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IN AN UNCERTAIN ENVIRONMENT

Piloting ecological sanitation (EcoSan) in the emergency context of Port-au-Prince, Haiti, after the 2010 earthquake

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The earthquake that struck Haiti in January 2010 and the cholera epidemic that followed from October 2010, resulted in one of the largest humanitarian relief efforts in history. Even prior to the earthquake, sanitation coverage in Haiti was the lowest in the hemisphere, but with 1.5 million people living in tents in a densely populated urban area that lacked basic infrastructure, the sanitation crisis presented new challenges to the WASH community. Many of the internally displaced persons camps were located in urban neighbourhoods with high groundwater, making onsite sanitation extremely difficult. In response to these unique conditions a small local organization, SOIL, partnered with Oxfam Great Britain to pilot urine diversion EcoSan toilets in camps throughout Port-au-Prince. This briefing paper covers this pilot project from March 2010 through March 2012. During that 2-year period, SOIL's toilets served over 20,000 people and treated more than 400,000 gallons of human waste, converting it to rich compost. This Briefing Paper addresses the toilet component of the operation, whilst another WEDC Conference paper (Kramer et al. under review) addresses the composting of the toilet wastes.

Introduction: emergency sanitation in Port-au-Prince

Because of the unique challenges faced in Port-au-Prince after the earthquake in 2010 many traditional emergency interventions, such as pit latrines, were not appropriate. These challenges included; a dense urban centre with little infrastructure; low sanitation coverage prior to the earthquake; limited available space for construction; landowners unwilling to allow permanent infrastructure; and a high water table. In response to these challenges, many organizations were forced to construct elevated latrines, which collected wastes in aboveground containers that required weekly desludging, or install portable toilets, which required emptying a minimum of every two days. Emptying costs for both of these options, particularly the portable toilets, were prohibitively expensive (WASH Cluster, 2010) and led to many organizations having to withdraw services before camps were closed, leaving people without proper sanitation facilities.

Other challenges faced during the emergency sanitation response were the transportation, treatment, and disposal of the excreta. Prior to the earthquake there were no official dumping sites for human excreta in Haiti, and wastes were disposed of in rivers, ravines, and wetlands. Immediately after the earthquake the government informally allowed human wastes to be disposed of in Trutier, the municipal dumpsite located just north of Port au Prince and, since 2011, two official waste stabilization ponds have been constructed in the metropolitan region by the Haitian government. However during the immediate emergency response organizations were forced to truck human wastes from the camps to unofficial dumping sites without adequate environmental and public health oversight.

Overview of SOIL

Sustainable Organic Integrated Livelihoods (SOIL) is a US-based non-governmental organization working on the promotion of ecological sanitation (EcoSan) in Haiti since 2006. Prior to the earthquake SOIL's work focused on public urine-diversion toilets (UDT) in urban and rural settings in northern Haiti. Following the earthquake in January 2010, SOIL established an office in Port-au-Prince and mounted an emergency sanitation response.

Project overview

Given SOIL's experience in northern Haiti, Oxfam GB approached SOIL with a request to pilot EcoSan UDTs in internally displaced persons (IDP) camps in Port-au-Prince. The primary objective of the initial pilot project was to design a toilet that was temporary, cost effective and whose on-going operation was supported by an off-site composting facility. This required a logistical support platform to collect and transport the waste and cover material necessary for use in the toilets. During March and April 2010, SOIL designed an EcoSan toilet with a wooden frame and plastic sheeting, a fibreglass UD seat and a plastic drum to collect the waste. All materials were sourced in country, reducing costs and avoiding costly shipping and customs complications. A dump truck was used to collect the full drums from the toilets and drop off clean drums with cover material. Drums were transported to a centralized composting facility where the wastes were safely treated and transformed into compost (Berendes *et al*. 2013, Kramer *et al.* under review). During the two years of this project covered by this review, more than 200 people were employed in toilet construction and maintenance.

The pilot commenced in March 2010, two months after the earthquake. This paper follows a 2-year period after the initiation of the project. The different phases of the pilot project were:

- A 1- month pilot phase in March 2010 where 2 toilets were built and tested at a small camp.
- A 2-month research and development phase until May 2010, during which time 48 toilets were built.
- A 4-month intense period of toilet building until August 2010, during which time 150 toilets were built.
- A stabilisation period until the end of 2010, during which time no toilets were built and usage was steady.
- A steep gradual decline in toilets served until June 2011 as people left the camps, from 200 to 120.
- A very slight decline in toilets served until March 2012, with 111 toilets at the end of the study period.

Toilet design

Although SOIL had four years experience with double-vault UDTs in northern Haiti, the double-vault model was not deemed appropriate for emergency use because; 1) the structures were often made with brick and mortar, which was prohibitively expensive, 2) a permanent structure would have been less likely to be approved by landlords, and 3) high usage within the densely populated camps would result in filling rates that would prevent sufficient decomposition within the vaults before they would require emptying.

The first toilets built in March 2010 were constructed in a camp of approximately 2500 people. The first toilet was identical to the double vault systems in northern Haiti except that a 55-gallon drum was placed beneath the toilet seat in the chambers to allow collection and offsite treatment. The second toilet was similar dimensions but was constructed with wood and plastic sheeting (Photograph 1) in place of cement blocks. Toilet seats were brought in from South Africa. The one-month testing period revealed a number of issues, which were addressed in subsequent models. In response to feedback from the camp residents and SOIL staff all toilets constructed after March 2010 had the following modifications:

- 15-gallon drums in place of 55-gallon drums, to facilitate transport and emptying (Photograph 2).
- Locally produced fibreglass UDT seats (Photograph 3)
- Guides in the chamber below the toilet seat to ensure that the drums are placed directly beneath the seat (Photograph 2).
- Non-separating drum-based toilets for children who had difficulty adapting the UDT seat (Photograph 4).

Photograph 1. SOIL UD Toilet, Jan 2011.

Photograph 2. 15-gallon drum with wooden guides.

Photograph 3. Fibreglass UD seat made in Port au Prince

Photograph 4. Non-separating children's compost toilet

Community education

SOIL was in a unique position to implement an emergency EcoSan pilot project in the IDP camps as a result of the organization's 3 years of relevant EcoSan experience, an understanding of Haitian culture and the local language, and a network of friends and collaborators in Port-au-Prince. This position allowed SOIL's pilot project to have a very strong 'software' component in terms of general communication and sharing of information and on delivering specific training events. There were 2 main steps to the education process:

- Initial training with community representatives; The initial meeting offered an opportunity for SOIL to understand the existing sanitation conditions in the camp, and for the designated camp committee to understand the benefits and responsibilities of managing an EcoSan toilet. Although SOIL was only offering EcoSan toilets, the full range of sanitation options available to the camp population was explained to them.
- Educating the general population; Public toilet inaugurations were planned so as to reach as many members of the camp population as possible. The messages spread at the toilet inauguration were short and simple and again focused on proper toilet usage and the environmental benefits of EcoSan technology. Wherever possible, local musicians, DJs, and animators were also integrated into the event to pull in a larger crowd and create a better learning experience.

Toilet management

All emergency toilets installed as part of this pilot were open to the public. Before the earthquake, from 2006-2009, SOIL installed over 50 public UDTs in Haiti, with 36 of these in the urban zone of Cap-Haitien (SOIL, 2011b). In most cases, public toilets that were not managed by a paid operator fell into disrepair and were no longer used. Given SOIL's previous experience and, in line with the basic principles determined by DINEPA (the sanitation directorate of the Haitian government) after the earthquake, SOIL's emergency toilets were managed by paid employees. This system provided income opportunities in the camps and ensured that the toilets met basic sanitary requirements.

SOIL toilet managers received special training on the use, operation, and maintenance of a UDT. A common problem with the UDTs, however, was clogging of the urine pipes. Cover material would sometimes be deposited in the urine chamber instead of on top of the excreta in the drum, which would then clog the urine pipes and cause flooding in the UDT seat. The problem could be attributed primarily to poor usage and maintenance, which required on-going supervision of the toilet managers and continuous engagement with community representatives.

Toilet maintenance

The problem of clogging of the urine pipe was also a technical issue and SOIL went through many versions of urine pipes before settling on a flexible hose that fit into a PVC pipe buried in a soak away pit behind the toilet (where the impermeable nature of the soil in the IDP camps did not permit infiltration into the ground, the urine was collected in 20l containers and transported to the SOIL compost site along with the excreta).

The flexible pipe allowed for easy removal and cleaning of the blocked urine conduit avoiding problems faced with early prototypes of the toilets, which had 90-degree bends in urine pipes.

Functionality of the UDTs was also dependent on access to appropriate cover material as well as proper use by toilet users and managers. Insufficiently covered faeces resulted in strong odours and fly breeding. Identifying a reliable source of cover material and educating users around its importance were essential pieces to the planning phase of the UDT project.

Monitoring and evaluation

SOIL hired a toilet supervisor to visit every toilet in the project area, at least once per week, and report on problems. Improved toilet maintenance, as well as meetings with committees to discuss specific management issues, very often came about as a direct result of the observations made by the toilet supervisor during the weekly supervisions. The supervisions involved an inspection of each toilet according to a detailed checklist as well as conversations with each toilet manager and other potential toilet users in the vicinity. This enabled the SOIL supervisor to develop a rapport with the toilet managers and community as well as acquire a better understanding of the reality concerning the operation of the SOIL toilets and the sanitation situation in general. The toilet supervisor prepared a weekly report that enabled SOIL to evaluate the performance of each toilet and to have an accountability tool with which to record SOIL's own performance in providing humanitarian assistance.

Financial cost of emergency EcoSan toilets in Haiti

One of the primary arguments made against the use of EcoSan toilets in emergencies is that EcoSan toilets are more expensive than traditional options, both in terms of construction as well as servicing. When comparing SOIL's construction costs with that of other sanitation options in Port-au-Prince, however, the construction cost ($750 per UDT) was comparable to that paid by other organizations constructing elevated latrines (SOIL, 2011a). In terms of on-going servicing of the toilets, a comparison of maintenance and collection costs for 3 technologies employed after the earthquake in Haiti demonstrated that SOIL's EcoSan toilets had similar maintenance costs to Oxfam GB's elevated latrines and were dramatically less expensive than portable toilets managed by private sanitation companies in Haiti (SOIL, 2011a). In addition, assuming that the compost generated from the toilet wastes is sold at current market prices, the revenue from these sales makes EcoSan the cheapest option of the three investigated in this comparative study (SOIL, 2011a, Figure 1). Indeed, SOIL has sold over 10,000 gallons of compost produced from the emergency toilets, generating over $2,500 in revenue (Kramer *et al.*, under review).

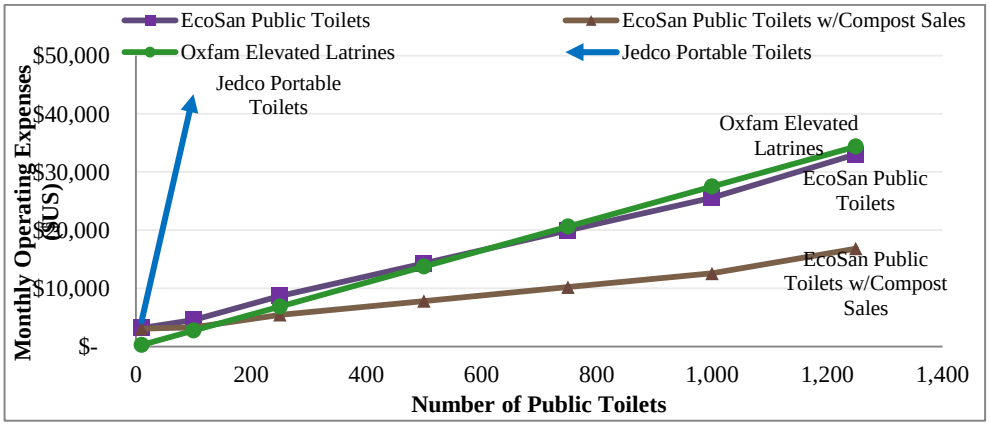

Figure 1. Graph showing comparative costs of emergency toilets in Port-au-Prince, 2011.

Source: SOIL (2011a)

Training and dissemination of knowledge

SOIL worked to disseminate their approach by:

- Publishing a 144-page document entitled "The SOIL Guide to Ecological Sanitation", in February 2011 (SOIL 2011b).
- Drafting National Guidelines & Minimum Standards on EcoSan (WASH Cluster, 2011)
- Consulting on other EcoSan projects in Haiti.
- Organizing a Sustainable Sanitation Conference in Port-au-Prince attended by over 50 national and international sanitation organizations, in June 2012 (Forster and Kilbride, 2012).

Benefits and limitations of UDTs in emergencies as compared to traditional technologies

Although EcoSan has been tested in emergencies, this pilot project represents the first use of EcoSan technologies in an urban IDP camp context. It is important to carefully evaluate the benefits and limitations relative to other more traditional approaches.

Benefits of EcoSan toilets

- Above-ground confinement of wastes allows for safe use in dense urban settings or areas where groundwater tables are high.
- Easily removable post-disaster and, as such, deemed acceptable by landlords who rejected more permanent installations.
- Reduced odour relative to conventional pit latrines, portable toilets, and elevated latrines due to the dry nature of the waste resulting from urine separation and the use of cover material.
- Transportation costs reduced because of urine-diversion, resulting in a reduced volume and weight of wastes requiring transport.
- A drum system provides a toilet with much greater storage capacity than a latrine or a raised latrine, which have defined capacities.
- UDTs with a drum system are low-risk during natural disasters, such as hurricanes, floods and earthquakes because the drums can be sealed to prevent spillage. Weekly removal of drums from sites also ensures that large amounts of human wastes are not accumulating in high-density population areas.
- Collection costs are lower or equal to other above-ground sanitation systems (elevated latrines and portable toilets) and do not require specialized trucks for transportation.
- In countries with few or non-existent waste treatment facilities, EcoSan toilets allow for safe, effective, and low-cost waste treatment without the need for extensive infrastructure.
- Wastes from EcoSan toilets are transformed into rich, organic compost that can be used for agriculture and reforestation, thereby assisting with long-term reconstruction following an emergency.

Limitations of EcoSan toilets

- The drum based system increases the risk of contact with faecal matter as toilet managers are required to change drums regularly. Because of this, additional hygiene training is required and toilet managers must have access to protective equipment.
- A readily available cover material must be provided to users for proper functioning of the toilets (and the compost process).
- EcoSan toilets using a drum-removal system must be supported by a well-managed compost site and a dependable collection service.
- UDT separation seat requires more community education and training of toilet managers relative to traditional non-separating seats.

Lessons learned

1. An accepted toilet design should be developed together with the users.
2. A slow start-up period of research and development provides a solid platform on which to base future interventions.
3. Toilet supervision, by trained and competent staff, using supporting documentation (checklists), is essential in assuring the quality of the toilet service.

4. Specific emphasis during training should be placed upon the technical problems of UDTs, e.g. clogging of urine pipes.
5. When implementing toilets in an urban IDP camp context, a healthy relationship with the camp committee is essential in delivering a quality service.

Conclusion

Based on internal organizational studies as well as evaluations of other emergency sanitation interventions in Haiti following the 2010 earthquake, the authors of this paper find that EcoSan was an effective emergency sanitation intervention that was comparatively lower cost than other options and ensured complete and safe treatment of wastes. The authors recommend that future emergency relief efforts with similar starting conditions (high water table, concentrated populations, and limited or non-existent access to waste treatment facilities) consider EcoSan as a low-cost and ecologically sound alternative to traditional emergency sanitation approaches.

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