

# Biodegradable bags as emergency sanitation in urban settings: the field experience

FRANCESCA COLONI, RAFAEL VAN DEN BERGH, FEDERICO SITTARO, STEPHANIE GIANDONATO, GENEVIÈVE LOOTS, and PETER MAES

*In addition to the dire medical needs resulting from the 2010 Haiti earthquake, over 1.5 million people were left without access to sanitation facilities. In the second phase of the overall emergency response, Médecins Sans Frontières-Operational Centre Brussels attempted to address the urgent need for safe and sanitary human excreta disposal in some of the most neglected camps for displaced people in Port-au-Prince, by implementing an approach consisting of defecation in single-use, biodegradable plastic bags. Construction and maintenance of facilities for this intervention was undemanding and cost-effective, and the approach offered a suitable solution to a number of technical constraints encountered in this urban setting. However, immediate acquisition of ecologically appropriate bags proved troublesome. Furthermore, a relatively low bag usage rate of 13 per cent (8–18 per cent) was observed, differing considerably from the rates reported in more controlled evaluations of such approaches, reflecting the operational limitations to this intervention. We therefore recommend this sanitation approach in urban settings only as a stop-gap approach when other interventions are not possible.*

**Keywords:** humanitarian sanitation, pit latrines, biodegradable bags, environmental burden

IN THE WAKE OF the 12 January 2010 earthquake that struck Port-au-Prince, Haiti, at least 1,500,000 people (UN OCHA, 2010) were left without a home, social infrastructure, or adequate access to sanitation facilities. The scale of the disaster and its consequences placed an exceptional burden on the already poor country and introduction of sanitary practices for the displaced population proved to be a major challenge. By March 2010, two months after the earthquake, toilets were only available for 1 in 400 persons, falling well short of the ratio of 1 per 100 persons targeted by the inter-agency emergency Water, Hygiene, and Sanitation (WASH) Cluster and its implementing

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partners (WASH, 2010) – itself only 20 per cent of the Sphere minimum standard of 1 per 20 (The Sphere Project, 2004). Even after four months (May 2010), the ratio of latrines per person was approximately 1 in 190, and in June 2010 a household survey on water, sanitation, and hygiene conducted by the Centers for Disease Control (CDC) in internally displaced people (IDP) camps, indicated that only 66.2 per cent of the respondents used a latrine in or in the immediate vicinity of the camps (CDC, 2010). Furthermore, 7.2 per cent reported using a canal or other open area for defecation. Such a lack of sanitation facilities for a prolonged period of time in such circumstances constitutes a clear and present public health threat. In addition, it can increase the strong feeling of a lack of dignity for a population already heavily affected by a disaster such as the Haiti earthquake.

### Constraints to implementation of sanitation measures

A number of constraints specific to the Port-au-Prince setting impeded a rapid implementation of sanitary measures

A number of constraints specific to the Haiti/Port-au-Prince post-earthquake setting impeded a rapid implementation of sanitary measures, in particular for human excreta disposal. The first clear complication was the densely constructed fabric of the city where collapsed buildings were still taking a lot of space. The areas spontaneously occupied by the population for their settlement were on average highly overpopulated. Apart from shelters there was very little remaining space to devote to infrastructures such as toilets, bathing facilities, etc.

Secondly, the uncertainty over the final locations of the IDP camps and the population effectively residing in them complicated the identification of a proper place and a correct number of toilets for each settlement, precluding the proper planning of a sanitation strategy. In particular, the population size within the settlements was difficult to estimate owing to: resistance from the population to move into the officially recognized camps out of fear they would develop into shanty towns; security threats forcing people to search for other refuges; use of the camps at night only; creation of fake encampments – the so-called ‘ghost camps’ – to attract humanitarian aid; and evacuation of camps in flood-prone areas during the rainy season.

Other challenges pertaining to sanitation efforts were at a more practical level. The high water table, rocky soil close to the surface, or the fact that camps were installed in the middle of the urban context on impermeable terrains (squares, parking lots, tarred surfaces) or in locations where the owners did not allow the digging of pits (football fields, golf courses), necessitated the use of either elevated toilets connected to a reservoir (a relatively resource-consuming approach) or of portable ones.

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Desludging capacity was particularly limited in the aftermath of the disaster

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Desludging capacity was particularly limited in the aftermath of the disaster: only a few private trucks were providing an unreliable and very expensive service. In the case of portable toilets, the cost was up to US\$20/cabin/day (including both rent and daily emptying). Additionally, the official landfill had a very limited reception capacity, being overwhelmed by the dumping of different types of waste produced in Port-au-Prince (from medical waste and debris from destroyed buildings up to the waste generated by the huge international community temporarily living in Port-Au-Prince).

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In this complex environment, the capacity of many actors to intervene efficiently was quickly overstretched

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### Aims

In this complex environment, the capacity of many actors to intervene efficiently was quickly overstretched, resulting in gaps and delays from which it was difficult to recover. Innovative approaches to providing adequate sanitation were therefore urgently needed. Most agencies involved in WASH activities focused on the implementation of techniques such as simple, ventilated, and raised pits. To answer the dire need for rapid control of indiscriminate defecation by initiation of temporary measures (which could be improved later on), we opted to implement a rapid approach consisting of defecation in single-use, biodegradable plastic bags. A similar concept was also explored in Haiti by Patel et al. (2011) in a formal trial under relatively controlled conditions; here, we present our operational field experience as a counterpart to this documented trial.

### Methodology

#### *Human excreta disposal: Conceptual approach*

Initially, Médecins Sans Frontières-Operational Centre Brussels (MSF-OCB) focused its emergency response to the earthquake on provision of medical care, including an important surgical component (Chu et al., 2011). As the overall needs of many people in the IDP camps were still unmet by March 2010 and in particular in areas neglected because of the precarious security situation (e.g. Cité Soleil, Sarthe), MSF-OCB provided 'package assistance' to 15 camps and 22,765 persons through distribution of tents, non-food item kits, sanitation, and hygiene promotion activities. Specifically in the context of sanitation, a first response consisting of a temporary sanitation method was deemed appropriate, considering the precarious living conditions of the population.

Based on these considerations and the constraints discussed above, we opted for a phased approach. In the initial phase, an existing

An existing practice – defecation in single-use plastic bags – was adapted and adopted as a stop-gap measure

practice in Haiti – defecation in single-use plastic bags – was adapted and adopted as a stop-gap measure. Specific adaptations included the rapid introduction of biodegradable plastic bags, the construction of temporary community cubicles and the organized collection of used bags for proper disposal, to counter the 'flying toilet' custom (UNDP, 2006). A second phase would then consist of the replacement of these temporary toilets with more permanent ones (ventilated, raised, or with buried tanks).

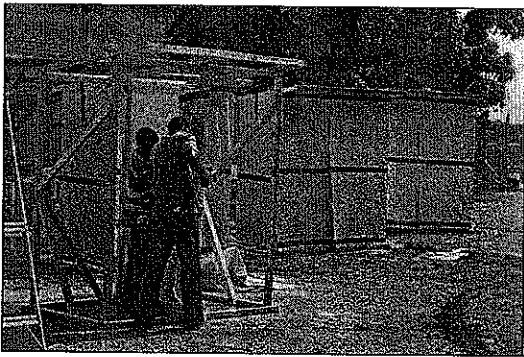
In the camps the identification of the toilet sites was done in consultation with the community

#### *Toilet construction: Methods and materials*

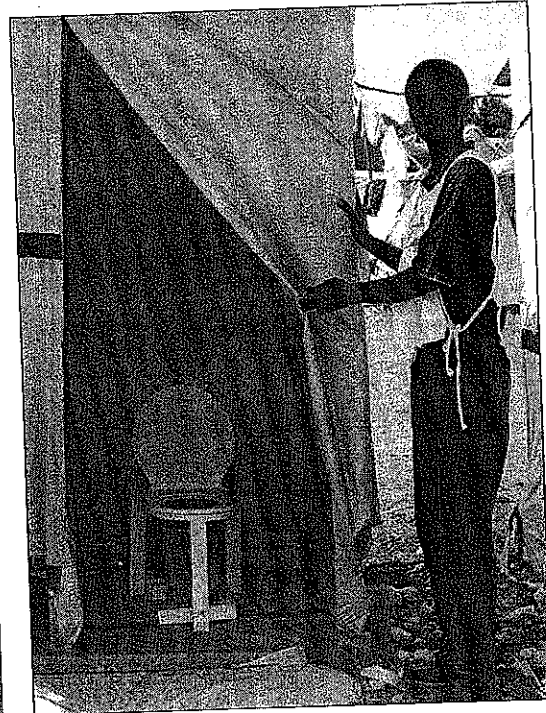
For the implementation of the first phase, a carpentry shop consisting of 15 workers and an 'installation team' consisting of four technicians were organized, and a number of cubicle prototypes were tested.

Separate cubicles for male and female use were constructed. For the calculation of the required number of cubicles, it was assumed that one cubicle could serve between 100 and 150 persons as the accumulation rate is not an issue with this type of toilet. In the camps the identification of the toilet sites was done in consultation with the community. The installation procedure comprised preparation of the terrain, gravel layering, covering of the floor with plastic sheeting, mounting of the cubicles and fencing off of the area.

Three different types of bag were used. All had the same size and design – approximately 10 litre capacity, T-shirt shape with two handles, dark coloured, not transparent – but differed in material and supplier (Table 1). For the initial trial period, ordinary plastic bags were purchased locally. For the scale-up, biodegradable bags were purchased in Santo Domingo and – when these turned out to be incompliant with EN 13432:2000 norms – in Europe.



The cubicles are constructed



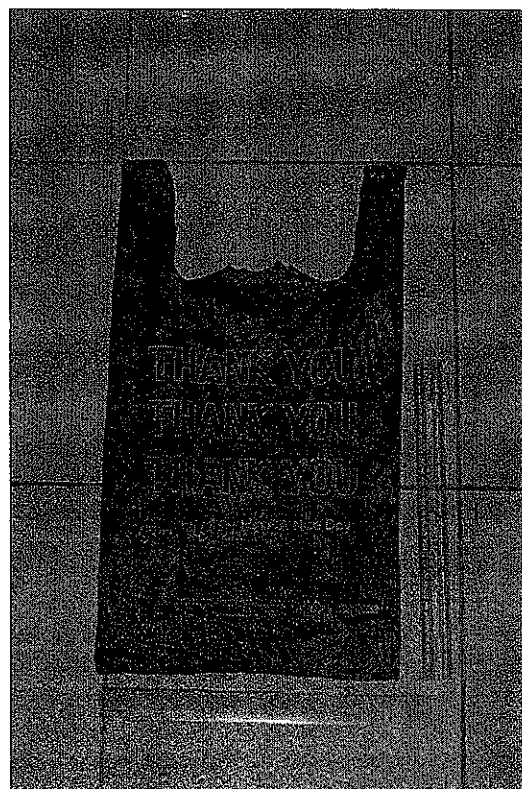
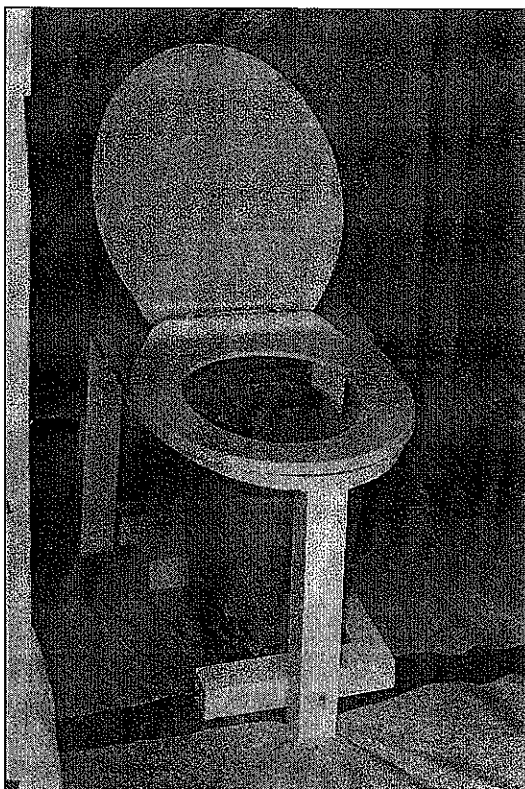
The completed cubicles

Table 1. Specifics on the bags used

	Type 1	Type 2	Type 3
Ecological properties biodegradable	Biofragmentable	Allegedly	Biodegradable
EN 13432:2000 compliant	No	No	Yes
Provenance	Haiti	Santo Domingo	Europe
Size (cm x cm)	35 x 40	41 x 46	30 x 35
Cost (€cent/pc)	0.7	9.8	6 (without transport)
Quantity ordered (pcs)	60,000	40,000	100,000

The hygiene committee of each camp appointed attendants to supervise toilets, explain use, distribute bags, and clean

To ensure proper use and correct bag disposal, distribution was centralized at the cubicle level. The hygiene committee of each camp appointed attendants (1 per 10 toilets) who had the multiple tasks of supervising the toilets, explaining their use, distributing the bags, and cleaning. Outside, covered plastic bins of 60 litre capacity, one per five cubicles, were installed for the disposal of used bags. These bins were collected to be emptied in the final disposal site (the landfill of Port-au-Prince) and replaced with cleaned and disinfected ones;



The pee-poo bag, and how it is disposed

collection was done daily, except in a small number of camps where collection was only possible 2–3 times per week.

Bag consumption was foreseen as 4 bags/woman/day (i.e. for collection of faeces and urine) and 1 bag/man/day (i.e. for collection of faeces only). In total, 191,200 bags were distributed.

**Timeline of the intervention**

Use of these toilets started at the beginning of April (week 14). The intervention was foreseen to last 2 months (i.e. 8 weeks), allowing the time both to understand which camps would stay longer and to prepare for the second phase of the approach relying on two desludging trailers which were at that point en route to Haiti.

In reality, toilets were used for different lengths of time. The temporary setup finally lasted till the end of September, reflecting the operational constraints to implementing the second phase in a timely manner. Acquisition of distribution and collection data was maintained till the end of July (week 29) for a total of 4 months (i.e. 16 weeks).

The temporary setup lasted till the end of September, reflecting the operational constraints

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### *Data collection*

Data analysis was based only on routine supply and waste processing data, no data on human subjects was collected or analysed in this study. Approach evaluation was based mainly on the personal appreciation and experiences of the hygiene promotion personnel involved in the construction and maintenance of the toilets.

## **Results and discussion**

### *Appreciation of the practical aspects of the intervention*

At the technical level, the intervention was evaluated positively. Specific benefits of the approach included its rapid implementation: the workshop and installation teams managed to produce and install 16 toilets/day because of the low material requirements, the simple standard design, and the easy installation (no digging required). The high mobility of the toilets was particularly advantageous in following the movements of the population, e.g. after flooding necessitated the evacuation of certain camps. Additionally, the size of the cubicle (0.64 m<sup>2</sup>) was considerably smaller than the recommended size of a traditional toilet (0.96 m<sup>2</sup>), indicating that three biodegradable plastic bag toilet cubicles (serving 300 persons) can be accommodated in an area for only two traditional toilets (serving 40 persons) (Reed, 2010). Environmental contamination was minimized thanks to the storage and transport of excreta in closed bags and covered collection bins. No detectable pollution of nearby water sources and reservoirs, either ground or surface, was caused at the location of the toilet. However, the system did result in an environmental burden at the final disposal site of the bags, as the sludge remained untreated. This is particularly problematic in a context such as Port-au-Prince, where only one landfill services the entire city of more than 2 million inhabitants (UN OCHA, 2010).

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In Port-au-Prince only one landfill services the entire city of more than 2 million inhabitants

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At the maintenance and usage level, too, several positive aspects were noted. Regular cleaning was sufficient as general maintenance and the collection of full bins using simple trucks circumvented the need for desludging. Different levels of hygiene promotion activity were required. On the one hand, demands for actual explanation of the use of the toilets were limited, as the use of plastic bags for defecation was already widely adopted by the population. Consequently, a balance needed to be found between formal compulsory explanatory hygiene promotion sessions and rapid deployment of the structures. On the other hand, the management of the entire sanitation approach was demanding and could have benefited from a more structured presence of a hygiene team. Maintaining the system of cleaning and

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Bag capacity was enough to contain both urine/faeces and provided material for personal cleansing

monitoring and distribution on a voluntary basis was a particular challenge in this context.

At the technical level, bag capacity was enough to contain both urine/faeces and provided material for personal cleansing. Bags proved to be resistant enough for their purposes – transfer operations did not result in spillage of excreta. No problem of leakages in the outside collection bucket were reported. Additionally, despite initial fears, formation of high amounts of biogas causing tightened bags to explode was not reported.

Several issues were encountered with the purchasing of the disposable bags. The first batch, purchased locally, was biofragmentable only, and was sufficient for the initial launching of the project and evaluation of appreciation by the population. The second batch, purchased in Santo Domingo, was more expensive and turned out to be only biofragmentable, too, rather than biodegradable, resulting in some environmental pollution. The third batch consisted of biodegradable bags ordered in Europe that took a long time to be produced (because of their short shelf-life suppliers keep a very limited ready-to-ship stock) and had a high price tag (Table 1) in addition to the transport costs.

#### *Monitoring of the approach*

Over the course of the intervention, a total of 15 camps were provided with a total of 197 toilet cubicles for the use of plastic bags. On a weekly basis, on average 119 toilets were in use, ranging from 49 to 165. Over all the IDP camps, a relatively low average bag usage rate of 13 per cent (ranging from 8 to 18 per cent) was observed. This rate differed significantly from the high usage rates identified in the Peepoo® trial documented by Patel et al. (2011). On the one hand, this may be explained by over-estimation of the IDP population living in the camps (camp only inhabited at night, shift to other sanitation facilities in the vicinity during the intervention, etc.), or by a general lower appreciation of the approach by the population – community cubicles only versus community cubicles and household use in the Peepoo® trial. On the other hand, this discrepancy may reflect the inherent differences between a small-scale trial in controlled settings (4,060 Peepoo® bags plus an unspecified number of biofragmentable plastic bags distributed, covering 2,211 persons over a total period of 6 weeks) and the operational reality of a full-scale intervention in the field (191,200 bags distributed to 22,765 persons over 4 months).

In general, the number of distributed bags tended to follow the size of the population receiving sanitation care (Figure 1) and the number of collected bins (Figure 2), reflecting the consistency in their usage rates. Several phenomena lay at the root of the decreasing trend during



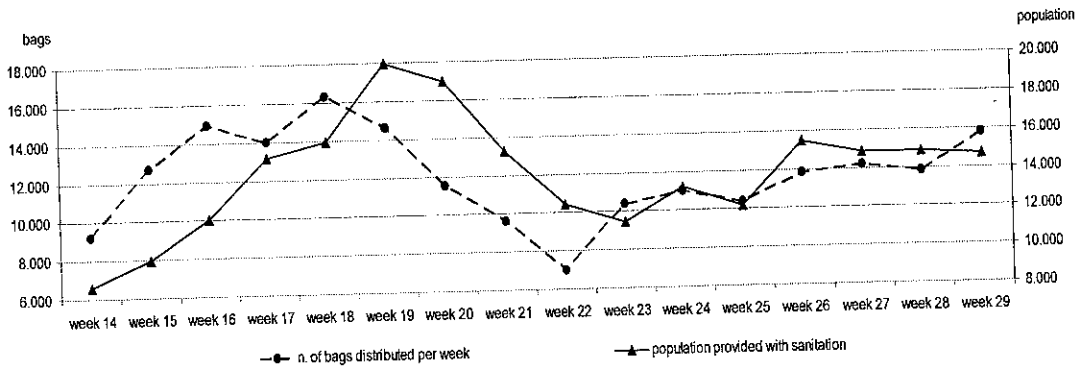


Figure 1. Plastic bag distribution versus population

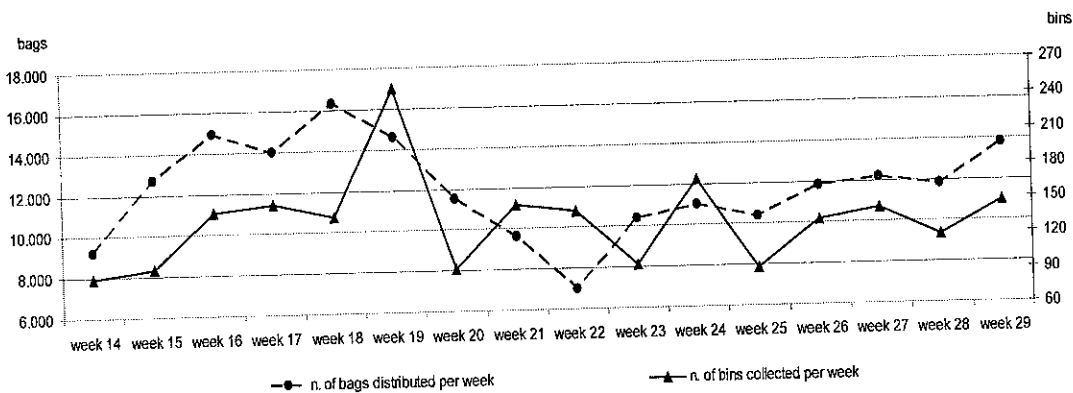


Figure 2. Plastic bag distribution versus outside collection bins collected

weeks 19–22 and the sharply decreased bin collection in week 25, including unexpected logistical constraints (such as the breakdown in week 20 of the truck in charge of bin collection and the destruction of two camps by a hurricane), a reduced presence in two camps due to specific security restrictions, and a delay in receiving the biodegradable plastic bags, forcing a slowing down of the programme.

The implementation of single-use biodegradable plastic bag toilets in an urban post-earthquake intervention was an efficient immediate response

### Recommendations and ways forward

Several recommendations can be formulated from this experience. The implementation of single-use biodegradable plastic bag toilets in an urban post-earthquake intervention was recognized a posteriori as an efficient immediate response (Reed, 2010). Additionally, the system seems compatible with other emergency scenarios, such as floods and hurricanes/cyclones in urban contexts, or in IDP/refugee camps.

We therefore consider it to be an adequate stop-gap approach to be used when other, more elaborate interventions are not applicable. However, there are several caveats:

1. Use of biodegradable material is a requisite to keep the environmental burden to a minimum and – as was the case in Haiti – such materials are not necessarily readily available immediately post-catastrophe. An emergency preparedness stock of such bags could be provided, though this would have to be reconciled with the relatively short shelf-life of such bags.
2. The site of final disposal should be well-considered, as the faecal matter itself is not treated in any way.
3. Institutionalization of temporary measures should be avoided; in the case of the intervention described here, temporary toilets were still in use after 4 months, despite the intention to phase-out after 2 months.
4. The system should be strongly discouraged during outbreaks of faecal-oral transmissible diseases (diarrhoea/cholera) because of the high risk of contamination linked with the direct manipulation of the bags.

Overall, the authors recommend that the implementation of such a sanitation methodology is repeated in other countries and the results analysed, in order to confirm whether biodegradable plastic bag toilets are a valid option to be considered more often in emergency responses. Results could, for instance, significantly differ in settings where defecation in plastic bags is not an established practice. Specific improvements could be incorporated in future interventions:

1. Self-sanitising bags, such as the Peepoo® bags in the trial documented by Patel et al. (2011), which disinfect the contents, prevent biogas formation, and reduce the odour, could be used, on the condition that they are extremely easy in use, their timely delivery or shelf-life are suitable for emergency response purposes, and pricing is acceptable.
2. Implementation at the household level in addition to the community approach could significantly reduce the feelings of insecurity and lack of privacy in the IDP camps. Additionally, it would have allowed access to sanitation facilities at night. An operational research study aimed specifically at the difference in acceptance between household- and community-level intervention could be designed.
3. Full exploitation of the modular design of the intervention should be considered: the superstructure initially used as cubicles for single-use bags could have been prepared for

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This sanitation methodology should be implemented in other countries and the results analysed

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An operational research study on the difference in acceptance between household- and community-level intervention could be designed

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be envisaged

reinstallation in the second phase as part of more traditional (e.g. simple, ventilated, and raised pits) toilets.

4. The use of bags only for faeces could be implemented, while an integrated urine-diversion system for liquids provides a real 'full package' sanitation service.
5. Closer involvement of the local authorities should be envisaged; in this intervention, information was only shared on the Cluster platform, and local authorities were not bilaterally contacted.

### Acknowledgements

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