TECHNICAL PAPER

Equitable and Sustainable WASH services in Bangladesh Delta Plan Hotspots

Assessment of WASH service delivery models in Bangladesh

brac IRC

1. Introduction

With the objective of increasing access to safe water and sanitation in communities and schools in the climate-vulnerable hard-to-reach areas of Bangladesh, BRAC and IRC have started the project titled "Equitable and Sustainable WASH Services in Bangladesh Delta Plan Hotspots" in 2022.

The Project is implemented through a sub-district approach in four (4) climate hotspots: coastal, Haor, Barind and floodplains in Bangladesh. The Project is implemented in 45 Upazilas (sub-districts) of fourteen (14) districts, and it is expected to benefit one million community members and students through safely managed water and sanitation services. An essential element of this Project is adapting existing water and sanitation service delivery models (SDMs) and introducing new ones that are suitable for the four climate hotspot areas, where current models often break down or are unsuitable for the harsh climate conditions.

This paper presents the results of an assessment of the appropriateness of existing water and sanitation technologies in coastal, Haor and floodplain areas and their subsequent service models in terms of installation and operation and maintenance (O&M). A separate research project is ongoing in the Barind areas; therefore these areas are omitted from the scope of this assessment. The appropriateness assessment has provided insights into the strengths and weaknesses of the existing water and sanitation service models in the three hotspots, highlighting the need for technological adaptation and innovation.

2. Assessment methodology

The Project has formed a Steering Committee to guide the assessment and subsequent innovation/piloting process. This document is meant to act as a guiding document for the Project team and the Steering Committee to carefully prioritise challenges/needs this Project can address through its innovation work.

The BRAC-IRC team has collected the technology and service model data through a household survey (part of the baseline survey of the project). Following a thorough literature review, primary data collection was conducted to identify the water and sanitation technologies and their SDMs. The assessment has considered the technologies used at scale, at the rural household and community levels. It has not considered the options that were installed for trial/testing purposes only. In the service model section, the assessment has looked into capital investment, the geographic appropriateness of the technology and the simplicity of O&M (availability of spare parts, skills available for repairs and the affordability of O&M). The service models were scored in a qualitative manner to understand their strengths and weaknesses (further explained in section 4). The scoring is done through two consultations with external expert groups (national water and sanitation experts) and one consultation with the Steering Committee of the project.

3. Identified service delivery models in Bangladesh

Before presenting the results of the assessment on the prevailing water and sanitation SDMs in the next sections, brief descriptions of the most common SDMs that are found in Bangladesh are provided below.

3.1 WATER SERVICE DELIVERY MODELS

User-managed (self-supply) shallow and deep wells fitted with a handpump: These are shallow or deep tubewells (fitted with handpumps) installed by individual households. The installation of these wells and handpumps is financed by the household itself and installed by or with support from local artisans. Often households use microcredit to finance the initial investments, especially the deep wells. This technology is appropriate for almost all areas except for areas where groundwater contamination exists. The households are also responsible for O&M. The O&M costs are affordable to non-poor and poor households since the required skills and spare parts are generally regularly available in (most) rural areas.

Local Government Institutes (LGIs) provided deep wells fitted with a handpump: These are deep tubewells (fitted with handpumps) installed by the Department of Public Health Engineering (DPHE) or

other LGIs for a group of households (usually for up to ten households). Ninety percent of the costs for hardware and installation are borne by DPHE or the relevant LGI and the remaining 10% has to come from the community or from the landowner. The installation is carried out by masons or handpump mechanics contracted by DPHE or the LGI. This technology is appropriate for almost all areas, except where groundwater contamination exists. A household (usually the owner of the land where the handpump is located or the household living closest to the handpump) is selected as caretaker and this household is expected to take responsibility for O&M. The O&M is affordable to most non-poor and poor households since the required skills and spare parts are generally regularly available in (most) rural areas. Affordability, particularly in the case of larger or major repairs, is likely to be a problem for hardcore poor households.

User-managed (self-supply) Rainwater Harvesting Systems (RWHS): These are household-based RWHS, installed by individual households, mostly in coastal areas. These RWHS are financed by the household itself and constructed or installed by or with support from local artisans/plumbers. This technology is appropriate for areas where groundwater and/or surface water contamination exists. It is, however, not expected to provide year-round water services due to limited water storage capacity. The household is responsible for O&M. The O&M is affordable to most non-poor and poor households since the required skills and spare parts are generally regularly available in (most) rural areas.

Local Government Institutes (LGIs) provided Rainwater Harvesting Systems (RWHS): These are household and community-level RWHS installed by DPHE or other LGIs for individual households. These are mainly found in coastal areas. Ninety percent of the costs for hardware and installation are borne by the relevant LGI and the remaining 10% has to come from the community. The installation is carried out by masons or handpump mechanics contracted by the LGI. This technology is appropriate for areas where groundwater and/or surface water contamination exists. It is, however, not expected to provide year-round water services due to limited water storage capacity. The newly installed RWHS systems come with a pre-filtration unit that extends their usability during the dry season. After installation, the household becomes responsible for O&M. The O&M is affordable to most non-poor and poor households since the required skills and spare parts are generally regularly available in (most) rural areas.

Community-managed Pond Sand Filters (PSF): A pond sand filter is a slow sand filter unit designed to treat surface water, typically pond water, for domestic water supply. The slow sand filters are installed near or on the bank of an existing pond, which does not dry up in the dry season. The water from the pond is pumped by a manually operated handpump onto the filter bed, which is raised from the ground (some PSFs are being tested with solar-powered pumps). The treated water is stored in a storage tank and from there collected through tap(s). These systems are often installed by DPHE, other LGIs and NGOs which bear the full or partial costs of construction. Users may be requested to bear some of the costs. The installation is carried out by masons or handpump mechanics contracted by DPHE, the LGI or the NGO. A user committee is formed and a household, usually located nearby, is selected as caretaker. The caretaker is expected to take responsibility for O&M. In an ideal situation, the users pay a user fee to the caretaker on a monthly or volume of water basis (tariff). This technology is appropriate for areas where groundwater contamination exists. O&M is affordable, but the required skills and spare parts are not always available in rural areas.

Community-managed membrane filters: There are different types of membrane filters, such as a nano filter or reverse osmosis filter. The most commonly available options are reverse osmosis membranes. These are often installed by DPHE, other LGIs and NGOs that bear the full or partial costs. Users may be requested to bear some of the costs. The installation is carried out by small engineering firms contracted by DPHE, the LGI or the NGO. It is energy dependent, and thus requires connection to an electrical grid or have its own solar power supply. In most cases, a user committee is formed, and a caretaker is appointed. Users are expected to pay for the water. The salary of the caretaker and other O&M-related costs are paid

from the user fees/tariffs. In some cases, these filters were used as vending machines with automated tailoring systems for increasing efficiency. This technology is appropriate for areas where water contamination exists, but generates a lot of wastewater. The O&M is affordable for non-poor households but not for most poor and hardcore poor households. It requires skills and spare parts which are not always available in rural areas.

Private entrepreneurs managed membrane filters: A membrane filter, such as a nano filter or reverse osmosis filter. These filters are installed and operated by private entrepreneurs. The finance may come from their own source or microfinance institutes or a mix of both. The installation is carried out by small engineering firms. The entrepreneur sells the treated water to its consumers on a volume basis. In some cases, they sell to water-to-water vendors at a wholesale rate after which the water vendor sells the water to the consumers (using a mini-van or tanker truck) at a retail rate. The entrepreneur is solely responsible for O&M. This technology is appropriate for areas where water contamination exists. The technology is energy dependent and generates a lot of wastewater. The tariff is affordable for non-poor households; however, it may not be affordable for most poor and hardcore poor households. It requires skills and spare parts which are not always available in rural areas.

Community-managed Arsenic-Iron Removal Plants (AIRP): These are arsenic and/or iron removal plants that work on the basis of physio-chemical separation techniques. These plants use electric pumps and are therefore dependent on the electrical grid or solar power. These plants are often installed by DPHE, other LGIs and NGOs which bear the full or partial costs. Users may be requested to bear some of the costs. The installation is carried out by masons or handpump mechanics contracted by DPHE, the LGI or the NGO. In most cases, the installer and users appoint a caretaker, users are expected to pay for the water. The salary of the caretaker and other O&M-related costs are paid from the user fees/ tariffs. This technology is appropriate for areas where water contamination exists. The O&M is affordable for non-poor households but not for most poor and hardcore poor households. It requires skills and spare parts which are not always available in rural areas.

Community-managed mini-piped water supplies: These are mini water supply systems with overhead water storage tanks and piped networks. Water is pumped into the overhead tank using electric pumps from surface or groundwater sources. In case of surface water, it usually includes a water treatment unit. The capacity of such systems varies and usually covers between 20 to 100 households. These systems are often installed by DPHE, other LGIs and NGOs which bear the full or partial costs. Users may be requested to bear some of the costs. The installation is carried out by masons or handpump mechanics contracted by DPHE, the LGI or the NGO. A household, usually located nearby, is selected as caretaker, and takes responsibility for O&M. A committee is formed to supervise the operation and settle disputes. The system usually serves water twice a day. Users are expected to pay for the water by paying a user fee to the committee on a monthly basis. This technology is appropriate for almost all areas; it has, however, high installation costs. O&M is usually affordable but requires skills and spare parts which are not always available in rural areas.

3.2 SANITATION SERVICE DELIVERY MODELS

User-managed (self-supply) toilets with onsite storage (pits): These are pit latrines commonly available in all rural areas of Bangladesh. These pit latrines are either connected to a single direct pit or to one or more offset pits. These latrines are financed by the household itself and constructed or installed by or with support from local artisans. The households are also responsible for the O&M of such toilets/latrines. Generally, these latrines are affordable for non-poor and most poor households but often unaffordable for hardcore poor households. They tend to be user-friendly unless there is a person with a disability in the household. O&M is usually affordable since both skilled masons and spare parts are available in most of the rural areas of Bangladesh. It is expected that most of the minor repairs can be carried out by the households themselves. The technology is appropriate for areas with low water tables and areas not prone to periodic flooding. Latrines with double

(twin alternating) offset pits are more appropriate (and more user-friendly) as they allow for safe emptying by the user households.

User-managed (self-supply) toilets with onsite storage (septic tanks): These are flush or pour-flush latrines connected to a septic tank. They are available to some extent in rural areas of Bangladesh, but more commonly found in urban areas. These latrines are financed by the household itself and constructed or installed by local artisans. In many cases, households borrow money (microcredit or other) to finance the initial construction costs. The households are also responsible for the O&M of such latrines. Considering the higher initial investment costs these latrines are generally more affordable for non-poor households than for poor and hard-core poor households. This technology, if designed, constructed, and operated correctly, is appropriate for almost all areas, except for areas with water scarcity. Its O&M is affordable to non-poor households only since it requires skilled masons. The technology is therefore not appropriate in areas where skilled masons are not available.

LGI pit latrine support for poor households: These are single direct pit latrines commonly available in all rural areas of Bangladesh. DPHE or LGIs support poor households by providing a number of concrete rings and a concrete slab. The household is responsible for the construction or installation of the latrine with or without the support of local artisans. The households are thereafter responsible for O&M of such latrines similarly to what has been described above. Whether O&M is affordable to these poor households will depend on the nature of the repairs required and the socio-economic situation of the household.

NGO pit latrine support for poor households: This is basically the same as described above for the LGI support to poor households. These are single or double pit direct/offset latrines commonly available in all rural areas of Bangladesh. NGOs support poor households by providing the hardware of the latrine as a grant. The household is responsible for the construction or installation of the latrine with or without the support of local artisans. The households are thereafter responsible for O&M of such latrines similarly to what has been described above. Whether O&M is affordable to these poor households will depend on the nature of the repairs required and the socio-economic situation of the household.

Table 1: Assessment of the water service delivery models for the coastal hotspot

Service delivery models	Responsible for		Assessment criteria						
			Initial installation			Operations			
	Installation	O&M	Affordability of capital costs	User friendliness	Technological appropriateness	Affordability of O&M	Availability of spare parts	Availability of skills	Overall assessment
User-managed (self-supply) shallow and deep well with handpump	User (HH)	User (HH)	+	+	-	+	+	+	-
Local Government Institutes (LGIs) provided shallow and deep well with handpump	LGI	User (HH)	+	+	-	o	+	+	-
Local Government Institutes (LGIs) provided RWHS	LGI	User (HH)	+	+	O	o	+	+	+
User-managed (self-supply) RWHS	User (HH)	User (HH)	+	+	O	+	+	+	+
Community-managed Pond Sand Filter	LGI or NGO	Users	o	-	O	o	o	o	o
Community-managed membrane filter	LGI or NGO	Users	o	+	O	-	o	o	o
Entrepreneur-managed membrane filter	Entrepreneur	Entrepreneur	-	+	O	o	o	o	o
Community-managed Arsenic-Iron Removal Plant	LGI or NGO	Users	o	+	+	o	o	o	+
Community-managed mini-piped water supply system	LGI or NGO	Users	-	+	+	+	o	o	+

Manual/pump assisted pit emptying: This relates to manual or mechanical pit-emptying services for rural households. Private entrepreneurs provide this service. They use either rope-bucket (manual) or electric diesel pump (mechanical) operated services to empty the latrine pits or septic tanks. The faecal sludge emptied from the pits and tanks is dumped either in a nearby surface water source or in a hole. The cost of emptying is to be borne by the households. This service is affordable for non-poor households. Most poor and hardcore poor households cannot afford this type of service and may have to do the emptying themselves.

4 . Assessment of the service models

4.1 SERVICE APPROPRIATENESS

This section analyses the appropriateness of the existing water supply and sanitation SDMs in the three mentioned climatic hotspots. The assessment is expected to identify limitations of the existing SDMs, which can be improved through piloting improved or new SDMs. Two major criteria were taken into account while designing the assessment, namely: i) initial installation/construction; and ii) operation (& maintenance). As mentioned in section 3, there are different water and sanitation service models available in rural areas of Bangladesh and their appropriateness varies greatly depending on the responsible service provider. What is appropriate for a professional service delivery utility/private provider may not be appropriate if it is a self-supplied/self-managed (by the household) or community-managed service. Thus, the assessment process has considered the appropriateness of the installation and O&M based on who is ultimately responsible for its day-to-day running/operations (local authority/utility/private service provider/household/community).

In the installation part, criteria taken into account are:

- Affordability of capital cost of the technology (affordability for the responsible entity)
- User friendliness (suitability for the user e.g. household/community)
- Technological appropriateness (suitability of the technology for a particular geo-hydrological condition)
- In the operation and maintenance part, criteria taken into account are:
- Affordability of O&M (affordability for the responsible entity)
- Availability of spare parts (to replace broken or worn-out parts)
- Availability of skills (to carry out the required O&M tasks)

The assessment follows a semi-qualitative scoring. Each criterion was scored: - for poor; o for fair; + for good. The primary (most important) selection criterion is technological appropriateness. If the technology is performing and suitable for the particular geo-hydrological condition, only then will the rest of the criteria be considered. If the technological appropriateness score is – (poor) then the overall score will also be – (poor).

4.2 COASTAL AREAS

The coastal areas are found in the south-western, south-central, and south-eastern part of Bangladesh[1]. The part that is bordering the Bay of Bengal. This is the area where tidal floods are frequently occurring. The Project works in 25 coastal sub-districts spread over six (6) districts (Bagerhat, Barguna, Khulna, Patuakhali, Pirojpur and Satkhira).

Based on the above explanation regarding the service appropriateness, the water service models available in the coastal areas are assessed (scored) as shown in the table below. Short descriptions of the SDMs are provided in section 3.1.

Likely impact of climate on water services in coastal areas:

- Fresh water scarcity
- Saline water intrusion
- Declining underground water levels
- Reduction in durability of WASH infrastructure due to recurring climate hazards (cyclones, storms, floods, etc.)

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Reflections on the appropriateness of the water SDMs found in coastal areas:

- In general, shallow and deep wells (fitted with handpumps) are the least appropriate technology for use in coastal areas due to a combination of saline water intrusion into groundwater aquifers and presence of contaminants like iron and arsenic. However, these services should be considered for specific locations as people are used to use shallow and deep wells. Availability of skills and supply chain of spare parts to repair these wells made this a convenient service for the communities (see section 3.1 for details).
- Rainwater harvesting systems are considered appropriate even though there are challenges such as water quality and inadequate quantities for year-round supplies.
- The community-managed models (PSF, membrane filter, AIRP or piped water supply) are better in terms of technical appropriateness. However, often they fail to provide long-term sustained services due to poor management (lack of ownership, inadequate service charges/tariffs, lack of adequate supply of spare parts and required technical skills).

The sanitation service models available in coastal areas are assessed (scored) as shown in the table below. Short descriptions of the SDMs are provided in section 3.2.

Likely impact of climate on sanitation services in coastal areas:

- Possible flooding of latrines, pits and/ or tanks
- Reduction in durability of WASH infrastructure due to recurring climate hazards (cyclones, storms, floods, etc.)

Reflections on the appropriateness of the sanitation SDMs found in coastal areas:

- In general toilets (or latrines) with septic tanks are the most appropriate technology in coastal areas as the impact caused by natural hazards is expected to be minimal if the human waste is safely contained in professionally designed and constructed watertight tanks. Initial installation costs, however, are expected to be high, and it will be difficult to empty the septic tanks on time in the absence of proper mechanical pit emptying services. Its maintenance is easy and less expensive if built properly. A lack of skilled personnel in rural areas hinders the construction and maintenance of septic tanks.

Table 2: Assessment of the sanitation service delivery models for the coastal hotspot

Service delivery models	Responsible for		Assessment criteria						
			Initial installation			Operations			Overall assessment
	Installation	O&M	Affordability of capital costs	User friendliness	Technological appropriateness	Affordability of O&M	Availability of spare parts	Availability of skills	
User-managed (self-supply) toilets with onsite storage (pits)	User (HH)	User (HH)	+	o	O	+	+	+	+
User-managed (self-supply) toilets with onsite storage (septic tanks)	User (HH)	User (HH)	-	o	+	+	+	-	+
LGI pit latrine support for poor households	LGI	User (HH)	+/-[1]	o	O	-	o	+	o
NGO pit latrine support for poor households	NGO	User (HH)	+/+[2]	o	O	-	o	+	o
Manual pit emptying	N/A	N/A	N/A	-	-	o	N/A	N/A	-

1 Mixed score: + (good) for LGI providing slab and 3 rings; - (poor) for hardcore poor households as they have to install the slab and rings and construct a superstructure.

2 Mixed score: + (good) for NGO for providing support to individual households; + (good) for hardcore households as it is expected that they get more support than just the slab and rings.

- Latrines connected to simple pits (either direct or offset) are less appropriate unless they are designed and constructed to cope with cyclones, storms, and floods. In general, this will require more sturdy construction techniques, and raising the pits and superstructures above anticipated flood levels will undoubtedly increase the initial installation costs. In general, twin offset pits are more appropriate as they can be emptied safely by the users/household and can therefore be considered as safely managed sanitation.
- LGI and/or NGO-provided support to poor households is similar to what is described above for latrines with simple pits. DPHE and LGIs typically provide a couple of concrete rings and a concrete slab, while the receiving household being responsible for transportation, installation, and construction of the superstructure. This may still be too expensive for hardcore poor households. The type of technology and the extent of the subsidy provided are likely to differ per NGO (see section 3.2 for details).

4.3 HAOR AREAS

Haor is a wetland ecosystem in the northeastern part of Bangladesh. Haor are bowl-shaped shallow depressions which during the rainy season receive surface runoff water from rivers and canals and become vast stretches of open water bodies[2].

The Project works in ten (10) Haor sub-districts spread over four (4) districts (Habiganj, Kishoreganj, Netrokona and Sunamganj).

The water service models available in Haor areas are assessed (scored) as shown in the table below. Short descriptions of the SDMs are provided in section 3.1.

Likely impact of climate on water systems in Haor areas:

- High levels of water turbidity during the rainy season
- Poor water quality (presence of contaminants like arsenic and iron; absence of household-level or community water treatment systems)
- Declining underground water levels (shallow as well as deep wells are drying up)

Reflections on the appropriateness of the water SDMs found in Haor areas:

- In general, deep wells (fitted with handpumps) are an appropriate technology for use in Haor areas as there is groundwater contamination from pit latrines and declining underground water levels. There is generally a steady supply of affordable spare parts, as well as skills for repairs in these areas.

Table 3: Assessment of the water service delivery models for the Haor hotspot

			Assessment criteria						
Service delivery models	Responsible for		Initial installation			Operations			Overall assessment
	Installation	O&M	Affordability of capital costs	User friendliness	Technological appropriateness	Affordability of O&M	Availability of spare parts	Availability of skills	
User-managed (self-supply) shallow and deep well with handpump	User (HH)	User (HH)	+	+	+	+	+	+	+
Local Government Institutes (LGIs) provided shallow and deep well with handpump	LGI	User (HH)	+	+	+	-	+	+	+
Community managed mini-piped water supply	LGI or NGO	Users	-	+	+	+	o	o	+

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- Community-managed mini-piped water supply schemes are the most appropriate technology, and these systems usually best meet the current and future demands of the users. It can better handle contaminants such as arsenic and iron. However, investment (and operation) costs are high and the challenging geography of Haor areas complicates this further. And as mentioned earlier, community management structures are usually a big challenge to get right (see section 3 for details).

The sanitation service models available in Haor areas are listed below according to the assessment criteria. Short descriptions of the service delivery models are provided in section 3.2.

Likely impact of climate on sanitation systems in Haor areas:

- Lack of space for sanitation
- Toilets become inundated during the wet season when Haor areas turn into lakes
- Lack of appropriate pit emptying services and faecal sludge treatment facilities

Reflections on the appropriateness of the sanitation SDMs found in Haor areas:

- In general toilets (or latrines) with onsite storage facilities (pits) are not appropriate for Haor areas unless they are designed and constructed to cope with the seasonal flash floods. Septic tanks, on the other hand, are technologically appropriate for use in Haor areas, but often not a viable solution due to insufficient space to build one or each household. Therefore, people usually build simple single pit ring-slab latrines partly on or near a Haor, which then get half or fully inundated during the monsoon.
- Skills and spare parts are available locally in Haor areas for building and repairing single pit ring-slab latrines. Thus, they are affordable and easy to maintain if properly built. Septic tanks are relatively easy to maintain too, but local masons often lack the knowledge and skills to design and build proper septic tanks (see section 3.2 for details).

Table 4: Assessment of the sanitation service delivery models for the Haor hotspot

			Assessment criteria						
Service delivery models	Responsible for		Initial installation			Operations			
	Installation	O&M	Affordability of capital costs	User friendliness	Technological appropriateness	Affordability of O&M	Availability of spare parts	Availability of skills	Overall assessment
User-managed (self-supply) toilets with on site storage (pits)	User (HH)	User (HH)	+	o	o	+	+	+	+
User-managed (self-supply) toilets with onsite storage (septic tanks)	User (HH)	User (HH)	-	o	+	+	+	-	+
LGI pit latrine support for poor households	LGI	User (HH)	+	o	o	-	o	+	o
NGO pit latrines support for poor households	NGO	User (HH)	0	o	o	-	o	+	o
Manual pit emptying	N/A	N/A	N/A	-	-	o	N/A	N/A	-

4.4 FLOODPLAIN (CHAR) AREAS

Floodplains are riverine sand and silt landmasses . These areas, which include low lying banks of the river systems (commonly known as Char in Bengali), are highly vulnerable to sudden and forceful flooding as well as erosion and loss of land[3]. The Project works in three (3) sub-districts of Jamalpur district.

The water service models available in the floodplain (Char) areas are assessed (scored) as shown in the table below. Short descriptions of the SDMs are provided in section 3.1.

Likely impact of climate on water systems in floodplain (Char) areas:

- Recurrent floods/flash floods
- Poor water quality
- Continuous land erosion

Reflections on the appropriateness of the water SDMs found in floodplain areas:

- In general shallow and deep wells (fitted with handpumps) are the least appropriate technology for use in floodplain areas because of land erosion and potential contamination of groundwater supplies.
- Community-managed mini-piped water supply schemes are the most appropriate technology as explained above in the section dealing with water service models in Haor areas. The community-managed mini-piped water supply schemes and community-managed iron removal plants are present in limited numbers, making it difficult to fully explore the availability and affordability of spare parts and the skills needed for repairs.

The sanitation service models available in floodplain (Char) areas are assessed (scored) as shown in the table below. Short descriptions of the SDMs are provided in section 3.2.

Likely impact of climate on sanitation systems in floodplain (Char) areas

- Recurrent flood/flash flood
- Continuous land erosion

Table 5: Assessment of the water service delivery models for the floodplain hotspot

			Assessment criteria						
Service delivery models	Responsible for		Initial installation			Operations			Overall assessment
	Installation	O&M	Affordability of capital costs	User friendliness	Technological appropriateness	Affordability of O&M	Availability of spare parts	Availability of skills	
User-managed (self-supply) shallow and deep handpump	User (HH)	User (HH)	+	+	-	+	+	+	-
Local Government Institutes (LGIs) provided handpump	LGI	User (HH)	+	+	-	o	+	+	-
Community-managed Iron Removal Plant	LGI or NGO	Users	o	+	+	o	o	o	+
Community-managed mini-piped water supply	LGI or NGO	Users	-	+	+	o	o	o	+

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Reflections on the appropriateness of the sanitation SDMs found in floodplain areas:

- In general toilets (or latrines) with onsite storage facilities (pits) are the most appropriate technology for use in floodplain areas because less initial capital investments are required. Due to the risk of land erosion, they may have to be rebuilt frequently. Investing in septic tanks may not be worthwhile, as these tend to be much more expensive.

5. Way forward

The SDM assessments described in this paper serve as a stepping stone towards achieving climate-resilient and sustainable WASH service delivery in the Project's targeted climate hotspots. Reflections in section 4 (assessment of the service models) show the limitations of the existing water and sanitation service delivery models. These limitations can be addressed through the introduction of new or adapted/modified technologies and/or their corresponding SDMs.

In most cases, there is a need for new or modified SDMs that focus on more appropriate operation and maintenance (O&M) approaches. As we can see in section 4, the need for new – more appropriate – water and sanitation technologies is most urgent in the coastal and Haor areas. The Project has highest potential for impact in these two hotspots due to greater geographic coverage compared to the other two hotspots. Currently, the Project is designing interventions to address the identified challenges and needs. Specifically, it is developing two SDM pilot interventions in these two hotspots[4].

Table 6: Assessment of the sanitation service delivery models for the floodplain hotspot

			Assessment criteria						
Service delivery models	Responsible for		Initial installation			Operations			Overall assessment
	Installation	O&M	Affordability of capital costs	User friendliness	Technological appropriateness	Affordability of O&M	Availability of spare parts	Availability of skills	
User-managed (self-supply) toilets with onsite storage (pits)	User (HH)	User (HH)	+	o	o	+	+	+	+
User-managed (self-supply) toilets with onsite storage (septic tanks)	User (HH)	User (HH)	-	o	+	+	+	-	+
LGI pit latrine support for poor households	LGI	User (HH)	+	o	o	-	o	+	o
NGO pit latrines support for poor households	NGO	User (HH)	0	o	o	-	o	+	o
Manual pit emptying	N/A	N/A	N/A	-	-	o	N/A	N/A	-

4 Technical Paper #2 will cover the pilot interventions and their findings.

DEFINITIONS

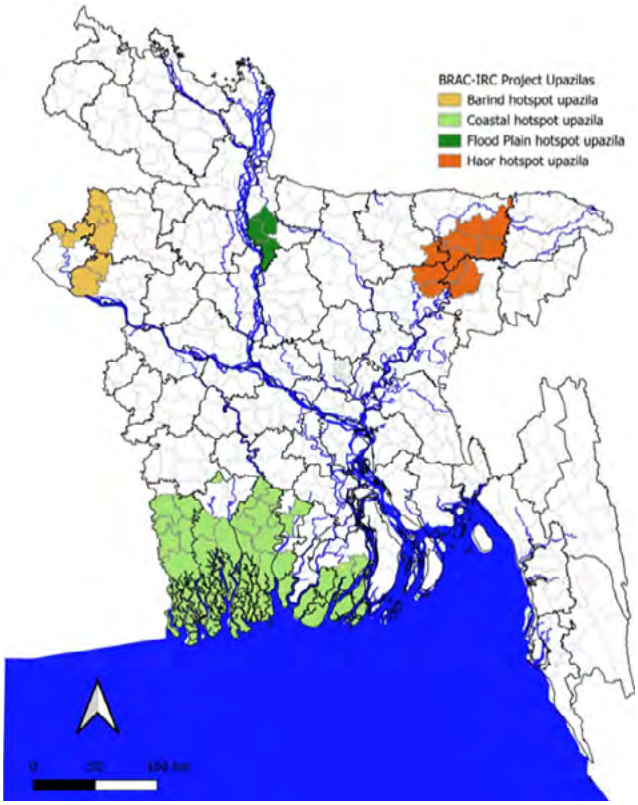
Coastal is the south-western, south-central, and south-eastern part of Bangladesh bordering the Bay of Bengal where tidal floods are frequently occurring.

Haor is a wetland ecosystem in the northeastern part of Bangladesh. It is a bowl-shaped shallow depression which during the rainy season receives surface runoff water from rivers and canals to become vast stretches of open water bodies.

Floodplains are riverine sand and silt landmasses. These areas, which include low lying banks of the river systems (commonly known as Char in Bengali), are highly vulnerable to sudden and forceful flooding as well as erosion and loss of land.

Barind is a geographic region in parts of northwestern Bangladesh. It is a comparatively high, undulating region, with high temperatures and known to be drought prone.

Figure 11: Map showing the project areas in the Delta Plan Hotspots of Bangladesh.



To learn more more about the Equitable and Sustainable WASH Services in Bangladesh Delta Plan Hotspots (2022-2026) see the project page:

bit.ly/BangladeshDeltaHotspots

About BRAC

BRAC is an international development organisation founded in Bangladesh in 1972, working with communities in marginalised situations, hard-to-reach areas and post-disaster settings across Asia and Africa, with a particular focus on women and children. It is a global leader in developing and implementing cost-effective and evidence-based programmes.

www.brac.net

About IRC

IRC is an international think-and-do tank that works with governments, NGOs, businesses and people around the world to find long-term solutions to the global crisis in water, sanitation and hygiene services. At the heart of its mission is the aim to move from short-term interventions to sustainable water, sanitation and hygiene services. With over 50 years of experience, IRC runs projects in more than 25 countries and large-scale programmes in eight focus countries in Africa, Asia and Latin America.

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