A Local level Case Study on

Effectiveness of Water Supply and Sanitation Technology in Vulnerable Coastal Zone of Bangladesh

Submitted to

CapNet Bangladesh

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1 Background

Bangladesh is one of the most vulnerable countries to the adverse impacts of climate change. This is due to a number of geographical and hydrological factors like its geographical location, hydrological influence of monsoon and regional flow patterns, high rainfall during monsoon while little in the dry season, extreme temperature with scanty rainfall, saline water intrusion, catastrophic natural disasters, etc.

The impacts of climate change on water supply and sanitation directly affect how the sustainable development goals of the country would be achieved and therefore puts the country at risk of obtaining poverty reduction, overall public health and conserving its ecosystem. By 2021, Bangladesh envision a situation where access to clean water and sanitation will no longer remain a luxury (Vision 2021, goal 4.7). In the seventh 5 years Plan, the Government of Bangladesh has targeted safe drinking water to be made available for all rural population.

Sustainable Development Goal (SDG 6) has a target to achieve universal and equitable access to safe and affordable drinking water for all. As a result of national and international initiatives, Bangladesh has made huge progress in sanitation over the last 25 years through reducing open defecation from 32% in 1990, to 5% today. To facilitate the promotion of water supply and sanitation among the vulnerable coastal community, different local and international NGOs, Government of Bangladesh (GoB) through the Local Government, with the investment from Annual Development Program (ADP), are implementing several hardware and software based programmes and projects.

To that note, as a part of activities, Bangladesh Centre for Advanced Studies, partner of Capacity Network (CapNet) proposed a study to assess the effectiveness of Water Supply and Sanitation Technology in Vulnerable Coastal Zone of Bangladesh.

2 Objective of the Study

I. To assess the efficacy of the existing water and sanitation technologies in improving the health condition and ensuring the water safety of climate vulnerable people
II. To assess the functional modality of technologies for water supply and sanitation in ensuring the quality and adequacy to meet the community demands in a resilient context.

3 Research Questions

1. What are the water supply and sanitation technologies that are being used in the coastal areas?
2. Are there any technology resilient to climate change induced disasters in the coastal areas? If yes, how? If not, why?
3. Are the technologies friendly to gender and elderly people? If yes, how? If not, why?
4. What are the community recommendations to make the technologies more effective

4 Methodology

The study considered a qualitative approach to meet the objectives in a rigorous process of data collection using the semi structured tools. The following section included a synopsis of the study approach, including how the data collection tools were prepared and conducted amongst the people from various socio-economic backgrounds. Based on the qualitative approach of the study, study team followed three different ways of data collection methods as given bellow:

Data collection method	Surveyed participants	Number
Focus Group Discussions (FGDs)	Community	8
Key Informants Interview (KII)	At Local Level: DPHE, Union Parishad, Chairman; Community People; caretaker of WASH technology; Private Sector Representative and	24
	NGO representatives at the national level included village education Resource Centre, Director, Wash (VERC); Water Aid; Hygiene, Sanitation and Water Supply (HYSAWA) and Dhaka Ahshania Mission	4

Table 4-1: Data collection method and data source

These methods were targeted to assess data from two different ends- implementers and beneficiaries. While selecting the Criteria of beneficiaries- gender, exclusion and disability were considered strictly, targeting at assessing data from different level of experiences and perception on the basis of their socio-economic and gender background. Given below, two **Up**azillas in coastal districts were the study sites.

Zone	District	Upazilla	Union
Coastal Zone	Satkhira	Shyamnagar	1. Burigoalini 2. Munsigonj
	Khulna	Dacope	3. Tildanga 4. Pankhali

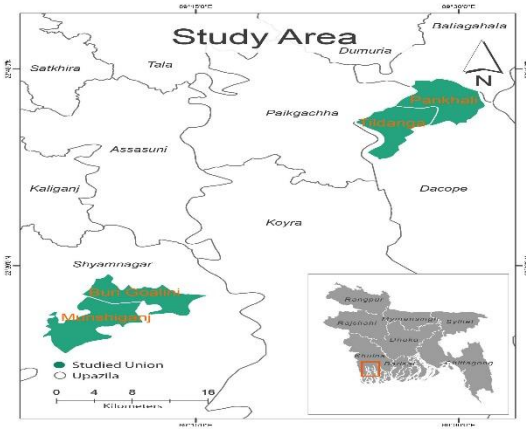

Table 4-2: Study site map

Consultation meeting with Upazilla Nirbahi Officer (UNO), and instead of his presence, Project Implementation Officer (PIO) at Upazilla Parishad guided up the study team to find out the most vulnerable Unions. And after selecting the Union, Union Parishad Chairman helped to find the most vulnerable villages to conduct the study. Thus, the study was conducted.

Scope of work

To assess the effectiveness of existing technology in the climate resilient context, the study incorporated some specific issues like resilience of the technology, gender and elderly friendliness and longevity. Also, the study considered the contextual variability issues of socioeconomic condition of the technology beneficiaries and the technological infrastructure.

5 Findings

Shyamnagar Upazilla in Satkhira District and Dacope Upazilla in Khulna District are the most climate affected areas, especially the Cyclones hit. Aila has been the most recent giant

catastrophe in those areas causing salinity intrusion both in ground water, pond water that also has mixed with soil. River bank erosion engulfs infrastructures of water and sanitation along with built-up and cultivable land of agriculture. A storm tide due to rising water commonly associated with low pressure weather system, Cyclone and Sea-level-rise, all these sea sourced disasters hit and destroy the water supply and sanitation technology. Also, salinity intrusion in surface water and ground water were caused by all these disasters as saline water from sea is brought to inland and cause water logging. Water logging is also a result of heavy rain fall which is trapped in low lands within the polders and dams for a longer time. Unlike decades ago, drought also developed that the field work revealed in the study areas. The most common source of potable water for poor people are getting dried up due to seasonal drought and life-threatening temperature rise.

The followings are the most frequent disasters at the coastal belt of Bangladesh. The box below shows if the disasters have an impact on the water and sanitation sectors.

Climate Change Disasters	Impact on Water Sector	Impact on Sanitation Sector
River Bank Erosion	Present	Present
Tidal surge	Present	Present
Cyclone	Present	Present
Sea level Rise	Present	Present
Salinity	Present	Present
Heavy and erratic rainfall	Present	Present
Drought	Present	
Water log	Present	Present

Table 5-1: Climate change impacts on water and sanitation sectors

Study reveals that almost all of the disasters are caused by climate change sternly affects, on both water supply and sanitation sectors not only drought.

Institutional support for adaptation

Institutional support from GO and NGOs end include materialistic support like different water supply and sanitation technologies and non-materialistic support like training for awareness raising and behavioral change for proper hygiene practice at community level that would help people to adapt the adverse impacts of climate change in water and sanitation sector. Moreover, a lot of private sector initiatives has been found to help people with low cost and resilient water supply and sanitation technology for the disaster affected poor people.

Sector/institutional support	Government organization	Non-government organization (INGO and NGO)	Private sector
Water supply	DPHE, UNION Parishad:	Rupantar, , Water-aid, Nobojatra, World Vision, Heed Bngladesh, Friend Ship, SDF	Ad-din, HSBC, Jam jam
	Digging pond, installing PSF, RWHS, Shallow Tube-Well, Deep Tube-well, Water Treatment Plant	RWHS, PSF, Reverse Osmosis, solar system PSF, technical support	Micro credit support, Technical support, selling drinking water
Sanitation	Ring slab, SATO plastic pan, Septic Latrine (Community and Institution)	WASH Awareness, Ring slab, Septic Latrine (Community and Institution)	Ring slab, SATO plastic pan

Table 5-1 Institutional Supports for people's adaptation to Climate change

Technology for water supply and sanitation

As an adaptation strategy to climate change induced water supply and sanitation crisis, people of those areas are dependent on some water supply technologies including Rain Water Harvesting (RWH), Pond Sand Filters (PSF), Reverse Osmosis (RO) and deep tube-wells, as well as pond water for drinking purposes. Except pond water, all the listed technologies are expensive and not affordable by the poor communities.

Technology for Water	Being used at present	Technology used 10/15 years ago
Rain water Harvesting	Present	Present
Shallow Tube well (STW)	Present	Present
Pond Sand filter (PSF) Solar and non-solar	Present	Present
Reverse osmosis	Present	
Pipeline water supply	Present	
Deep tube well	Present	Present
Managed Aquifer Recharge (MAR)	Present	
Water treatment plant	Present	

Table 5-2 Present and past of water supply technology

Rain Water Harvesting system, Pond Sand Filter and Shallow Tube well have been identified as old technologies that are still existing as water supply technology. Among these three, Rain Water Harvesting system and Pond Sand Filter are still effective and most demanded technology for potable water at household level though are considered as moderate level for resilient to climatic disasters. Shallow tube well is hardly used, just because of its less effectiveness in saline and Iron free water supply. It is also least resilient to disasters.

Technology for Sanitation:

Technology for Sanitation	Being used at present	Was used 10/15 years ago
SATO pan ring slab latrine (inset and off set)	**Present**	
Ring slab latrine (inset and off set)	**Present**	**Present**
Septic tank latrine	**Present**	**Present**
Pit latrine	**Present**	**Present**
Hanging latrine		**Present**

Table 5-3 Present and past of sanitation technology

The most recent sanitation technology is SATO Pan Latrine that is designed technologically in a way it requires less volume of water to keep the pan clean and sealed. All the others are old and still existing in the community. Most people are used to ring slab latrine as it is comparatively cheap, can be easily installed and replaced. Septic tank latrine costs a lot but sustainable and resilient to most of the disasters in the climate vulnerable areas.

Resilient and non-resilient technology

Study intended to assess the resilience of water supply and sanitation technology in the climatic context in the local community. To do so, empirical data have been analyzed in a way to show the level of resilience of the existing technology for water supply and sanitation into three main categories. Categories are as: not resilient at all, moderate and fully resilient to the prevailing climatic disasters. Red mark shows not resilient at all, yellow mark shows moderate level of resilient and green mark shows fully resilient.

Water supply technology

Technology VS Resilience	Non-Resilient	Moderately Resilient	Fully Resilient
Rain water Harvesting			
Shallow Tube well			
PSF of Solar Energy and Normal PSF (Pond sand filter)			
Reverse osmosis			
Deep tube well			
Managed Aquifer Recharge (MAR)			
Water treatment plant			

Table 5-4 Resilient and non-resilient technology for water

Level of Resilience	Color Chart
Non-Resilient	
Moderately Resilient	
Resilient	

Indicators to identify whether a technology is resilient, moderately resilient or resilient

Certain indicators were identified as parameters to verify whether the technology is resilient or not. This was done based on participant's perception. Considering the climate change induced disaster and geo-conditional coastal context of the zones, the indicators for water technology included Sustainability, functionality, water quality and quantity, user-friendliness of the technology. For the sanitation technology, the indicators included Sustainability, Functionality

and Accessibility. If the technology serves the maximum purpose in being sustainable, functional, ensures water quality and quantity and has adequate user friendliness, it will be coined as a very 'resilient' technology; one that is moderately functional in terms of these indicators, will be termed as 'moderately' resilient and the one that is least functional in terms of these indicators will be considered as not a very resilient technology.

The table shows that Reverse Osmosis, Water Treatment Plant and Manage Aquifer Recharge are fully resilient to the disasters. These water supply technologies don't get malfunctioned and the water collected through them never get contaminated. Moreover, they are highly modern technological product that they can extract water from any available source and can purify in an easy and faster process. The best example is Reverse Osmosis. Managed Aquifer Recharge (MAR) is a technique of recharging ground saline water with fresh rain water through collecting rain water and passing it into the ground. Water treatment plant is a cost worthy and vast technical collaborative technology even though it is the most effective technology in the coastal area. It's also a fully resilient technology for water supply.

All the others are either non-resilient or moderate resilient technology just because of their fragility and vulnerability to the disasters or highly dependent on some specific sources of water. If the water is not available or any disaster hit tremendously, these technologies get malfunctioned or disordered.

Reasons why technologies not fully resilient

Rain water Harvesting: This technology has been identified as a moderate level of resilience. As it is dependent on the rain water. Hence, due to less rainfall in monsoon and the extreme heat in dry season this technology is ineffective.

Pond sand filter: This technology has been identified as a moderate level of resilience for its higher susceptibility to some disaster. Flood and water logging inundate the ponds and intrude salinity to pond's water which is the main water source for this technology.. In Addition, it cannot supply purified water at all rather than the presence of visible filter filling into the water. Another disadvantage is, due to its constructing material and model, different micro-bios can easily contaminate water.

Deep tube well: Through pipe is buried deep into the ground this technology can't but deliver iron, saline free water. Moreover, it's vulnerable to flood and water logging.

Sallow tube well: Shallow tube-well not an appropriate technology for coastal people. Up-taking the saline water, probability to be inundated in flood and malfunctioning in dry season study identified it as a not resilient technology for water supply.

BRAC WASH installed nine tube wells but due to the high intensity of salinity they became non-functional except for one ‘’ said by local dealer Bidhan Biswas, water sanitation supplier in Khulna.

Sanitation Technology

Technology/Resilience	Non Resilient	Moderately Resilient	Fully Resilient
SATO pan ring slab latrine (inset and off set)			
Ring slab latrine (inset and off set)			
Septic tank latrine			
Pit latrine			
Hanging latrine			

Table 5-5 Resilient and no-resilient technology for sanitation

Level of Resilience	Color Chart
Not Resilient	
Moderate Resilient	
Resilient	

Indicators to identify the resilient technology

Considering the climate change induced disaster and geo-conditional coastal context

Sanitation Technology: Sustainability, Functionality, Accessibility

SATO pan latrine: A SATO latrine is basically a ring slab latrine that has a low water consumption sealing system. It has a vital solution for water scarcity as it reduces the water usage to keep the pan clean and seal the tank. Thus, it's use-worthy in drought prone area. In coastal area, flood, surge and water logging may damage it just like common ring slab latrines are damaged.

Ring slab latrine: Ring slab latrine is highly vulnerable to most of the climatic disasters like, flood, surge and water logging. Moreover, by getting in touch with saline water for a longer time, the ring slab starts decaying. It's inundated by flood and water logging etc.

Pit latrine: Pit latrines are the simplest form of dry latrine. None of the interviewees claimed that this type of latrine is resilient to any prevalent disasters in the coastal zone. It is easily destroyed and high-water consuming old technology for sanitation.

Potential Water Supply and Sanitation technology

To identify the most potential technology for water supply and sanitation, the study considers the sustainability, cost effectiveness, accessibility in market of the technologies. The study listed a number of potential technologies including rainwater harvesting, reverse osmosis, Managed Aquifer Recharge (MAR), water treatment plant, septic tank latrine.

The technology of rainwater harvesting is one of the most rising technologies within the village which is incredible in effectiveness. It's cost effective and can be maintained easily. The most important part of this technology is that it does not require any electricity and technical expertise for operation and that women can easily handle it. Reverse osmosis is another technology which is community based and everyone has an access to collect water from it through very minimal installation cost. It has the capacity to produce huge volume of water per hour that can meet whole community water demand within a certain period of time. Thus, women don't need to spend a lot of time standing in a long queue. It is the most scientifically advanced technology and can provide 100% purified water. Other technologies include the Managed Aquifer Recharge, water treatment plant and the septic tank latrine which are excellent technologies in place within the communities. The following table demonstrates the potential technologies with rationale for why it has huge potential to be used in a large scale.

Potential Technology	Why the technology has high potential for use?
Rain Water Harvesting	- It is a household based technology; cost effective and easily maintainable - No electricity and technical expertise required to operate - Rainfall is the water source and every tin shaded household has the opportunity to store or collect water from the rainfall - women can easily handle it 
Reverse Osmosis	- Most scientifically advanced technology and can provide 100% purified water - Community based water technology - Everybody gets an access to collect water at low or free of cost - As community people cannot afford to bear the installation cost, business sector might have an opportunity to do business - Can produce huge volume of water per hour that can meet whole community water demand within a certain period of time. Thus, women don't need to spend a lot of time standing in a long queue 

Managed Aquifer Recharge (MAR)	- The most recent and potential technology considering the natural process of water preservation and purification - Channeling rainfall into deep ground during rainy season is a tough task that women can do it easily - DPHE technician, Satkhira, said that, while storing water under the ground natural system purifies the water - Most importantly it's a potential technology for fresh water 
Water treatment plant	- Like the reverse osmosis, it's a community-based water technology from where people can get salt and contamination free water at a namely cost or free of cost - Private sectors are being interested gradually in doing business - GOs and NGOs are showing their interest in installing this technology 
Septic tank latrine	- Sustainability - Safety in water logging - Resilient to saline water - Easy accessible 

Table 5-6 Potential Technology for water and sanitation

Major Problems and Technical Issues of the Technology

There are certain problems of using rain water harvesting system within communities which includes its dependence on rainfall and has low storage capacity. There could also be a growth of parasites if the water is stored for a long time. Shallow tube wells on the other hand has a risk of getting contaminated by salinity and iron. PSF is a technology that is largely dependent on the available of pond water quality, and also requires caretaker and community awareness. Reverse osmosis is a huge implementation in the communities and requires electricity and expertise which is quite expensive. It also required highly trained technicians. Similarly, there are associated problems of using pipeline water supply, deep tube wells, managed aquifer recharge and water treatment plants too. The following table not only demonstrates the challenges of using these technologies but also offers recommendations to fix them.

Technology	Problems and Issues	Recommendation
Rain water Harvesting	- Depends on rainfall and low storage capacity - Growth of Parasites for long time water storage	- Most of the interviewees suggested to provide the Rain Water Harvesting System with a storage capacity of 3000 ltre at every household - Women of the households should be well trained up to maintain the technology
Shallow Tube well	- Saline and Iron contamination	- No further intervention with this technology by GO or NGO
Pond Sand Filter	- Dependent on availability of pond water and water quality - Cannot remove salt - Physical structure is highly contagious - Requires caretaker and community awareness	- Re-excavation of existing ponds - Digging new ponds and restore the existing ponds - Train up Management committee - Raise pond banks to keep ponds protected from saline water intrusion from shrimp field and sea water

		- Provide incentives to the owners of the ponds
Reverse Osmosis	- Huge implementation cost - Require electricity - For operation and maintenance, highly trained technicians and operators are required - People are supposed to pay for the water though at low cost -	- Should be installed at every village to reduce time and distance to collect water - Charge per liter should be lowest not free - Ensure uninterrupted electricity supply - Alternative source of electricity should be ensured in case of impacts from disasters - Machinery parts should be duty and tax free - Highly trained technician should operate the technology -
Pipeline water supply	- Leakage of pipes contaminates the water supply - Huge implementation cost - Requires a long-term plan - People have to pay for water -	- Implanters should have a long-time implementation plan and use stronger peripheral pipes under the ground so the pipes are strong enough to with-stand the ground pressure - Proper maintenance for the supply pipes are required so that water doesn't get contaminated - Subscription charge should be free
Deep tube well	- Salt and iron contamination - Higher installation cost	- Implementers should reduce their trends to install this technology as it cannot supply saline free water in most of the

		cases
Managed Aquifer Recharge (MAR)	- Bad smell due to contamination by salt and iron - Local community is not adapted in using the technology - Due to drought the recharge process become slow - No feasibility study has been performed	- A feasibility study and scientific research must be conducted before running this technology -
Water treatment plant	- High implement cost - No one wants to drink water - Hard to manage - High electric cost	- There should be a Water treatment plant installed at every village to reduce time and labor of people - Technician must be highly trained - Management committee should be well organized and monitored

Table 5-7 Problems and recommendations for the technology

5. Conclusion

Access to safe water and sanitation is a prerequisite to human health, environmental sustainability and economic prosperity of a community. The frontline sufferers of climate change impacts are poor, marginalized and less capable to adopt modern technology in term of money. Though a lot of progress has been achieved though nationally and internationally accomplished programmes and project, but Bangladesh has still a long way to go to meet the Sustainable Development Goal (SDG) of providing universal access to clean water and sustainable sanitation by 2030. To that end, most advanced technology for drinking water and sanitation is an only way. Rain water harvesting system, water treatment plant, reverse osmosis and manage aquifer recharge are the most potential and resilient technology will be the ultimate solution for potable drinking water scarcity. For the sanitation crisis, septic tank latrine at household or at community is another solution for sanitation in climate vulnerable coastal community.