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INTEGRATED DEVELOPMENT FOR WATER SUPPLY AND SANITATION

Sanitation strategies for flood-prone areas

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LACK OF APPROPRIATE sanitation facilities in flood-prone and high-water table areas of Bangladesh is one of the important contributing factors for health and environmental degradation. In flood-prone areas, overflow of pit latrines during flood pose a high health risk. The major problems of sanitation in flood-prone areas are surface water contamination and loss of accessibility to the latrine during flood. The main problems of sanitation in coastal areas of Bangladesh are loss of latrine capacity and groundwater contamination due to high-water table.

The present research looked for appropriate sanitation technologies as well as strategies and policies related to health promotion, personal hygiene practices, community involvement, socio-economic conditions and custom, culture and people's belief.

Methodology

The present research essentially focussed on two broad aspects of sanitation - strategies and technologies, with the aim of investigating a sustainable sanitation package for the high-water table and flood-prone areas of Bangladesh. To collect data of these two aspects of sanitation, several methods such as literature review, observation, interview, group discussions, case studies, local level workshops, interview of key informants and questionnaire survey were followed. Field level data collection covered pre-flood, during flood and post-flood periods. Purposive sampling technique was used to identify households in three study areas – Dhaka (Area 1), Patuakhali (Area 2) and Sylhet (Area 3) characterised by different types of flood occurred in Bangladesh. Data collected through various methods was then gathered for analysis. Survey data was coded and analysed with the help of SPSS - statistical package for analysis of social information.

Present situation: survey findings

- The survey shows that the latrine consists of five rings of the diameter of 33 inches and height of 12 inches on average and 1 slab of the size of 9-12 sft. Each latrine has a single pit of the average depth of 5 ft. Of the total sampled latrines, the superstructure of more than half are made of bamboo, while only 5 per cent are made of brick. 15 per cent and 16 per cent latrine superstructures are made of jute-cloth and tin-sheet respectively. District-wise construction and maintenance cost of latrines is shown in Table 1.
- Of the total sampled latrines, data indicates that 92 per cent are installed and constructed by the local unskilled labourers. 99 per cent latrines were constructed without any skilled supervision. In selecting location, privacy influences more (37 per cent) than the ease of access factor (35 per cent) as shown in Table 2. People give less importance to the health factor in selecting the location of their latrines.
- More than two-thirds latrine are found to be defective in all respects such as ring joint, ring setting, slab setting and overall infrastructure.
- Of the total latrines, 41 per cent were overflowed during the times other than flooding. Of the overflowed latrines, 53 per cent were overflowed because of over-use followed by rainwater (40 per cent) and the rise of groundwater table (7 per cent).
- All the sampled latrines in the study areas are inundated during flood. The type of flood, duration of flooding and depth of inundation are shown in Table 3. The table shows that the normal river flood and rainwater flood inundated 100 per cent of the sampled latrines in Dhaka, while in Sylhet all sampled latrines are inundated by flush flood and rain water flood. In Patuakhali, latrines are flooded by tidal and rainwater floods.

Table 1. Construction and maintenance costs of latrine

Areas	Construction Cost in Taka*	Maintenance Cost in Taka
Area 1	1,246	194
Area 2	1,220	191
Area 3	1,230	222

* 1 US$ = 48.50 Taka

Table 2. Factors influencing the selection for latrine construction by district (%)

Factors	Study Areas		
	Area 1	Area 2	Area 3
Nearer to canals	44	4	12
Privacy	28	36	48
Ease of access	20	54	32
Health	8	6	8

- Table 4 indicates the level of knowledge on health, hygiene and diseases of the households. Data says that 90 per cent of the households suffered from some sort of diseases in the past year and 47 per cent could not identify a reason behind the suffering, while 48 per cent mentioned that the flood water was the reason for these sufferings.
- In order to have an improved sanitation facilities, each family is willing to pay on an average Taka 530.
- 52 per cent respondents mentioned that an embankment around the latrine can improve the situation followed by canal digging (30 per cent) and proper drainage system (18 per cent).

Appropriate technologies

Technological options for sanitation suitable for the study areas are identified as follows:

Technological option 1: raised pit latrines

Technically correct solution to the problem of latrine flooding is to construct "Raised Latrine" (WEBSTER, M, 1998). There are many ways to raise the latrine depending on local conditions. Raising of latrines is the basic principle of these proposed technological options.

Earth stabilised raised pit latrine

Earth stabilised raised pit latrine is suitable for the areas, which are flooded during monsoon months. This type of latrine can be used in areas facing all four types of flood viz., river-water flood, rainwater flood, flush flood and tidal flood that occur in Bangladesh every year (FPCO, 1994). The latrine is raised to avoid floodwater intrusion into the pit. Pit volume is increased as it is raised which renders the extended life of the latrine. This latrine requires more space area to stabilise soil around the raised portion of the pit lining. In this type of latrine, any type of pit lining whether it is porous or non-porous can be used above the ground level for raising the pit. Details of the earth stabilised raised pit latrine is shown in Figure 1.

Step latrine

The principle of step latrine is also similar to the earth stabilised raised pit latrine. This latrine is also raised to avoid floodwater intrusion into the pit. Non-porous lining is used above ground level to prevent sullage leaking. The extended portion of the pit is often made water-sealed by plastering both sides.

This type of latrine requires relatively smaller horizontal space than earth stabilised latrine. However, steps will be required to gain access to the latrine. Moreover, the lining above ground level must be strong and durable to support the superstructure. Step latrine is suitable for flood-prone areas where limited space is available for latrine construction.

Mound latrine

Mound latrine is also an option suitable for flood-prone areas where space is limited and watertight linings are not available. In this type of latrine, pit lining is also extended above ground level to prevent the latrine from flooding. A mound of soil surrounds the extended section of the pit. Part of the section of the lining can be used as leaching area provided it is made of permeable soil.

However, it is not recommended on clay soils to avoid seeping out at the base of the mound rather than infiltrate the ground.

Technological option 2: sand enveloped latrines

Sand envelope surrounding the pit is an appropriate measure to reduce groundwater contamination. Based on this principle, two technological options of latrine installation for the high-water table areas are recommended.

Sand Enveloped Pit Latrine

A sand filter around the pit can be dug to limit disease-causing microorganisms from leaking the water supply, if there are drinking water sources such as tube-wells or dug-wells nearby. The risks of contaminating groundwater can be minimised by placing a 500-mm thick envelope of sand around the pit (WB, 1996) and constructing an impermeable pit bottom as shown in Figure 2. The impermeable bottom can be made from plastic sheet or puddle clay. The minimum horizontal distance of separation from drinking water sources should be 10 metre.

Sand Enveloped Raised Pit Latrine

Sand envelope around the pit can be provided with any of the three technological options recommended for flood-

Table 3. Details of flooded latrines

Areas	Types of Flood	Duration of flooding	Depth of inundation
Area 1	Rainwater & river flood	3 days to 2 months	0.5-3.0 ft.
Area 2	Rainwater flood tidal flood	7-12 days 2-3 hrs.	1.0-1.5 ft. 0.5-1.0 ft.
Area 3	Rainwater & flash flood	2-15 days	0.5-2.5 ft.

Table 4. Level of knowledge on health, hygiene and diseases of the households (%)

Causes of Diseases	Study Areas		
	Area 1	Area 2	Area 3
Don't know	44	24	66
Flood	54	65	30
Virus	2	11	4

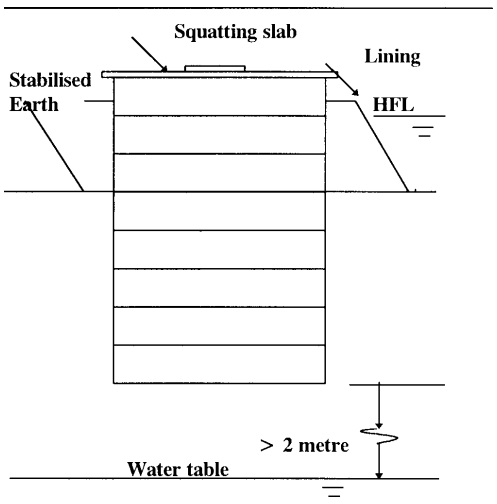

Figure 1. Earth stabilised raised pit latrine

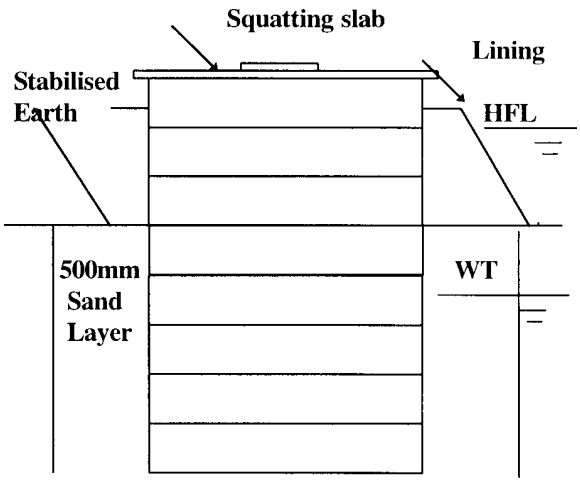

Figure 2. Sand enveloped raised pit latrine

prone areas and the latrine is called Sand Enveloped Raised Pit Latrine. The extended portion of the lining above ground level can be water-sealed or earth mound can be made to prevent leakage as discussed in case of the step or mound latrine.

Sanitation strategies

Mere the provision of sanitation facilities are not enough to achieve the goal of sound health and environment; rather an integrated approach combining technologies and strategies is needed for achieving overall success in this sector. Based on the findings of this research, some strategies are recommended that have addressed some key issues of sanitation.

Level of knowledge

The level of knowledge of health and hygiene of rural people in Bangladesh is very low (MoPERD, 1994). Data says that 90% of the households suffered from some sort of diseases and 47 per cent households could not identify a reason behind the illness. Improved understanding is required for a successful sanitation programme.

Motivation

The study reveals that people are reluctant in improving their sanitation facilities as the impacts of improved sanitation is not direct. Motivation is imperative for the acceptability of an improved sanitation option. Social status, cleanliness for religion, privacy etc. may be strategically applied to motivate people. Mass campaign is also very effective in motivation programme.

Integrated approach

Field level data indicates that although 100 per cent households use tube-well water for drinking and cooking, majority of them use polluted water from various sources for other household use. Therefore, an integrated approach combining water, sanitation and hygiene education is needed for achieving overall success.

Local level capacity building

Sanitation facilities should be improved through formulating appropriate policies and undertaking programme in these areas. Capacity building of the local authority as well

Table 5. Suitable latrines for the project area

Project areas	Local conditions					Suitable latrines
	Soil type	Groundwater level	Flood		Willingness to pay(Taka)	
			Type	Depth		
Dhaka	Stable Semi-stable	> 2 metre	Normal Rainwater	0-181 cm.	483	-Earths tabilised latrine -Step latrine -Mound latrine
Patuakhali	Stable Unstable	0 to 1 metre	Normal Tidal	0-90 cm.	486	-Sand Enveloped latrine -Sand Enveloped Raised latrine
Sylhet	Stable Semi-stable Unstable	0 to > 2metre	Flush Rainwater	0-181 cm.	690	-Earth Stabilised latrine -Step latrine -Mound latrine

as community-based organisations towards the sustainable development of overall sanitation programme should be strengthened.

Promotion of private sectors

The present study observed that the sanitation coverage under public programme is not adequate. Private sectors should be encouraged and supported to establish sanitation production centre at the critical problem areas for effective sanitation coverage.

Discussions and concluding remarks

Department of Public Health Engineering (DPHE) produces sanitary latrine consisting of 5 rings and 1 slab, which cost Taka 515. The additional costs of each type of latrine, consisting of eight rings and one slab are estimated and found to be in the range of Taka 326 to 600. More rings may be required to raise a pit as per field requirement to avoid floodwater intrusion into the pit. This will incur a higher cost of latrine. However, the extended portion of the pit will also increase the capacity of latrine. Survey results reveal that the average cost of the existing latrine including superstructure in the study areas is in the range of Taka 1220 - 1246 and people are willing to pay Taka 530 on average for an improved latrine facilities. The required number of rings for raising the pit including necessary works can easily be performed with this additional amount which the local people are willing to pay.

Group discussions, interview and local level workshops indicate that the recommended improved latrines are acceptable to the community, although these incur a higher cost. The cost of installation of such a latrine is within the capacity of the local people and thus it is affordable to the community. In terms of accessibility, people opined that the use of raised pit latrine is much better than having no latrine at all during flood period.

The suggested technical options offer improved type of latrines in which the above discussed defects can be eliminated. The technologies of these latrines are very simple and local people can install such latrines if they are trained.

Latrines suitable for different study areas are shown in Table 5. Latrines suitable for flood-prone areas can also be used in the high-water table areas if the drinking water is not collected from shallow groundwater source. Earth stabilised latrines, step latrines and mound latrines are found to be suitable for flood-prone areas of Dhaka and Sylhet. The sand enveloped latrines and sand enveloped raised latrines are suitable for Patuakhali areas.

The technological options for sanitation identified and suggested in this research may be promoted to overcome or minimise the sanitation problems in flood-prone and high-water table areas.

References

FLOOD PLAN COORDINATION ORGANISATION (FPCO), 1994, *Flood Action Plan, Ministry of Water Resources*, Govt. of Bangladesh.

MINISTRY OF PLANNING AND EXTERNAL RELATION DIVISION (MoPERD), *1991, Report of the Task Forces on Bangladesh Development Strategies for the 1990's*, The University Press Ltd., Dhaka.

WEBSTER, M., 1998, *Personal communication*

WORLD BANK, 1996, *Information and Training for Low-cost Water Supply and Sanitation*, Washington, D. C. 20433.

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