

# A Case Study on the Development of Sustainable Sanitation Facilities for the Disaster Affected Low-Income Rural Population in Bangladesh

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**Abstract** - The prevalence of unhygienic sanitation technologies has been a major cause of concern for environmental pollution and health hazards. The implementation of the United Nations Sustainable Development Goals has resulted in an increased focus on developing innovative and cost effective techniques to address sustainable sanitation for low-income population. Bangladesh is a global success story in sanitation by reducing open defecation to less than one percent at present. At the same time, Bangladesh is one of the most disaster prone countries in the world and the most vulnerable due to climate change. The development initiatives undertaken to achieve 100 percent sanitation coverage at national level have always been hampered by natural disasters, especially in coastal areas. Alternative techniques, as opposed to traditional ones, should be explored more for the design and implementation of disaster resilient latrines. Two coastal districts Khulna and Satkhira were selected for their vulnerability where several techniques had been used for the construction of hygienic latrines. Three innovative techniques where the platform is elevated before the installation of the latrines were considered in this study to evaluate their usefulness, among which the third technique using cement concrete was found to be the most sustainable and disaster resilient. However, the cost associated with this technique is comparatively higher than the others. Mainstreaming these techniques among the rural deprived population should be strongly considered to improve their sanitation status. Financial and technical support is required to appropriately select reliable technology that can be effectively adapted to local conditions. There is an increasing demand for integrated solution to address not only technological implementation, but also maintenance, social acceptance and gender equity.

**Keywords:** sustainable, sanitation, elevated, latrines, disaster, Bangladesh.

## I. INTRODUCTION

The United Nations (UN), international organizations and local governments across the globe have initiated several programs to deal with the negative impact on human health and the environment caused by the lack of access to sustainable sanitation. 191 UN member states and at least 22 international organizations agreed and committed to establish the Millennium Development Goals (MDGs) by 2015 at the Millennium Summit in 2000. MDG 7 (Target 7C) was intended to halve the proportion of the population without sustainable access to safe drinking water and basic sanitation by 2015. In order to tackle the global sanitation crisis and improve the existing condition, World Toilet Organization was established in 2001 and 19 November was declared “World Toilet Day” in 2013. In September 2015, the 2030 Agenda for Sustainable Development was adopted at the UN Summit, which emphasized new efforts to achieve 17 Sustainable Development Goals (SDGs) over the next 15 years [1]. SDG 6, on clean water and sanitation, is focused to ensure availability and sustainable management of water and sanitation for all [2].

Poor sanitation is widely accepted as the main contributor to waterborne diseases. At least 1.8 billion people in the world use a source of drinking water that is fecally contaminated [3]. Poor sanitation not only results in increased prevalence of diseases and pollution of the environment, but also reduces social and economic development due to impacts such as anxiety, risk of sexual assault, and lost educational opportunities. The total global economic loss due to inadequate water supply and sanitation was estimated to be US \$ 260 billion annually [4]. In 2015, it was estimated that 2.4 billion people in the world (one in three people) had no access to improved sanitation facilities, out of which 946 million people still practiced open defecation [5]. About 49% global population living in rural areas lack improved sanitation facilities as compared to only 18% in urban areas [6]. Open defecation is still a major problem globally, although many countries have made remarkable progress. Bangladesh has achieved 33 percent reductions in terms of population

practicing open defecation from 1990 to 2015 [6]. It was reported that less than one percent of Bangladeshi population defecated in the open in 2017 [7].

Although Bangladesh has already made significant strides, the situation is still alarming due to its geographical location, inadequacy of appropriate and adaptive technological options, and lack of public awareness. Bangladesh is a disaster prone country, where the frequency and intensity of disasters are gradually increasing due to the impact of climate change. According to the Global Climate Risk Index 2019, Bangladesh is ranked seventh among the most affected countries due to extreme weather events from 1998 to 2017 [8]. Inconsistent behavior of seasons, sea level rising, cyclones, frequent floods, waterlogging, river erosion, flash floods and mudslides in hilly regions lead to severe water and sanitation crisis. The Government of Bangladesh, with the support provided from other national and international non-governmental organizations (NGOs), had strived to achieve 100 percent sanitation coverage by 2013 through regular supply of hygienic latrines and proper maintenance through continuous use by all. But the initiatives that have been undertaken by various stakeholders are always destroyed by frequently occurred natural disasters and push Bangladesh back to the developing stage. Every year a good proportion of water and sanitation facilities such as shallow tube wells and sanitary latrines are built without taking into consideration the effects of natural calamities. As a result, many of them are damaged leaving the affected people deprived of the facilities and make them vulnerable to several health risks. For example, following the catastrophic cyclones Sidr and Aila which struck the southern part of Bangladesh in 2007 and 2009 respectively; housing, sources of safe water supply and sanitation facilities were fully destroyed. The damage of water and sanitation facilities further indicates avoidable loss of resources not only for the affected people but also for development efforts carried out by national and international communities that are supporting such projects in Bangladesh.

The objective of the present study is to critically review several techniques used in developing sustainable sanitation facilities for low-income rural population who were severely affected by frequent disasters in southern part of Bangladesh.

## II. MATERIALS AND METHODS

### a) Study area

A number of simple but innovative techniques have been used for the construction of sanitary latrines in south-west of Bangladesh by various stakeholders including the Government of Bangladesh, local and national NGOs, and international development organizations. Numerous latrines were

constructed in two of the most vulnerable districts of Bangladesh, which are frequently hit by various catastrophes. Khulna and Satkhira districts were selected for this study considering their previous history of disasters and the vulnerability for predicted future calamities. Several upazilas under these two districts were severely affected following Sidr and Aila, while some were constantly waterlogged being low-lying area. Moreover, the economic condition and sanitation status of these two areas were extremely poor.

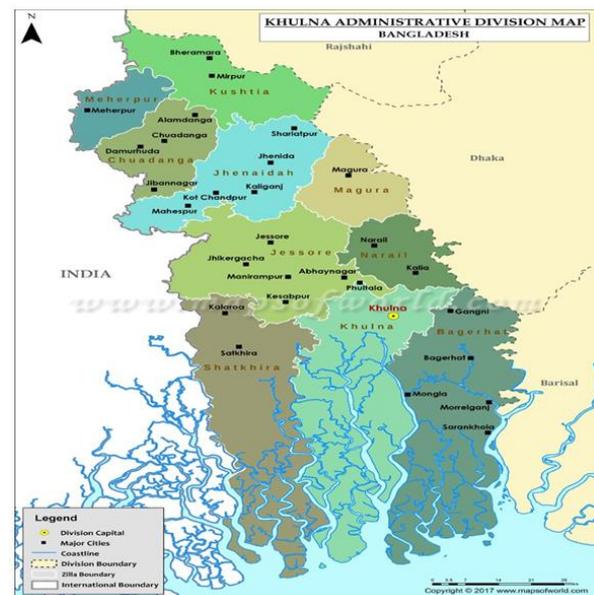


Figure 1: Location of Khulna and Satkhira district [9]

### b) Selection of techniques

As a first measure, a number of criteria were explored in terms of selection of materials, geological context, accessibility, household needs, design, durability, local culture, acceptability and affordability for the construction of latrines. Based on these findings, the design was finalized which was context specific, i.e., the latrines will be elevated using a suitable technique. Considering the flood prone and waterlogging characteristics of the area, the latrines were designed to raise about four to six feet high from the ground level so that people can use them even during emergency situation. In general, three techniques were considered in implementing this concept which is given below:

#### i) To elevate the platform by piling up of soil

This technique was the simplest one in which a mound (earthen formation of higher elevation) was constructed of compacted soil or sand, and then concrete slab and superstructure were constructed on top of the mound. The ideal cost effective material to elevate the land would be soil due to its higher compaction and load bearing properties. Due

to the scarcity of soil in that area, soils were dug from the surrounding land of the household premises. The excavated soils were then piled up to elevate the platform for at least four to six feet high. Once the platform was elevated, eight rings were placed in each latrine which would ensure long term usability and enough capacity to contain human waste. Moreover, the possibilities to contaminate the existing ground water table would be greatly reduced due to the raised platform. Other technical features included two feet nine inches diameter reinforced cement concrete (RCC) slab, two feet six inches diameter RCC ring, three inches thick cement concrete casting and plastic pan with water seal, which would make these hygienic latrines more useable for the targeted population. The superstructure, six feet high, was made of bamboo post, bamboo mat and corrugated iron (CI) sheet which were locally available. Bricks were laid down in such an order to form stairs for the entrance to the latrines. Grass was planted throughout the mound to provide slope stability of the surface. The main drawbacks of this approach were the stability of the elevated platform and longevity of the superstructure during extreme weathering condition (cyclone, storm surge etc.).



Figure 2: First technique

*ii) To elevate the platform by piling up of soil inside bag*

The second technique was a modified approach originated from the first one. Due to the frequent flooding and constant waterlogging nature of the area, the stability of the raised platform may be damaged in course of time. In this technique, the platform was constructed by using soil bags. First the excavated soil was compacted and then placed inside empty cement bags stacked on top of each other to create an elevated platform using different layers in a stable manner.

Approximately 200 cement bags were required to raise the platform for each latrine. In this case, the raw materials that were used to construct the latrine components (i.e., slab, ring etc.) were carefully selected so that they can endure extreme

weather condition prevalent in the coastal area. The remaining features were similar to the first technique. The main drawback of this technique was the durability of the cement bags. Although these bags were expected to last at least couple of years without any supervision, unforeseen circumstances may arise where they can be damaged. For example, cement bags that were placed in the top layer can be torn due to various external reasons (e.g., weathering, birds etc.). This may result in spreading out of soil from the bags, which will make the elevated platform less stable. It may even collapse in the long run for worst case scenario.



Figure 3: Second technique

*iii) To elevate the platform by using cement concrete*

The third technique was designed to eliminate the limitations of the previous two techniques. This approach was comparatively costlier as the latrines were constructed using cement concrete to raise the floor. The latrines were designed to be three to five feet high from the ground level depending on locations. The technical elements in terms of RCC slab, ring and superstructure were similar to the other techniques. Due to structural improvement, the latrines would be able to better withstand extreme weathering events such as storms, cyclones etc. They were more hygienic and would last longer than the other options. The expenses were on a higher side to construct these latrines as they will provide a permanent solution. The maintenance of these latrines will relatively be easier compared to other techniques if proper instructions were provided. However, this technique was moderately resource intensive as it takes time to construct and requires reasonable level of skilled labor. These latrines were found to be the most suitable and disaster resilient in design for low-income family members who live in remote areas.



Figure 4: Third technique

### III. DISCUSSIONS

#### a) Challenges faced during and post implementation

Collection of soil and filling up the cement bags in order to elevate the original ground level (first and second technique) was difficult. As there is scarcity of soil in these areas due to low-lying topography, soils were dug within the boundary of the households. As a result, lower lands were created very close to the latrines. These places may be filled with water, especially in the rainy season, to create permanent water logging. Another challenge was to increase the durability of the cement bags. Mud, a mixture of soil and water, can be used to cover the top surface of the cement bags just like earthen plaster after a certain interval to make them long lasting. Disabled people would find these latrines extremely difficult to access. One of the biggest challenges would be the proper maintenance of the latrines. To ensure the sustainability of the latrines, the household members should be instructed about latrine usage and maintenance techniques during and after the construction so that they were properly used and kept clean.

#### b) Opportunities created post implementation

The latrines would provide sustainable sanitation facilities to underprivileged people, who were not previously familiar with hygienic latrines. The elevated latrines were well accepted by the targeted low-income people. Members of a family will find using these latrines more hygienic and comfortable as compared to use shared facilities with other families previously. They will promote better hygiene practices among the users including hand washing, personal hygiene and menstrual hygiene. The best and effective use of these latrines can only be ensured by extensive sanitation and hygiene promotion. The number of waterborne and sanitation related diseases (e.g., diarrhea, dysentery) were expected to reduce a great deal.

### IV. CONCLUSION

WHO defines sanitation as the provision of facilities or services that separates people from urine and feces. Safe access to sanitary latrines and management of excreta are the basic targets for global sanitation [1]. Sanitation related issues are highly variable from location to location, season to season and community to community. In general, people who lack sanitation facilities are often living in the most challenging geographical and climatic setting [10]. The installed latrines will contribute to ensure sustainable sanitation in Bangladesh, taking into account the geographical location and socio-economic condition of the people. Information will be needed from these latrine users to find out their satisfaction level and user friendliness of the latrines. However, it should be kept in mind that different approaches are required for different situation. This particular technology, elevated sanitation, is most effectively applicable in waterlogged and flood prone areas. Hence advance research will be required to evaluate appropriate design option for low-cost sanitation technologies in different parts of Bangladesh so that it will reflect hydro-geological context and promote better sanitation to meet up the needs, social acceptability and affordability of the local people. Developing economical, acceptable, technically precise and environment friendly sanitation technology for the rural population require holistic and integrated approach that must address social, cultural, institutional and educational factors.

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