

The search for appropriate latrine solutions for flood-prone areas of Bangladesh

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Proper excreta management in flood- and cyclone-prone areas of Bangladesh is a challenge. The appropriateness of latrine technology depends on groundwater table, geographical context and acceptance by the community. Field trials by Oxfam GB found that raised pit latrines are more appropriate in flood- and cyclone-prone areas, and more widely accepted by the community, than other technologies. In addition, urine diversion and Ecosan latrines were also felt to be appropriate and acceptable in certain contexts. To reduce the risk to health, a pump was promoted, instead of manual desludging of latrine pits, and met with a favourable response from the community and sweepers.

Keywords: sanitation; pit latrine; appropriate technology; desludging; flood; community acceptance; sustainability

IN MOST EMERGENCIES, basic latrine coverage is a major challenge. Recurrent floods, cyclones and prolonged waterlogging make it especially difficult to adapt appropriate sanitation both for the displaced and those living with floods and waterlogging conditions.

On average, 20 per cent of the area of Bangladesh is inundated by annual floods. The major problems of sanitation in areas prone to floods and waterlogging are surface water contamination and loss of accessibility to the latrine itself.

In rural Bangladesh more than 90 per cent of the latrines are pit latrines. Culturally, Bangladeshis use water to clean themselves after defecation. Therefore, urine, cleaning water and excreta all accumulate in the single pit, which causes rapid filling of the pit and subsequent return to open defecation where space is limited.

In flood-prone areas, overflowing pit latrines pose a significant health risk. This is a particular problem either where safe desludging techniques are not used to remove excreta from full latrine pits or where there is a lack of awareness of hygienic ways to dispose of the sludge.

In flood-prone areas, overflowing pit latrines pose a significant health risk

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A lack of sanitation due to flooding or waterlogging affects women and adolescent girls in particular

Lack of appropriate sanitation facilities due to flooding or waterlogging means that women and adolescent girls in particular are forced to control defecation and urination until dark, with implications for their health and physical comfort. In such situations, there is often no scope for maintaining privacy, dignity and personal hygiene particularly menstrual hygiene management.

The significant lack of appropriate, socially and culturally accepted technological options for safe disposal of human excreta in the difficult, flood-prone areas of Bangladesh means the Government of Bangladesh target of 100 per cent sanitation by 2013 is not likely to be reached and/or sustained.

Field trial sanitation and desludging technologies

Oxfam GB has undertaken four pilot projects to field trial the sanitation and desludging technologies

In the last two years, Oxfam GB has undertaken four pilot projects to field trial the sanitation and desludging technologies recommended by the Bangladesh WASH Cluster. The goal of these pilot projects is to help Bangladesh achieve 100 per cent sanitation coverage by piloting and promoting socially and culturally accepted technologies that are appropriate to emergency contexts such as:

- flood-prone/*char* (river basin) areas;
- waterlogged areas;
- *haor* (low-lying water body) areas;
- cyclone-affected coastal areas.

The aims of the projects were to:

- Identify context-specific, socially and culturally appropriate, cost-effective and sustainable sanitation technologies for flood-prone areas for women and men, children and the disabled.
- Identify sanitation facilities that are appropriate for flood-prone and high water table areas allowing people to have continuous access to the facilities during and after floods.
- Identify latrine technologies, which can increase pit life.
- Identify sanitation technologies that are adaptable to climate change.
- Assess the social and cultural acceptance of those technologies for women and men.
- Assess the impact of inappropriate sanitation/poor sanitation in flood-prone areas particularly for women and adolescent girls.
- Identify socially and culturally appropriate and cost effective desludging technology for emptying the latrines' pits and safe disposal of excreta.
- Replicate these technologies.

Nine types of latrine were field-tested together with a technology for the low-cost desludging of pits

The latrines and technological options

In total nine types of latrine technology were field-tested together with a technology for the low-cost desludging of pits. All latrines were raised up above the highest flood level. The latrine types were:

- *Ecosan latrine.* This technology stores urine and composts faeces for use as fertilizer. This technology ensures the reuse of resources as a nutrient and increases the life of the pit.
- *Urine diversion latrine.* Urine is separated from faeces and can be used as a plant nutrient. Urine diversion also increases the life of the pit.
- *Combined pit latrine (direct and off-set pit).* A raised plinth and pit is divided into two to make it very shallow. It is appropriate for low water table areas and for reducing groundwater contamination.
- *Earthen raised single pit latrine.* Common and popular technology in Bangladesh that uses rings and slab. The plinth is raised to reduce groundwater contamination.
- *Single pit latrine with cement and sand/mud coated plinth.* This is also a raised pit latrine. A raised plinth is coated with cement and mud/sand to prevent erosion by water waves during a flood.
- *Cluster latrine.* This latrine has two chambers with one roof and four pits (off-set single pit with nine rings for each latrine chamber) for a family of four to eight people. It is appropriate in *haor* areas, where there is limited space.
- *Drum latrine.* Instead of rings, mild steel drums are used to line the pit. This is a temporary solution for the first phase of an emergency when concrete rings are unavailable.
- *Clay pot or kolsi latrine.* Another temporary solution using locally made clay pots that may be appropriate in the first phase of an emergency, before supplies of the usual materials for latrine construction arrive.
- *Floating toilet.* An airtight plastic container or drum is used to float a latrine on a body of water. This option may be appropriate where there is no space to build latrines because of flooding.

Table 1 provides a comparative analysis of the latrine types and use. All latrines were constructed with a raised plinth that could withstand the highest flood level. For the sub-structure, the technical drawings and designs were followed properly in every area. Superstructures for the latrines were developed according to user demand and availability of local materials.

Manual desludging of pits is a risk to health and source of environmental pollution. In Bangladesh, the job of manually desludging pit latrines is usually done by sweepers; traditionally sweepers are drawn from a low-ranking caste. Safe desludging technology was also piloted in the field trials. Oxfam imported two diaphragm desludging pumps

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The drum latrine is a temporary solution



The clay pot or *kolsi* latrine may be used in the first phase of any emergency



The floating latrine may be used where there is no space on dry land to build a toilet

and successfully manufactured four more pumps locally. Field testing and monitoring was conducted with a view to assess, among other things, its use, operation and maintenance, and social and technological acceptance.

Field activities

Beneficiary households were selected following the selection criteria:

- disaster-affected households;
- vulnerable, poor families;
- socially excluded families;
- women-headed families;
- families with disabled members;
- families without a latrine and unable to afford to install a latrine.

The beneficiary households were selected in consultation with the community. At the beginning of the projects baseline data were collected to assess the sanitation situation of the targeted areas; gender and disability issues were important considerations. The beneficiary – usually the female members of the user household – selected the latrine technology and site for the latrine. A village committee consisting of 5–11 members was formed in each village to ensure community participation, community monitoring, site selection, operation and maintenance. Women formed the majority of most committees. Committees had monthly meetings with project staff to discuss the

At the beginning of the projects baseline data were collected to assess the sanitation situation

Table 1. Comparative analysis of latrine technology and efficiency

Technological option	Appropriate for flood	Sustainability	Cost	O&M	Desludging	Extra economic benefit	Community acceptance	Remarks
Ecosan latrine	Yes	Long term	Comparatively high	Not easy. Need special orientation and care	No need	Community get urine for as plant nutrient and compost fertilizer	Moderately accepted. Need more motivation.	Recommended with proper and long-term promotional activities
Urine diversion latrine	Moderate	Short term (1–2 Years)	Comparatively high	Easy	Pit can be filled up by faeces and needs desludging	Community get urine for as plant nutrient	Fairly positive. Need more motivation.	Recommended with proper and long term promotional activities for O&M
Combined pit latrine (direct and offset)	Yes	Long term	Moderate	Easy	Pit can be filled up by faeces and needs desludging	No	Highly accepted	Highly recommended but at lower cost
Earthen raised single-pit latrine	Yes	Long term	Low	Easy	Pit can be filled up by faeces and needs desludging	No	Highly accepted	Highly recommended
Single-pit latrine with cement and sand/mud coated plinth	Yes	Short term	Low	Easy	Pit can be filled up by faeces and needs desludging	No	Moderately accepted	Cement and sand is recommended but not cement and mud
Cluster latrine – two chambers (offset single pit for each chamber)	Yes (assumed as there is no flood this year)	Long term	Moderate	Easy	Pit can be filled up by faeces and needs desludging	No	Highly accepted	Highly recommended with proper and O&M
Drum latrine	No	10–15 days only	Low	Not easy	Pit filled up after 10–15 days and needs desludging every week	No	Rejected	Only for emergency
Clay pot or kolsi latrine	No	10–15 days only	Low	Not easy	Pit filled up after 10–15 days and needs desludging every week	No	Rejected	Not recommended for replicate
Floating toilet high	Yes	Long term	Comparatively	Easy	Chamber can be filled up. Needs replacement	Community get urine for as plant nutrient	Highly accepted	Highly recommended

project activities and future plans. Project staff and village committees also played a vital role in implementing the projects and monitoring to determine the appropriate sanitation technology for flood-prone areas in terms of technical appropriateness, cost effectiveness, feasibility and social acceptance. Project engineers provided support to the community in selecting the option that would take account of climate change adaptation.

Partnerships and collaborations

The Government of Bangladesh (Department of Public Health Engineering (DPHE)), Union Parishad Chairman, village committees, local NGO partners and the communities were all involved extensively at each stage of the development and implementation of the project. Oxfam maintained a close relationship and coordination with DPHE on a regular basis. The local NGOs added a great deal with their long-term relationship and contextual experience of being the first responders to floods. Communities were very open about which technologies and approaches would improve their resilience to floods and which wouldn't. The functionality of each latrine was closely monitored during the normal period and during as well as post-flood. Oxfam emphasized the social and cultural acceptance of the technologies. The project also focused on an integrated approach combining sanitation, desludging technology, handwashing facilities and hygiene promotion.

Sweepers appreciated the desludging technology as it increases their income and reduces health hazards

Desludging technology: Diaphragm hand pumps

Community feedback on the desludging technology was that: 'This is a good technology as it reduces bad smell and ensures less pollution of environment'. Sweepers also highly appreciated the technology as it simultaneously increases their income and reduces health hazards. However, disposal sites for the sludge were identified as a problem in the context of flood-prone areas (see Table 2).

Table 2. Performance of desludging pump

<i>Special features</i>	<i>Advantages</i>	<i>Disadvantages</i>
Simultaneous sucking and disposal of sludge at certain distance without contact with sludge	Removes waste safely	Unable to deal with dry sludge and other solid objects
Manually operated	Low operation and maintenance cost	Requires disposal site
Desludging of a latrine (5 rings) within 15–20 minutes	Easy transport and operation	High up-front cost of equipment (approx. US\$300)
Pump body and all other accessories locally assembled and produced	Less environmental pollution	Cleaning of the equipment
Suitable for emergency, camp and slum situation	Reduces labour and health hazard	Requirement for secure storage

Lessons learned and evaluation findings

Currently traditional earth raised latrines are still seen as most appropriate

The drum latrine and clay pot latrines were least appropriate

Table 3 provides a summary of the findings of the field-testing. The findings show that there a number of advantages and disadvantages to each type of latrine which depend on the support of the community, the funds available and the nature of the flooding. The table shows that some are clearly more acceptable than others and that currently traditional earth raised latrines are still seen as most appropriate. Of the technologies trialled the community found the drum latrine and clay pot latrines were least appropriate. The combined pit latrine (direct and off-set pit) was well accepted by the *haor* community. This option also shows the greatest flood resistance. The single pit latrine with cement and sand/mud coated plinth was moderately acceptable but technically it did not prove sustainable in the long run. The ecosan latrine was also found satisfactory but additional motivational activities were required.

The challenges encountered during the fieldwork were:

- lack of local availability of skilled masons for the construction of the urine diversion latrine (UDL) and ecosan toilet;
- lack of ready-made or prescribed design as well as availability of materials, meaning that several design modifications were made during the construction period;
- efficacy of UDL in an emergency period was questioned;
- users are motivated to use and maintain new and appropriate sanitation technologies in order to reduce the spread of water-borne diseases and protect groundwater as well as surface water;
- as ecosan and urine diversion latrines are new technologies for the community, proper use, operation and maintenance is a challenge;
- effective usage of urine and excreta compost in agriculture to increase crop yield without use of chemical fertilizer;
- transportation of materials to remote areas;
- how to provide sanitation in response to unexpected floods;
- lack of available space for latrine installation/community willingness to provide space for a latrine.

It is more cost-effective to pay for a durable toilet than pay for repairs every year

This pilot study also illustrates that the sustainability of flood-resistant latrines depends on technology and cost. Therefore, given the annual nature of the floods it is definitely more cost effective to spend more money on a more durable toilet rather than having to pay for repairs every year. It is also recommended that the Bangladesh WASH cluster, local DPHE and other stakeholders do more to inform communities on how to build flood-resistant, low-cost toilets and develop different low-cost technologies for desludging.

Table 3. Summary of the findings of the field testing

	<i>Special features</i>	<i>Field findings</i>	<i>Recommendation</i>
Ecosan latrine	<ul style="list-style-type: none"> In-built system ensuring separate storage of faeces, urine and anal-cleaning water 2 separate chambers for accumulation of faeces allowing them to convert into compost Functional before, during and after flood Long-term use Urine and compost as fertilizer Desludging is not required 	<ul style="list-style-type: none"> All latrines functioning well Higher cost than normal pit latrine New technology for users Moving for anal cleaning after defecation is slightly inconvenient Reluctant to use urine and compost Accepted by community Recommended for further scale up reducing the cost by using local materials 	<ul style="list-style-type: none"> Further scale-up is recommended but reducing the cost by using local materials. It is to be noted that the study needs more time to assess proper utilization of compost fertilizer.
Urine diversion latrine (UDL)	<ul style="list-style-type: none"> Single pit; in-built system which ensures separate storage of faeces, urine and cleaning water Appropriate for flood, and water-logged context Urine as plant nutrient Desludging required but less frequent Can be used first phase of emergency Low cost compared to ecosan Easy maintenance 	<ul style="list-style-type: none"> Latrines are functioning/well maintained Comparatively higher cost than pit latrine New technology to the user Inconvenient to move for anal cleaning after defecation Urine can be used as a plant nutrient Less probability of ground/surface water contamination 	<ul style="list-style-type: none"> Community is fairly positive regarding replication. More research required to assess length of pit life and community acceptance.
Combined pit latrine (direct and offset)	<ul style="list-style-type: none"> Two pits (direct-3 rings, offset-4 rings) Pit connected by PVC pipe Volume can be increased without increasing depth Can be used all year round even during flood User friendly Long-term use Easy maintenance Suitable for shallow water table areas Easy to de-sludge 	<ul style="list-style-type: none"> Users appreciated the technology Used & maintained by community Cost is reasonable for its life-time Replication demanded but at lower cost Less probability of groundwater contamination 	<ul style="list-style-type: none"> Community accepts the technology as this latrine is like a regular latrine. Replication is highly demanded but at a lower cost.
Cluster latrine – 2 chambers (offset single pit for each chamber)	<ul style="list-style-type: none"> Two chambers with different pits constructed in the same compound Shared by 3–4 families Twin pits with 9 rings Connected offset two pits, easy for desludging Easy maintenance Minimizes space requirement 	<ul style="list-style-type: none"> Functioning smoothly Relatively moderate cost Use and cleanliness is sometimes a challenge due to shared facilities Maximum number of users in minimum space Suitable for limited space areas Further scale up is highly recommend 	<ul style="list-style-type: none"> Further scale up is highly recommended, as this latrine is quite appropriate for the area. Community accepts the latrine because it can be used by a many users with minimum space. Software activity is recommended as there is more than one user households

Earthen raised single-pit latrine	<ul style="list-style-type: none"> • Single pit • Plinth raised by earth; uses turfing to prevent erosion • Functions before, during and after flood • Low cost • Easy O&M • Desludging required 	<ul style="list-style-type: none"> • Relatively low cost • Well operated and maintained by users • Appropriate for water-logged area • Scale up is highly recommended in flood- and cyclone-prone areas • Plinth is not vulnerable to heavy rain 	<ul style="list-style-type: none"> • Community accepts the technology as this latrine is like a regular latrine. • Demand exists for replication.
Single pit latrine with cement and sand/mud coated plinth	<ul style="list-style-type: none"> • Single pit, plinth coated by cement and mud/sand to prevent erosion • Functions before, during and after flood • Low cost • Easy O&M • Desludging required 	<ul style="list-style-type: none"> • Relatively low cost • Properly used and cleaned by users • Appropriate for a water-logged area 	<ul style="list-style-type: none"> • Community is not interested in promoting the cement and mud-coated single-pit latrine, as it is vulnerable to intensive rain. • Scale up of cement and sand coating is recommended
Drum latrine	<ul style="list-style-type: none"> • Single pit • Drum, open at both ends • Readily available materials • Instantly usable • Applicable only in first days of emergency • Need frequent desludging 	<ul style="list-style-type: none"> • Relatively low cost • Easily O&M • Appropriate only in emergency situation • A temporary solution • Carrying material is challenging 	<ul style="list-style-type: none"> • Recommended only for emergency situation but not as regular option. • Promotion of concept is recommended with high raised plinth.
Clay pot or kolsi latrine	<ul style="list-style-type: none"> • Applicable for emergency response • Very temporary solution • Needs desludging every two to three weeks 	<ul style="list-style-type: none"> • Easy O&M • Material carrying is risky (fragile containers) • Scale up is not recommended 	<ul style="list-style-type: none"> • This type of latrine is a temporary solution during emergency situations but is not recommended due to its short life span • Recommended only for emergency situation in an area where there is a body of water • Accepted by community • There needs to be further promotion of the concept
Floating toilet	<ul style="list-style-type: none"> • It is a UDL latrine (separate storage of faeces, urine and cleansing water) • Replaceable container used to collect excreta • Two containers with filter media are used to treat water used for anal cleansing • Separate jerry cans are used to store urine • Empty containers act as buoyancy • Functional all the time it is on the water • Potential for long-term use • Urine can be used as a nutrient for plants • Excreta disposal is required 	<ul style="list-style-type: none"> • All latrines are functioning well • Higher cost than normal latrine • New technology for users • Moving for anal cleaning after defecation is a hassle • Stakeholders at national level are keen to replicate the idea, even in urban slums 	<ul style="list-style-type: none"> • Recommended only for emergency situation in an area where there is a body of water • Accepted by community • There needs to be further promotion of the concept