Urban slum dwellers in Kenya and Bangladesh benefit from using Peepoo bags which are self-sanitising and biodegradable

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Abstract

The multiple challenges of urban slums limit the ability of conventional infrastructure-based sanitation systems to quickly address the pressing sanitation needs of urban slum dwellers. The Peepoo is a self-sanitising, single-use, biodegradable "toilet bag" which can become valuable fertiliser after use. This paper presents results from two medium-scale studies with the Peepoo bag system: One feasibility study was conducted in the Silanga Village slum in Kibera, Kenya (278 participants, 3,354 Peepoo bags used over 28 days) to investigate socio-cultural expectations, economic viability and the suitability of the collection system. Another feasibility study was conducted in three slums in Mymensingh, Bangladesh (100 participants, 738 Peepoo bags used over ten days) to gauge the socio-cultural acceptability of the Peepoo bag with water-washing practices. Both studies found a very high level of user acceptance with a multitude of perceived benefits. The greatest benefit reported by users in Mymensingh (28%) was the possibility to go to the toilet more frequently, instead of having to restrain themselves for lack of access to a safe and hygienic toilet facility (even more important for females). The results provide an outlook for future use of the Peepoo bags in urban slums and for other emergency situations.

Keywords: ecosan, emergency, fertiliser, sanitation, urban slums

INTRODUCTION

This paper reports on key findings from two medium-scale field tests in urban slums in Kenya and Bangladesh with an emerging toilet technology called "Peepoo" from the Swedish company Peepoople. A detailed description of the two studies is provided in JAC (2009) and GTZ (2009), respectively.

The Peepoo bag is a low-cost, dry toilet technology that isolates excreta (in particular: faeces) from human and animal contact in order to provide sustainable sanitation in urban slums and for emergency sanitation situations. The bag is made from degradable bioplastic (EU standard EN13432) and comprises a mixture of aromatic co-polyesters and polylactone acid, with small additives of wax and lime (the base ingredient of the mixture is "Ecoflex" manufactured by BASF in Germany). The plastic is produced using 45% renewable materials (Peepoople intends to find a solution to make the plastic 100% renewable in the future).

As a personal, single-use toilet, the Peepoo bags work like a micro-treatment plant that kills pathogens in faeces within 2-4 weeks of excretion via the toxicity of ammonia (produced from urea granules as each Peepoo bag contains 4 g of urea granules). Scientists at the Swedish University of Agriculture in Uppsala have thoroughly researched this ammonia-based sanitation technology (e.g. Nordin et al., 2008).

It is mandatory that the Peepoo bags are embedded in a sanitation *system*, which includes not only the bag itself, but also its distribution, use (see Fig. 1), storage, collection, treatment and beneficial reuse as fertiliser. Such a system has the potential to be both an ecological and a sustainable sanitation solution as it can be employed in a manner which destroys dangerous pathogens and allows safe reuse of nutrients, along the lines of the ecological sanitation (ecosan) concept. To be considered sustainable, the system must meet all sustainability criteria as defined in the Sustainable Sanitation Alliance's first vision document: these are financial, socio-cultural and institutional, health and hygiene, technical and environmental criteria (SuSanA, 2009).

Used Peepoo bags can be composted or buried directly in the soil and utilised as a complete fertiliser with high nitrogen value. The value of this fertiliser can serve as a step towards poverty reduction and attaining sustainability of the collection and distribution system by creating business opportunities and generating income for community members.

Fig. 1: How to use Peepoo bags – demonstrated by users in Silanga (source: Peepoople).

As a non-infrastructure based technology, the Peepoo bag offers a number of advantages for urban slums:

1. It addresses the political unwillingness and difficulties to make infrastructure investments in "temporary" informal urban settlements.
2. In places where it is not socially acceptable for women to leave the home or to be seen accessing sanitation facilities (or defecating in the open), it offers them the opportunity to go to the toilet at their convenience. In addition to reducing stress and health problems related to withholding urine and faeces (such as urinary tract infections and constipation), this reduces exposure to violence for many women who wait until nightfall to go to the toilet and put themselves at increased risk of physical and sexual abuse.
3. Compared to flush or pour-flush toilets, this technology saves scarce water resources.

Despite the clear potential benefits of the Peepoo toilet system, it is novel, and its vast departure from traditional approaches to sanitation raised concerns that it might not be an appropriate solution. Practical research began with one small pilot study in Kibera in 2008 (Nordin et al., 2008) and was followed by a medium-scale pilot study in Kibera in December 2008 with two main objectives: (i) to evaluate if the Peepoo bags meet individuals' sanitation needs with respect to socio-cultural expectations and (ii) to analyse if the Peepoo bag system is viable in socio-economic terms through the generation of fertiliser.

Since the results from these studies were encouraging, and to gain more experience in a South Asian urban setting, a second medium-scale feasibility study was conducted in three slum colonies around Mymensingh, Bangladesh. This study was funded by GTZ-Bangladesh and was embedded in the Second Urban Governance and Infrastructure Improvement Project of the Local Governance and Engineering Department, which is working to enhance the quantity and quality of facilities and services in urban centres. The goal of the Mymensingh study was to gauge the socio-cultural and religious acceptability and perceptions of users of the Peepoo bags with water-washing practices.

Sanitation situation in Kibera (Nairobi, Kenya)

Kibera, located in Nairobi, Kenya, is the largest slum in Africa with approximately 1 million inhabitants. Toilets are rare in Kibera, and 50-630 people may share one latrine (UNDP, 2006). The situation in Kibera is "some of the worst deprived situations in water and sanitation in the world" – a silent emergency (UNDP, 2006).

The latrines in Kibera lack privacy, safety and accessibility. External services cannot empty latrines because there is no space wide enough for vehicular movement causing pits to overflow. The "flying toilet" has become the norm in Kibera: the act of defecating in a polythene bag and then disposing of it by any means possible, including tossing it through the air. Two out of three Kibera residents identify flying toilets as their primary excreta disposal system (UNDP, 2006).

In addition to the public health and environmental degradation issues involved with flying toilets, the use of polythene bags causes widespread drain blockage leading to flooding during the rainy season. In the Peepoo feasibility study in Kibera, more than 50% of the study respondents stated that he/she utilises flying toilets for excretion needs, demonstrating a significant need for an immediate sanitation solution (JAC, 2009).

Sanitation situation in Mymensingh (Bangladesh)

Bangladeshi urban areas face unique ongoing and emergency sanitation challenges due to the geographical vulnerability of the land to seasonal flooding and the increasing impacts of climate change. There are 94 slum settlements in Mymensingh, Bangladesh, with limited toilet technologies (GTZ, 2009). Three of these were included in this study:

1. Kalibari/Thana Ghat is a Hindu and Muslim settlement. The Kalibari side has three community toilet blocks (at the time of the study, only four of the twelve toilets were functional). Thana Ghat has 14 "hanging toilets" which empty directly into fields and channels that run into the river, the main source of water for bathing, cooking and even drinking.
2. Malgudam is a community of mainly waste collectors, next to Mymensingh's railway station where there are no community toilets and a limited prevalence of private latrines.
3. The Freedom Fighters' Colony is home to one Muslim and nine Hindu households who all share one unsanitary latrine.

METHODOLOGY FOR FIELD TESTS

Methodology for Case 1: Silanga Village slum in Kibera, Nairobi (Kenya)

Silanga Village covers approximately 23 acres with an estimated population of 6,200 families consisting of 43,250 people. During the inception stage, stakeholder meetings were held in preparation for this study. For the field test, 53 families of at least 5-7 individuals were randomly sampled to constitute a representative sample of Silanga Village. The consultants chose and designed appropriate recruitment questionnaires, instruction sheets, a user diary, and conducted several focus group discussions and in-depth interviews (all details in JAC (2009)).

For the field test, five assistants from Silanga Youth Group were recruited under the supervision of Millennium Environmental Services (a community-based organisation) for delivering and coordinating the collection of the Peepoos by wheelbarrow on a daily basis. Some land was identified next to Udungu Centre where the used Peepoos were disposed and later buried in the soil. **A total number of 3,354 Peepoo bags were distributed to 278 participants over a period of 28 days**. Thus, on average, each family member received 12 Peepoo bags during the study period, which lasted from 6 December 2008 to 7 January 2009.

During the Silanga Village field test, Peepoo users were asked to keep a diary to record their excretion behaviour according to specific categories and the effects of the Peepoo bags and the possible improvements in their lives. After the completion of the field test, a random sample of 53 participants was interviewed to ascertain data about their experiences with the Peepoo bags.

Methodology for Case 2: Three slum colonies in the city of Mymensingh (Bangladesh)

The following steps were taken for the feasibility study in Mymensingh, which involved **100 participants, 738 Peepoo bags and lasted 10 days** (all details provided in GTZ (2009)):

1. Two focus group discussions were conducted in April 2009.
2. A pre-intervention household and participant survey was administered to ascertain data on family composition, income levels, housing situation, participants' current sanitation situation, practices, and the initial reactions to the Peepoo toilet technology.
3. A 10-day field test was carried out in May 2009.
4. A post-intervention survey was administered with the users which focused on the practices associated with using the Peepoo, the feelings and attitudes of the users, other family members and community members, and the perceived benefits of the Peepoo.
5. Post-intervention interviews were also held with collectors, surveyors, municipality officials and community leaders to assess their views on the Peepoo toilet technology.

In total, 100 individual participants (not whole families) were selected for inclusion in the field test based on willingness to participate, age (7 months to 75 years) and gender (54 females and 46 males), to have a statistical distribution of age and gender. 92 of the 100 selected participants finally used the Peepoos bags. On day one, each participant was given two Peepoos and on days two to ten, used Peepoos were collected and replaced one-for-one.

To ensure good cooperation by participants and community members, two collectors were hired from within the communities for Peepoo distribution and collection. The used Peepoos bags were collected in buckets and transferred by wheelbarrow to a motorised trolley

provided by the municipality. All used Peepoo bags were taken to a nearby field for burial and subsequent demonstration by Bangladesh Agricultural University of pathogen destruction and the bio-degradability of the Peepoo bags (demonstration results not yet available).
An extensive photo set of the Mymensingh case is available here: http://www.flickr.com/photos/gtzecosan/sets/72157620750794055/

RESULTS AND DISCUSSION

Frequency of defecation and frequency of use of Peepoo bag

Prior to the test period, there had been a draught in Kenya for several months resulting in high food prices. This led to insufficient diets within the participant group and Silanga Village in general. The average participant had bowel movements only once every two or three days. This explains the low average Peepoo bag usage of 12 per person during the 28-day test period.

In Silanga, the Peepoo was used by a significantly higher percentage of women than men. Children were the second most likely demographic group to utilise the Peepoo since it was easy for children to use the bags by placing them in a small container, to be used like a potty. This data indicates that the Peepoo would greatly help to address women and children's sanitation needs in urban slums.

In the Mymensingh case, the average number of bags used over the ten-day period was eight – women using a slightly higher average (8.7 bags) than men (7.2 bags). It was found that most participants did not need to defecate daily, and therefore used less than one bag per day. Usage rates were also reduced by the movement of some participants to rural areas to participate in rice harvesting, which took place over the same period as the field test.

Ease of use, size of Peepoo bag, bag-holding container

64% of Silanga participants and 70% of Mymensingh participants found the Peepoo easy to use though concern was raised over the bag's size: 60% of Silanga participants and 57% of Mymensingh participants felt that the bag should be bigger to make it easier to use (to facilitate urination and defecation simultaneously, for women). However, the disadvantage of a larger bag size is that users could be tempted to use the same bag more than once which would endanger the hygienisation process: the amount of 4 g of urea is balanced to the size of the Peepoo bag.

In both Kenya and Bangladesh, users preferred placing the Peepoo in a readily available container (e.g. tin can of 15 cm diameter) to facilitate handling, rather than holding the bag in their hand while using it. In Mymensingh, 99% of respondents stated that they placed the container on the ground when using the Peepoo, kept the container stationary and sat on top of it, like a pedestal (this was one of the methods explained to them during the participant selection process).

Odour

Most of Silanga respondents (94%) stated that the used Peepoo bag did not smell or smelled only a little. Also in Mymensingh, only few participants (12%) indicated noticing any bad smell, which occurred once or a few times. However, during the Mymensingh study, when large numbers of Peepoos were collected and placed in the trolley, open to the mid-day sun, the heat (approximately 39°C) did cause a detectable odour.

Perceived benefits

In Silanga, 90% of users felt that the Peepoo bag is safe and clean to handle. At least 90% of the Silanga users also stated they strongly recommended the Peepoo as a sanitation solution within Kibera. When asked if Silanga participants would consider Peepoo bags for everyday use, more than 85% of respondents said "yes".

Similarly, almost all (88%) of Mymensingh participants indicated that the bag had benefited them, 87% felt that the Peepoo was better than their normal sanitation practices, and 81% would recommend the Peepoo to others.

When asked what they liked about using the Peepoo, the most common response amongst the Mymensingh participants was that it could be used anytime, followed by the fact that it did not require leaving the house and that it was easy to use (Fig. 2). Regarding specific benefits they derived from using the bag, it was interesting to note that the Mymensingh participants' main benefit was "being able to go more frequently" (28% of participants quoted this benefit, see Fig. 4). This was important for female (57%) and male (43%) slum dwellers who have to routinely hold back the urge to go to the toilet, due to difficulties in accessing a safe toilet.

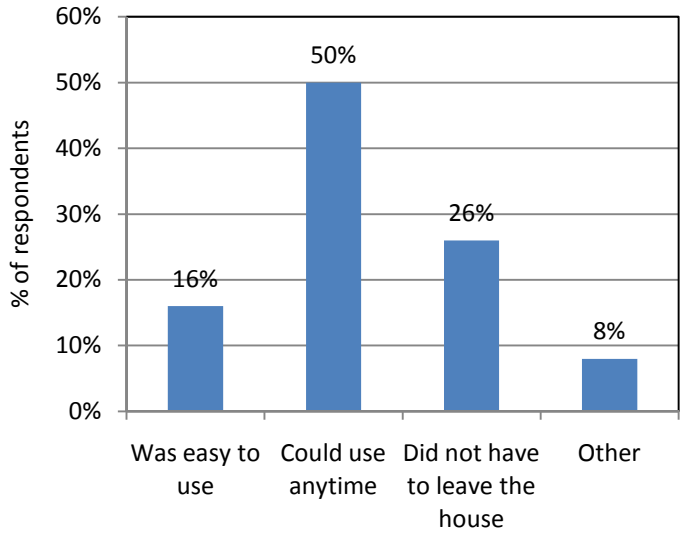

Fig. 2. Answers to the question "what did you like about the Peepoo bag?" from participants in the Mymensingh study after they had used the bags (92 answers).

Fig. 3: Handing over a used Peepoo to a collector in Mymensingh (source: A. Wheaton, May 2009).

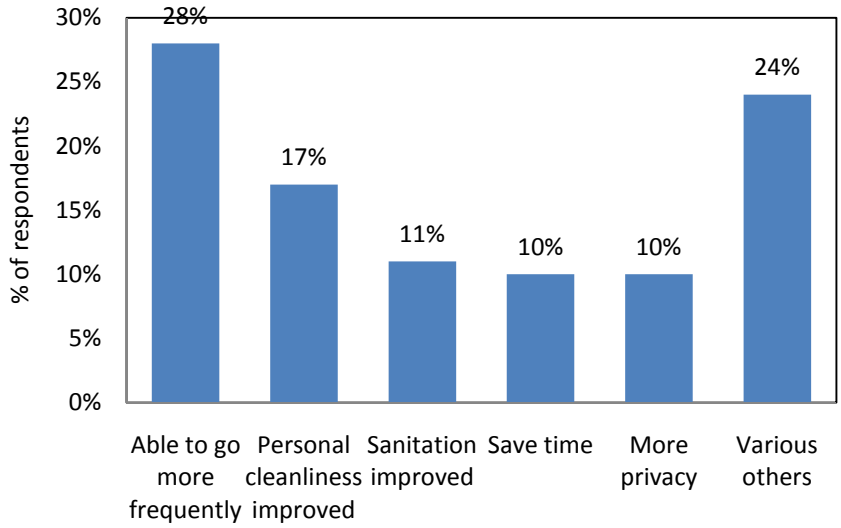

Fig. 4. Answers to the question "what benefits did you get from using the Peepoo bag?" from participants in the Mymensingh study after they had used the bags (82 answers).

Fig. 5. The collector for Malgudam community carries used bags over to her collection bucket (source: A. Wheaton, May 2009).

Being able to use the Peepoo bags can also save time in Kibera since residents have to queue for extended periods of time at the few available public or pay-toilets. Elderly and handicapped individuals are often unable to travel to the toilet or unable to stand in line, relegating them to even less hygienic options for urination and defecation.

An overwhelming 84% of the Silanga users said that they would use the resulting fertiliser themselves while 85% of Mymensingh participants said they would consider selling their used Peepoo bags as fertiliser (results from fertiliser trials with used bags at both locations were not available at the time of publication).

Price of the Peepoo bags

More than 80% of the Silanga respondents were of the opinion that the Peepoo bags should be sold for less than Ksh 5 (EUR 0.044) per bag to make them affordable to the slum dwellers whilst 17% thought it could be sold for more than EUR 0.044.

In Mymensingh, only 39% of respondents indicated that they would be willing to pay for the bag. At present, most of the toilet facilities in their communities can be used for free (construction costs of community toilets were covered by NGOs and external funding). When asked about an appropriate price for the Peepoo, the average suggested price was 0.65 Tk (EUR 0.007), but 19% of users agreed to a proposed price of 1 Tk (EUR 0.011).

The actual price of the Peepoo bag is expected to be EUR 0.04 once they are produced on a large scale. It is expected that the future sales price of Peepoos when mass-produced will be competitive with flying toilets and the user fee for public toilets in Nairobi. As with other urban sanitation systems, initial government subsidies will probably be necessary for the bags and the collection system to make the Peepoo bags affordable for the slum dwellers.

CONCLUSIONS AND RECOMMENDATIONS

Two medium-scale field tests with Peepoo bags were carried out which involved 278 participants in Silanga, Kenya and 100 participants in Mymensingh, Bangladesh. At both locations, the surveys found a clear "endorsement" of this concept by the users. For example, at least 90% of the Silanga users stated they strongly recommended the Peepoo as a sanitation solution within Kibera, and 88% of Mymensingh participants indicated that the bag had benefited them. The benefit most often cited by Mymensingh participants was that they could go to the toilet more frequently – a benefit which reminds us of the daily struggle of slum dwellers who have to hold back their urges for lack of safe toilets.

Observed problems which need to be addressed in further work include: difficulties in using the bag when defecation is accompanied by urination (for women), difficulties in closing the Peepoo bag with a knot, odour problems when many filled Peepoo bags are stored together during collection and transport, and making the price of the Peepoo bags affordable to users.

Further large-scale trials should be conducted in urban slums of Kibera, Mymensingh or other cities (using mass-produced, and therefore cheap Peepoo bags) in order to optimise the Peepoo bag system further (including collection, reuse and overall sustainability aspects). Government subsidies for the bags and collection system might be necessary – at least in the initial stages – to allow the poorest of the poor to afford this type of technology, just like with other urban sanitation systems.

When use is scaled up in the future, it will be possible to measure the Peepoo bag's impact on environmental sanitation, diarrheal disease prevalence, quality of water bodies and drinking water sources, and quality of life improvements. The Peepoo bag system can be an immediate solution for urgently needed sanitation improvements in urban slums in Africa and Asia, whilst the more time-consuming processes for urban slum upgrading should also be pursued by all stakeholders.

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