, Uganda

Anne Nakagiri [a,*], Robinah N. Kulabako [a], Philip M. Nyenje [a], John B. Tumuhairwe [b], Charles B. Niwagaba [a], Frank Kansiime [c]

[a] Department of Civil and Environmental Engineering, College of Engineering, Design, Art and Technology, Makerere University, P.O. Box 7062, Kampala, Uganda
[b] Department of Agricultural Production, College of Agricultural and Environmental Sciences, Makerere University, P.O. Box 7062, Kampala, Uganda
[c] Department of Environmental Management, College of Agricultural and Environmental Sciences, Makerere University, P.O. Box 7062, Kampala, Uganda

ARTICLE INFO

Article history:
Received 19 March 2015
Received in revised form
19 June 2015
Accepted 3 July 2015
Available online 13 July 2015

Keywords:
Maintenance
Operation
Performance
Pit latrines
Smell
Urban poor

ABSTRACT

In many urban poor areas of Sub-Saharan Africa (SSA), demand for human excreta disposal is met, predominantly by pit latrines. This study aimed at determining the status of pit latrines (design, construction, operation and maintenance) and its influence on latrine performance (filling, smell and insect nuisance). The study was conducted on 130 pit latrines in typical urban poor areas of Kampala, Uganda. Data on design, construction, usage, operation and performance of the pit latrines was collected by interviews, observations and measurements; and analysed by descriptive statistics, bi-variate analysis and logistic regression. Results showed that the level of pit content was predicted by rain or storm water entry, terrain, cleaning before or after use and number of households using the latrine. Smell was predicted by cleanliness, stance length, superstructure material and whether the latrine was private or public. The predictor of presence of flies was the superstructure material. To improve the performance of pit latrines in urban poor areas, researchers and practitioners should develop local latrine design standards (dimensions, construction materials and number of users) and cleaning guidelines for local policy makers to implement.

1. Introduction

Access to improved sanitation in urban poor areas of developing countries is low. Urban poor areas, commonly referred to as slums, are heavily populated areas, characterised by substandard and unplanned infrastructure, poverty, and lack basic services like water and sanitation (Struyk & Giddings, 2009; UN-HABITAT, 2009). Human excreta disposal in urban slums of Sub-Saharan Africa (SSA) is predominantly by use of pit latrines (Katukiza et al., 2012; Thye, Templeton, & Ali, 2011). Pit latrines have been adopted and are used because of their low cost, simplicity of construction and ease of operation and maintenance. However, their use in urban slums is characterised by several challenges. Jenkins, Cumming, Scott, and Cairncross (2014) reported that some of the pit latrines in Tanzania did not meet the criteria of hygiene, safety and sustainability of sanitation systems because they were full or overflowing. Pit latrines in central Tanzania, were found to have high numbers of *Culex quinquefasciatus* mosquitoes, *Chrysomya putoria* and *Psychodidae* fly families (Irish, Aiemjoy, Torondel, Abdelahi, & Ensink, 2013). In Kenya, Caruso, Dreibelbis, Ogutu, and Rheingans (2014) found that the disgusting smell of latrines prevented their use by primary school pupils. Smell, flies and high filling rates are problems that have been associated with pit latrine use in Kigali, Rwanda (Tsinda et al., 2013). In slums of Kampala Uganda, Kwiringira, Atekyereza, Niwagaba, and Günther (2014a) reported high pit filling rates and smell as barriers for latrine usage and subsequently open defecation. Earlier, Tumwebaze, Orach, Niwagaba, Luthi, and Mosler (2012), faulted smell as one of the reasons for user dissatisfaction with use of their pit latrines.

Understanding the design, construction, operation and maintenance of pit latrines within urban slum contexts could help come up with strategies to improve their performance in these settings. Research has shown that the presence of a door, superstructure quality (in terms of height and construction materials for walls) as well as the slab type, affect the cleanliness of a latrine (Sonego &

* Corresponding author.
E-mail address: anakagiri@gmail.com (A. Nakagiri).

http://dx.doi.org/10.1016/j.habitatint.2015.07.005
0197-3975/

Mosler, 2014). Absence of a roof over the latrine and temporary superstructures as opposed to brick superstructures positively correlated with high numbers of flies (Irish et al., 2013). Relatedly, models on pit latrine filling have shown that adding non-degradable material into the pit and water inflows significantly influenced its filling (Brouckaert, Foxon, & Wood, 2013; Todman et al., 2014). Although not statistically related, smell has also for long been known as a proxy for dirty toilets.

The aim of this paper is therefore to determine the status of pit latrine structures, in terms of design, construction, operation and maintenance and the influence of these factors on their performance (filling, smell and insects nuisances) in a typical urban slum area.

2. Materials and methods

2.1. Study area

This cross-sectional study was conducted in Kampala, the capital city of Uganda. Kampala has a population of 1.79 million people (UBOS, 2013), of which about 60% resides in slums (Rugadya, Nsamba-Gayiiya, & Herbert, 2008). This research is part of a study being undertaken to enhance the performance of pit latrines in slums of Kampala Uganda, focussing on Lufula Zone in Bwaise II Ward/parish, Kawempe Division. To get information more representative of Kampala, other zones within Bwaise II parish and slums spread across the five divisions of Kampala, which are known to house different ethnic groups were included in this research. The slums outside of Bwaise II were, Kasubi in Rubaga Division; Naguru-Godown and Kinawataka in Nakawa Division; Kifumbira in Kawempe Division; Kisenyi in Central Division and Namuwongo in Makindye Division (Fig. 1).

2.2. Data collection

Data was collected from traditional/simple and ventilated improved pit (VIP) latrines, which are used by 95% of the households in slums of Kampala (Tumwebaze et al., 2012). All (38) pit latrines, were assessed within Lufula zone, Bwaise II. In addition, 44 pit latrines were randomly selected and assessed in the other zones of Bwaise II and 48 from other slums of Kampala, outside of Bwaise II. In total, therefore, 130 pit latrines were studied.

Information in this study was obtained through field observations, measurements and user interviews. Data collected during observations and measurements of the pit latrines included facility design, stance size, materials used for construction, the structural condition of the latrine, presence of bad smell, and flies or other insects. Presence of bathroom, hand washing facilities and areas used for disposal of greywater were also noted. In addition, whether or not, the latrine had an access manhole for pit emptying was also noted. All information obtained was recorded in a pit latrine design assessment sheet. Questionnaires were used to record information obtained during the user interviews. The interview addressed the ways in which the pit latrines were operated, including public or private use, numbers and types of users, and the materials other than excreta, which were put in the pit. The details on latrine maintenance (cleaning and what is done when they are full) and user satisfaction were also noted.

2.3. Data analysis

The data were analysed using SPSS version 21. Descriptive statistics mainly percentages, means and standard deviations were used to describe the status of the pit latrines. Bivariate analysis (cross-tabulation and correlation) was used to establish variations within performance of pit latrines. The relationship between performance of pit latrines and their status was determined by binomial logistic regression, whereby a best fitting model was created, from which variables useful in predicting the performance factors were identified. The variables used in the regression analysis are listed in Table 1. All conditions for logistic regression including linearity and multicollinearity were satisfied. The difference in performance of the pit latrines between the flooded and non-flooded areas plus the different latrine design types was assessed using the ANOVA at a significance level of 95%.

3. Results

3.1. Design and construction of pit latrines

The design, construction and structural condition of a pit latrine are important to ensure its proper functioning. The pit latrines in this study were all rectangular in shape, with VIPs and simple/traditional types at about 23% and 77%, respectively (Table 2). These were mainly built out of brick and plastered (77%), with timber doors (89%) and corrugated iron roofing sheets (91%) although there existed facilities with either polyethylene or mud and wattle walls (Table 2). The vent pipes of the VIPs were all made out of uPVC, mainly grey in colour (87%) and located within the superstructures (93%). Additionally, all vent pipes lacked fly screens. Fig. 2 shows existing pit latrine structures within the study area. Majority of latrines were constructed using strong and durable materials which met the recommended standards.

The number of stances per pit latrine ranged from 1 to 10, with a mean value of 2 (Table 3). The brick built structures had up to 10 stances, while timber, polyethylene, mud and wattle and roofing structures were limited to 2 stances. All pit latrine superstructures were placed directly above the slab. The slabs were all squat type, majority made of concrete (95%) of which only 10% were found to be smooth (Table 2). The minimum drop-hole length was 180 mm and the maximum width was 150 mm (Table 3).

The latrine slabs were placed directly over a single pit that was either sunk in the ground (36%) or elevated above the ground to a mean height of 935 mm (Table 3). Raised pit latrines were found in both terrains (Table 4), although the number and height of pit were significantly higher ($p \leq 0.001$) in the flooding areas. Elevated pits were all constructed using plastered brick work. Access to the elevated pit latrines was by concrete steps (61%), ramp (10%) or ladders (25%) and in some cases none (4%). Some pit latrines (47%) were constructed with an attached bathroom stance (Fig. 2), majority of which (82%) were discharging their grey water into open drains. Almost all pit latrines (98%) lacked hand washing facilities.

Thirty nine percent of the pit latrines had cracks while 40% showed signs of rain or storm water entry (Fig. 3). This indicates that some of the latrines were not structurally sound. Significant differences were noted between the structural condition of pit latrines in both terrains ($p \leq 0.001$) with more latrines having cracks and showing signs of rain or storm water entry in flooding areas. With regard to the construction materials, most of the plastered brick structures were structurally sound while more of the non-plastered ones showed signs of collapse and rain or storm water entry. All polyethylene and mud/wattle structures showed signs of collapse and rain or storm water entry (Fig. 3).

3.2. Operation and maintenance of latrines

Operation and maintenance of a pit latrine is crucial for its performance. Majority of the pit latrines (85%) were operated as private to households, shared by mostly 5–8 households, although up to 20 households were found using a single latrine stance. The