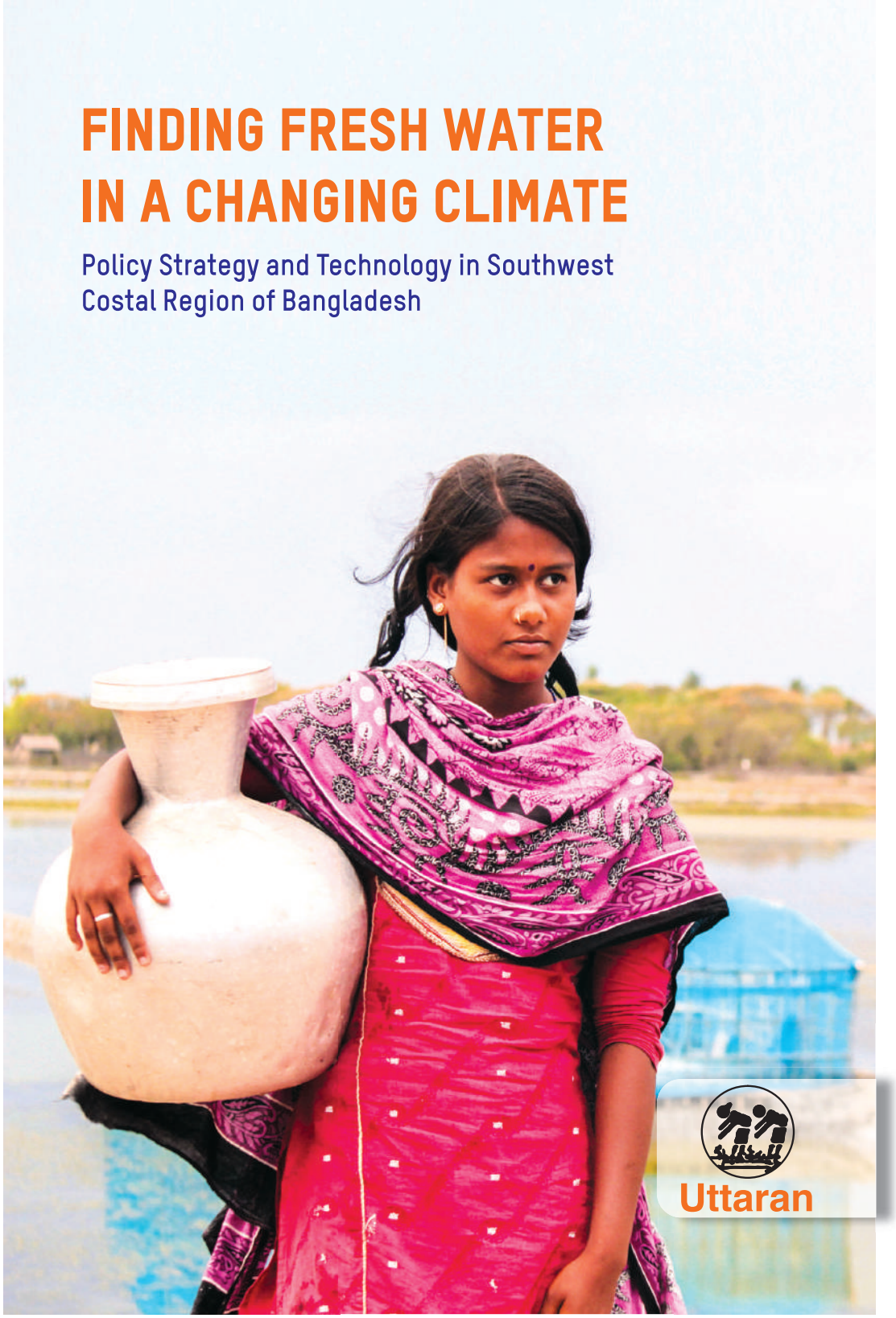
FINDING FRESH WATER IN A CHANGING CLIMATE

Policy Strategy and Technology in Southwest Costal Region of Bangladesh



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FOREWORD

Drinking water crisis for the people of southwest coastal Bangladesh is not a new phenomenon. Over the years, the people here have had to go through a lot of hardship to ensure potable water for them. Now with climate change bringing new threats in all sectors, drinking water scarcity will reach to its peak due to salinity intrusion and sea level rise. For the last 34 years, Uttaran has been working in the southwest coastal region and has given particular focus to ensure safe drinking water for the locals. Our close understanding about the local ecosystem has enabled us to understand the environmental and social challenges faced by the people to ensure drinking water.

Fifteen years ago, Uttaran published a book titled "Supeyo Panir Shondhane" in which we discussed available fresh water options in the southwest coastal zone and the gaps in government policy to address this problem. But since then a lot has changed. Government had significant achievement in ensuring fresh water for around 97% of the people (without including arsenic) of the country and almost fulfilling the MDG water goals. But it is very sad to say that this number does not include those poor people who regularly are running around miles after miles just to get a cup of fresh drinking water. So after 15 years, Uttaran has again wanted to review what changes had happened in the life of the coastal people in terms of collecting and accessing potable water.

One of the major changes that have occurred since 2004 is that the government of Bangladesh has taken a new strategy to ensure safe water for the coastal zone through the "National Strategy for Water and Sanitation Hard to Reach Areas of Bangladesh." Due credit should be given to the government for that. But still some gaps regarding water options remain which is discussed through this book. Uttaran has identified 13 different water options that are available in the coastal zone and discussed their potentialities and limitations. These water options will become very important for the area if Bangladesh are to achieve the

SDG targets which commit to leave no one behind. We have tried to recommend about the best water options for the coastal zone, steps that can be taken to ensure fresh water supply here and have also managed to bring forward the demand of the local people for ensuring free potable water.

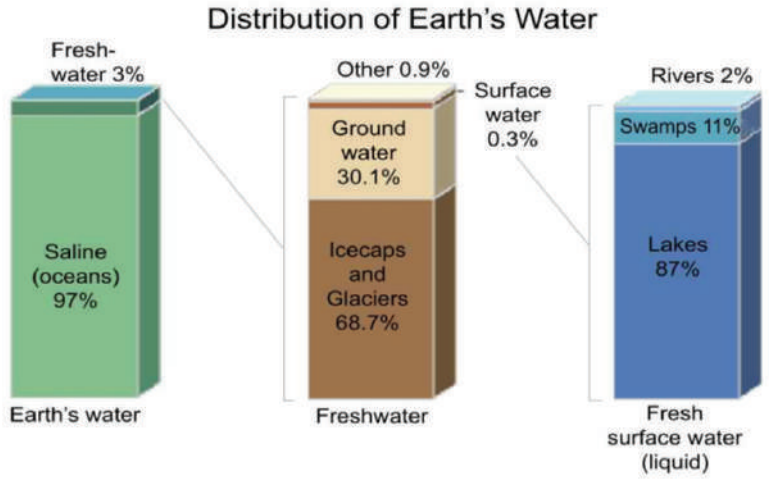
My special thanks go to all the members who contributed to bringing about this policy analysis. I express my hearty gratitude to grass root staffs of Uttaran and members of Paani Committee without whom gathering the required information would have been impossible. I am grateful to Department of Public Health, Khulna, NGO Forum For Public Health, and every other stakeholder who shared their valuable information with us. Special thanks should be given to Government of Bangladesh, UNDP Bangladesh, SIMAVI, Care Bangladesh, BSRM for their generous support to Uttaran in WASH sector over the years.

Shahidul Islam
Director, Uttaran

SETTING THE CONTEXT

"Intense scarcity of fresh water supply is forcing people from southwest coastal region of Bangladesh to migrate away from their homelands"

Water is the foundation of life. Water scarcity is a theoretical concept to many and a harsh truth for others. While the amount of freshwater on the planet has remained fairly constant over time—as it is being repetitively recycled within the atmosphere back into our cups—the population has exploded. Thus every year competition for a clean, pure supply of water for drinking, cooking, bathing, and sustaining life increases. Today, nearly 1 billion people in the developing world do not have access to it. Yet, we take it for granted, we waste it, and we even pay too much to drink it from little plastic bottles. And still today, all around the world, far too many people spend their entire day searching for it and walk miles and miles to fetch it. Improvement of life due to the development of science, the per capita use of water has increased, however, safe drinking water in the world is limited and its sources are not equally distributed all over the world. Further, human interventionsare intensifying this crisis, making water sources of the world polluted and unusable. Therefore, presently, experts of the world are taking into consideration this matter with great care.



Global Water Distribution

Intense scarcity of fresh water supply is forcing people to migrate away from their homelands in search of fresh drinking water sources. Globally around 2 billion aredrinking water from contaminated sources which results in the death of around 502,000 people (WHO, 2018). On top of that, economic and agricultural development is also impeded and environment and eco system are effected as to fresh water scarcity.

While nearly 70% of the world is covered by water, only 2.5 % of it is fresh. The rest is saline and ocean-based. Out of the total fresh water available, 68.7% is stored in glaciers and ice caps around the world which makes it inaccessible. 30.1% of the fresh water is found in underground aquifers and 0.3% in lakes, ponds and rivers. Around 0.9% of the world fresh water is found in other sources like atmosphere and soil (USGS, 2016). Figure above shows the distribution of Earth's Water. Out of the available global fresh water, 70% is being used for irrigating agricultural fields, 22% is being used in industry and 8% for domestic purpose which includes 0.025% for drinking purpose (Khokhar, 2017). This inadequate volume of safe drinking water is getting polluted as to human activities and natural processes. It is getting polluted in different regions as to different reasons, such as, the presence of arsenic, nitrate, fluoride in the water, salinity, disposal of industrial and other waste in the water bodies, and use of fertilizer and pesticide.

SAFE DRINKING WATER IN BANGLADESH

"Bangladesh generally encounters water related problems in two seasons, in the monsoon and in the dry seasons"

Bangladesh is situated in the lower part of the Ganges, Brahmaputra and Meghna (GBM) river basin and these three rivers are the main source of water in Bangladesh. Around 92% of the water that flowsover Bangladesh is sourced outside of its boundaries (Chan, Roy, & Chaffin, 2016). Fifty-seven rivers flowing over Bangladesh share borders with India, Myanmar, China, Bhutan and Nepal. As a result, the fresh water flow in Bangladesh is in general abundant, particularly during monsoon when around 8% of the global flowing water flows through these rivers into the Bay of Bengal (Jakaria, 2011). But still Bangladesh is considered as a country where people have lack of access to safe drinking water.

Bangladesh generally encounters water related problems in two seasons, in the monsoon and in the dry seasons. During the monsoon heavy rainfall causes flooding which results in massive destruction of human habitat and agricultural productions. Being a delta, flooding is a common phenomenon in Bangladesh. If heavy rainfall in the upstream combines with high tidal actions during full moon or moonless night, then severe flooding like that of 1998 or 2000 can occur. During this period of the year, there is extreme scarcity of potable water due to flooding and contamination which leads to outbreak of water borne diseases like diarrhea causing deaths (Uttaran, 2006).

During the dry season (December –May) the rainfall of Bangladesh significantly reduces to a mere 22% of the annual rainfall (Climate of the World, Bangladesh, 2019). Moreover, during this time the fresh water ponds and lakes which become full during the monsoon starts to evaporate and become completely dried out by March or April. This increases the concentration of salt in water in the coastal areas, thus turning the brackish water into saline water. During this time the people of rural coastal Bangladesh becomes completely dependent on ground water for their daily life.

During the sixties the former government of East Pakistan (Bangladesh) decided to implement Coastal Embankment Project (CEP) to control flooding and stop saline water entering the flood plain and increase agricultural products.A total of 139 polders were constructed along the coastal belt and more than 7500 km of

coastal embankment were constructed, among which 39 polders, 282 sluice gates and 1500 KM of coastal embankments were constructed in the southwest coastal zone (Kibria, 2011). The immediate result of this project was brilliant as the agricultural production increased by almost three times but after 15 years or so, the southwest coastal region of Bangladesh started to experience a different problem. Siltation of the coastal rivers due to construction of polders started causing water logging in this region which again had an adverse impact on life and livelihood of the people living here (Kibria, 2011). Moreover, the project has also put the fragile and unique coastal ecosystem under threat making it vulnerable to salinity intrusion and other disasters (Islam & Kibria, 2006).

The co-riparian rivers that flow through Bangladesh are a major source of water in the country. But in recent years several development initiatives like the construction of barrage in the upstream of Ganges, Brahmaputra, Mahananda, Tista and several other rivers have reduced the water flow. Particularly during the dry season the water flow of Bangladesh gets reduced by 30%. The Indian government is also planning to construct new embankments and has started the river linking project on Brahmaputra Meghna and other rivers which would further aggravate the problem by reducing 70% of the water flow (Rashid, 2012).

MDG, SDG and drinking water

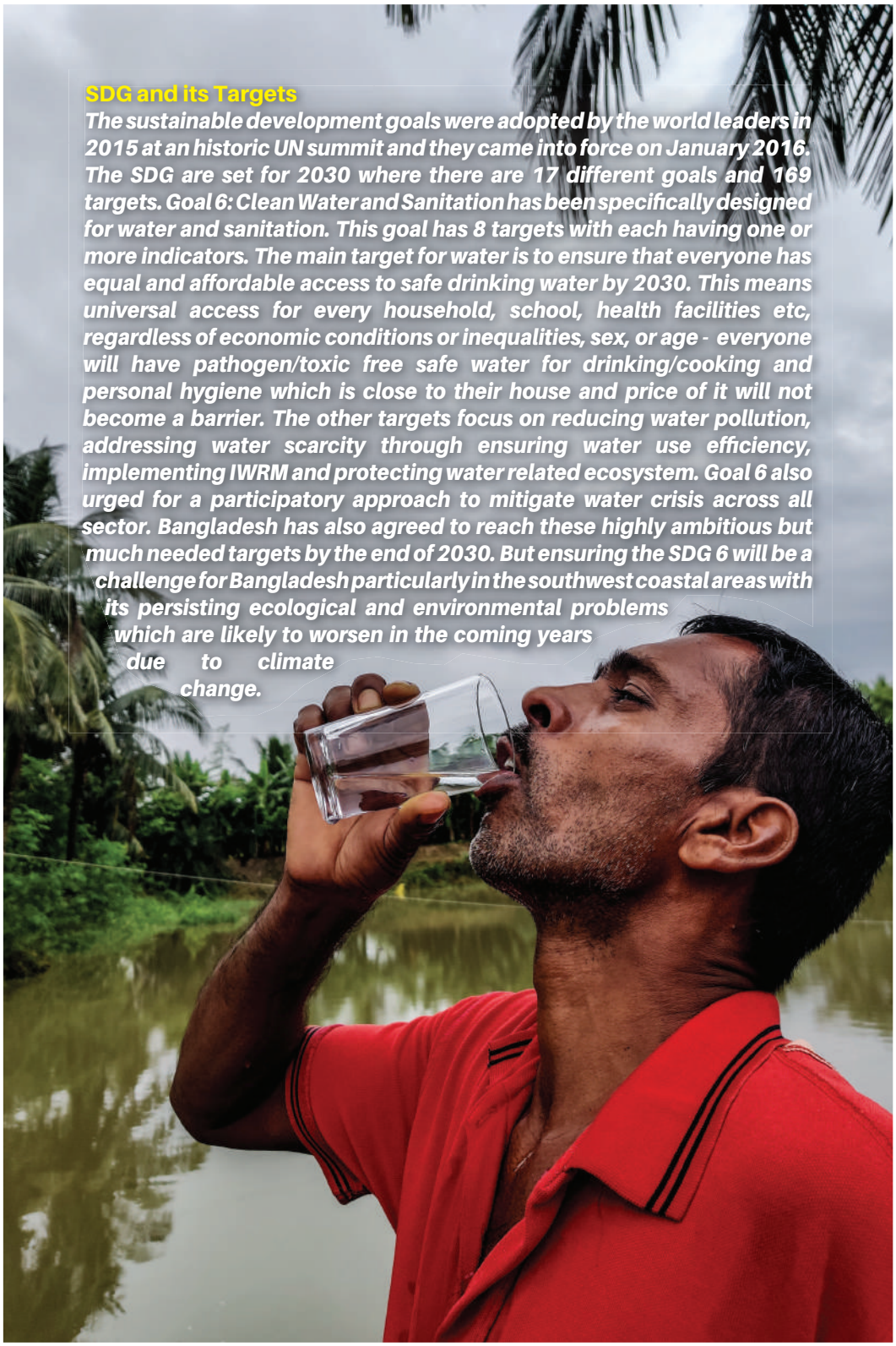
Millennium Development Goals

MDGs focused on quantity of coverage where as SDG puts more emphasis on quality and quantity of coverage

Sustainable Development Goals

MDG BEYOND NUMBERS

In 2000, around 68% people in Bangladesh had access to safe improved safe drinking water. During the same year Bangladesh signed and started to implement Millennium Development Goals or MDG. MDG targeted that 100% people in Bangladesh will have access to safe drinking water. Bangladesh has achieved this goal as around 98.5% people in the country now have access to improved safe drinking water source (Bangladesh bureau of statistics, 2017). However, around 22% of the tube wells in the country are arsenic contaminated (Sara, Richard, & Zheng., 2012) and if these are taken into account then only 84% of people in the country have access to improved safe drinking water. Moreover, the salinity issues were not taken into consideration which would have further decreased the percentage.



SDG and its Targets

The sustainable development goals were adopted by the world leaders in 2015 at an historic UN summit and they came into force on January 2016. The SDG are set for 2030 where there are 17 different goals and 169 targets. Goal 6: Clean Water and Sanitation has been specifically designed for water and sanitation. This goal has 8 targets with each having one or more indicators. The main target for water is to ensure that everyone has equal and affordable access to safe drinking water by 2030. This means universal access for every household, school, health facilities etc, regardless of economic conditions or inequalities, sex, or age - everyone will have pathogen/toxic free safe water for drinking/cooking and personal hygiene which is close to their house and price of it will not become a barrier. The other targets focus on reducing water pollution, addressing water scarcity through ensuring water use efficiency, implementing IWRM and protecting water related ecosystem. Goal 6 also urged for a participatory approach to mitigate water crisis across all sector. Bangladesh has also agreed to reach these highly ambitious but much needed targets by the end of 2030. But ensuring the SDG 6 will be a challenge for Bangladesh particularly in the southwest coastal areas with its persisting ecological and environmental problems which are likely to worsen in the coming years due to climate change.

SCARCITY OF SAFE DRINKING WATER IN SOUTH WEST COASTAL REGION OF BANGLADESH

"Climate change induced sea level rise, salinity intrusion, severe humanitarian crisis and potable water scarcity can be predicted easily."

Bangladesh has a total of 13 coastal districts and almost all of them face potable water scarcity due to salinity. The southwest coastal region comprising of Khulna, Jashore, Satkhira and Bagherhat district is the most vulnerable among these coastal districts. The lower part of Jashore, Khulna, Bagerhat and all of Satkhira has severe fresh water crisis. This is mainly due to high salinity in ground and surface water. A large percentage of people living in this region are forced to travel a long distance every day in search of safe drinking water. In some places this distance can be up to 10 KMs (Uttaran, 2006). Salinity in ground and surface water, arsenic contamination of shallow aquifer, lack of aquifer, difficulties in extracting saline free water from deep aquifer as to the presence of hard rock and stone layers are responsible for it (Uttaran, 2006). Moreover, the situation is worsened by recurrent disasters in this region and constant water logging. Additionally, salinity intrusion due to intensive shrimp farming and tidal surges brought in by cyclones like AILA is further aggravating potable water scarcity in the region. With climate change induced sea level rise and salinity intrusion, a severe humanitarian crisis and potable water scarcity can be predicted easily.

The government of Bangladesh or any research organization is yet to do any hydrological study in the southwest coastal Bangladesh. The underground aquifers are very hard to find in this region and often DPHE or others who install water options have to rely on local or past information for installing deep or shallow tube wells. Thus fresh water sources or pockets in many hard to reach areas are still to be located or used.

THE CAUSES OF FRESH WATER SCARCITY IN THE SOUTHWEST COASTAL REGION OF BANGLADESH

Known Causes of Fresh Water Scarcities

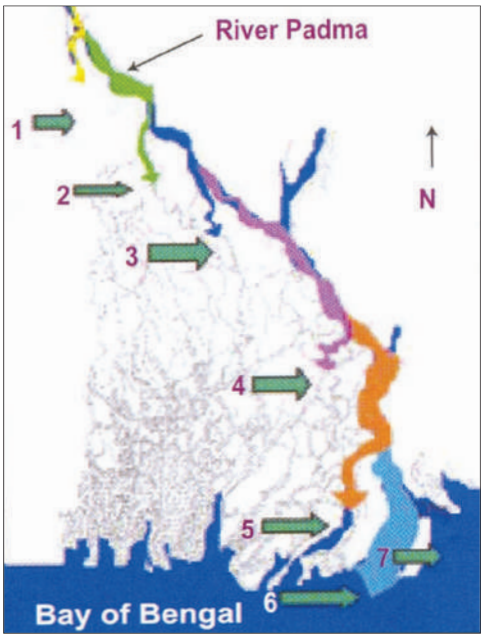
- Lack of fresh water flow from upstream due to the change of the course of Ganges river and closing of the face of the origin of Matha Vanga river
- Coastal embankment project and the Impact of water logging.
- Reduction of the flow of ganges in dry season due to upstream withdrawal
- Tiger shrimp farming
- Arsenic contamination
- Lack of aquifer
- Land subsidence
- Excessive use of ground water

A. Lack of Upland Flow

In the past, the south-west coastal region was rich in fresh water, as Ganges had been flowing through it. The agricultural land was fertile. However, the scenario changed as two disastrous events occurred in this region. Firstly, the change of the course of the river Ganges, and secondly, closing of the face of the origin of MathaVanga river.

The Change of the Course of River Ganges;

The Ganges River had been flowing over Khulna and ChabbishPorgona district up to 15th or 16th century.Since then, due to different natural causes, the river Ganges gradually changed its course towards the south-east (Uttaran, 2006). This resulted in the reduction of availability of fresh water in the region. Thus the agricultural system that dependent on fresh water and potable water sources has encountered serious consequences.

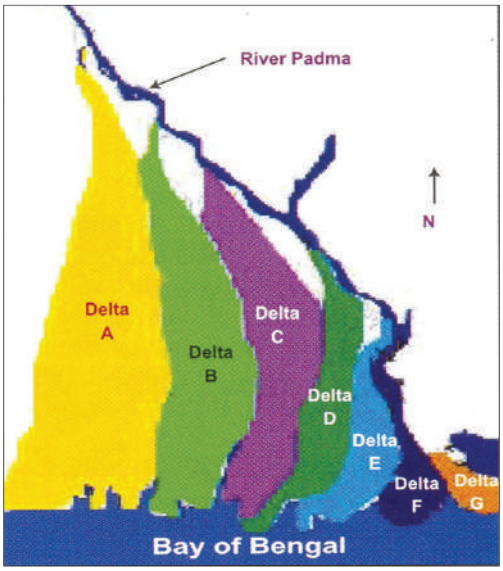


1,2,3,4,5,6 and 7 are the direction of the changes of course of the river Padma

Closing of the Face of the Origin of MathaVanga River

The region encountered further fatality with regards to fresh water flow in 19th century when the face of origin of MathaVanga River, a distributary of Ganges, was closed. British colonizers used MathaVanga River as a means of transportation from Kolkata to North Bengal. The strong current of the MathaVanga caused naval accidents, which led to the death of many people. In order to reduce the severity of MathaVanga's current, they sank large boats full of soil on the place of origin of the river. As a result, temporarily, the current of the

river reduced. Later, the mouth of the river was closed permanently due to sedimentation, which has separated the river MathaVanga from Ganges and the place has turned to only a drainage channel for rain water (Uttaran; Committee, Paani; CEGIS; IWM, 2013). British colonial government had adopted different strategies to revive the channel. However, none of their efforts were proven to be effective. In 1919, world renowned water scientist Sir William Cox presented a plan for making a barrage, on the river Ganges at the lower part of the MathaVanga to raise the water level by 7 feet at the upstream of barrage (Uttaran, 2006). He emphasized that the execution of his plan would certainly revive the river MathaVanga. But his plan was not implemented by the colonial power.



A, B, C, D, E, F and G are the delta created by river Padma in succession

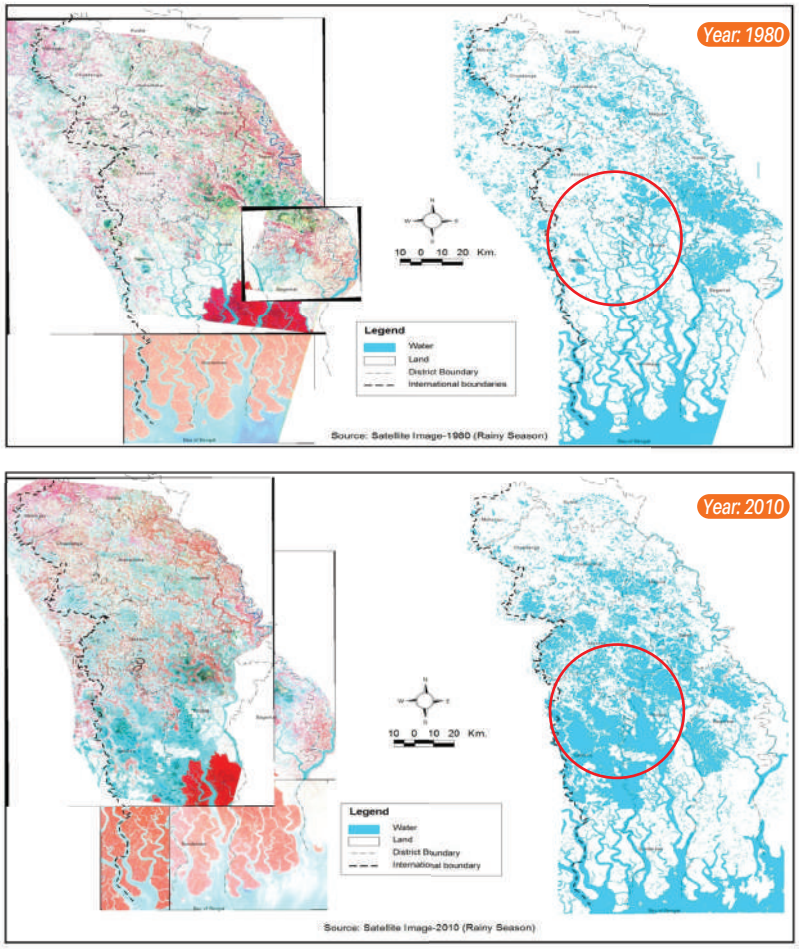
The death of the river MathaVanga in 19th century caused disaster for the people of Jessore and Kustia region. Cholera and malaria spread in epidemic form due to a lack of fresh water and thousands of people died (Uttaran, 2006). In a similar manner, it had an adverse impact on the agriculture and on Sundarban. For example, the Satkhira range of Sundarban which is depended on the river Kabodakh and Bethna, distributaries of MathaVanga, experienced major change. The salinity of the area increased due to lack of fresh water flows and the brackish water vegetation got replaced with saline water vegetation. The reduction of fresh water flow in the basin of MathaVanga and its distributaries caused severe drinking water scarcity in the southwest region which persists till date.

B. Coastal Embankment Project and the Impact of Water Logging

Sediments brought in by rivers and tidal waters have formed the land mass of the coastal region. This process of land formation was hampered by the implementation of coastal embankment project in 1960s. Under this project, 139 polders were constructed, among which 39 were in southwestern Region (Kibria, 2011). The polders were constructed to restrict the movement of saline waters in tidal flood plains during tidal actions, so that the agricultural production can be intensified. This intervention d-linked the river from the flood plains and stopped the sedimentation process completely. Sediments which are carried by high tide started to drop inside the river bed rather than on the flood plains. This resulted in the reduction of navigability of the coastal rivers and thus drainage shortage causing severe water logging during the monsoon (Kibria, 2011). The water logging problem becomes more acute when saline water from the rivers enter into the flood plains during high tide.

Water logging has severely affected the life and livelihood of around 5 million people living in the southwest coastal regions. Every year around 1-1.5 million people of the area are affected by water logging. Water logging can last up to a

whole year in some places but normally goes on for around four to eight months (Islam & Kibria, 2006). During this time, people's houses, agricultural lands, aquaculture ponds, roads, community places get inundated. Water scarcity during this time becomes very severe, as most of the water is either contaminated or saline. Fresh water options, like tube wells, fresh water ponds etc. gets submerged under water and becomes unusable causing extreme potable water crisis. In 2015 more than 30% people of Khulna Jessore and Satkhira district experienced water logging and during this time the people suffered severe potable water crisis (Uttaran, 2015). Hundreds and thousands of children and women were affected by water borne diseases like diarrhea.



Map Showing water logged Areas in Rainy Season of 1980 and 2010

C. Reduction of the Flow of Ganges in Dry Season Due to Upstream Withdrawal

Ganges or Padma is the largest river that flow over Bangladesh. In the past, roughly 170,000 cusec water used to flow through this river during the dry season. Even in 1930s and 1940s this flow had been about 135,000 cusec (Uttaran, 2006). But due to the construction of Farakka barrage for the agricultural and domestic use in Bihar, Uttara Pradesh, Hariyana, the flow of Ganges has severely reduced below Farakka point down to 67 or 69,000 cusec (Begum, 1987). The Ganges Water Treaty of 1996 clearly states that through the Farakka Barrage 40,000 cusec of water will be diverted and in the dry season when the availability of water goes below 70,000 cusec then both countries will get 35,000 cusec in each year (Ganges Water Treaty , 1996). But unfortunately that has not been the case for Bangladesh as we have seen that volume of water in the Ganges sometimes drop way below 25,000 cusec in between the months of March to May. India diverts water through a feeder canal from Farakka barrage to river Hugli to ensure proper navigation at Kolkata port. The economic loss of Bangladesh from 1976-1993 due to the construction of Farakka Barrage is over $3 billion with the agriculture, fisheries, forestry, industry, public health and navigation sectors being the most severely impacted. (Swain, 1996)

The above discussion states that India is withdrawing water flow of the Ganges for two purposes:

- Withdrawal of water for agricultural and domestic purpose in Bihar, Uttara Pradesh, Hariyana and other nearby areas
- To ensure the navigability of Calcutta Port, withdrawal of 40,000 cusec of water during dry season from Vagirothi river

This has resulted in some severe consequences in Bangladesh, particularly in south and southwest coastal region:

- Increase in salinity in the rivers of Khulna and Barisal Division ((Mirza, 1998)
- River Bank Erosion in Barisal and Khulna Division (Kawser & Samad, 2016)
- Hampering the agricultural production and damaging the ecosystem (Uttaran, 2006)

- High salinity causing various diseases of trees in Sundarban (Rahman & Rahaman, 2017)
- Increased and intensified fresh water scarcity (Kawser & Samad, 2016)
- Reducing the longevity of industrial machineries in southwest region.
- Increase in production cost of electricity due to unavailability of water in dry season. (Uttaran, 2006)

D. Tiger Shrimp Farming

Currently in the southwest coastal region, tiger shrimp farming is going on in large scale. Tiger shrimp needs saline water to survive. So for their cultivation, farmers bring in saline water from the nearby rivers inside the polders into their

land (Ahmed & Diana, 2015). Ponds adjacent to these farms which once were a fresh water source have now become saline due to seepage. Additionally, as the farm lands remain inundated under saline water for a long time so shallow aquifers which once supplied fresh water has also became saline. (Uttaran, 2000). Thus the areas nearby shrimp farms faces severe potable water crisis,

resulting in people collecting water from far away sources. Moreover, when shrimp farming was booming in the region, the government started to lease out the state-owned reserve ponds for shrimp cultivation which further intensified the production of shrimp and thus leading to declination of fresh water availability.

E. Arsenic Contamination

Ground water of this region contains excessive arsenic. A study carried out by Uttaran, indicated that 79% of the tested tube wells of the area contain arsenic beyond the acceptable limit (Uttaran, 1997). Existence of arsenic in the underground has further aggravated the crisis of drinking water in the region. Moreover, over extraction of a very few limited source of fresh ground water is leading to arsenic contamination of those sources.

F. Lack of Aquifer

Ground water occurs in permeable geological formations known as aquifers, which is a formation, having structures that permit appreciable water to move through under ordinary field conditions. For extraction of groundwater, medium clean sand is suitable. This sand has considerable porosity and permeability and can store huge amount of water. Fine sand also can store considerable amount of water. However as the position of the area is in the lower part of Ganges delta, the sediments of the region are mainly clay, silty clay, peat, peaty clay (Uttaran, 2006). These sediments have very low permeability and are not able to hold water. As a result, the region lacks aquifer from where fresh groundwater can be extracted. In some places aquifer is present in such a depth from which fresh water extraction is very difficult and expensive. For instance if the ground water table is below 1200 feet then it becomes very expensive and difficult for extraction (Uttaran, 2000). This situation can be observed in Koyra, Paikgacha, Asasuni, Shyamnagar, Kaligonj,Tala,Debhata, Dakop, Mongla and Sharonkholaupazilas of Khulna, Satkhira and Bagerhat district (Uttaran, 2000). Inhabitants of these areas cross 2 kilometers on average and in extreme cases 7-8 kilometers to collect fresh drinking water. Additionally,since cyclone AILA, ground water accessibility has become even harder. AILA brought huge tidal

surges with it and a huge portion of agricultural and homestead land of the mentioned upazilas remained inundated under saline water for two to three years after the cyclone. Thus due to accumulation of saline water on the surface, the shallow fresh water aquifers became saline as well making it difficult for the people to access fresh water aquifers.

G. Land Subsidence

The wetland in the lower part of the Ganges delta has an annual subsidence of around 1-2 CM each year (Hoque & Alam, 1997). During the pre-polder system, this was not a problem because sedimentation on the tidal wetland was occurring but now as the rivers are blocked using polders that sedimentation is not happening which is increasing the rate of the land subsidence and thus contributing towards waterlogging and water scarcity (Kibria, 2011).In last 3-4 decades,due to continuous subsidence of land within the WAPDA embankment, land is gradually going down and the expansion of saline water is tangible.

H. Excessive use of Ground Water

Since 1980s, vast land of the south-western region, except the slight saline wetland, has been brought under irrigation for cultivation of Boro rice through extraction of underground water in the dry season. Excessive use of ground water for irrigation has increased the harvest but created severe problems for underground water table (Uttaran, 2000). The shallow water table is declining fast because the rate of withdrawal of water is much higher than the rate of natural recharge of water table. This unplanned massive withdrawal for irrigation has created problems for both fresh and safe water which will have long-term implications.

FUTURE CONCERNS

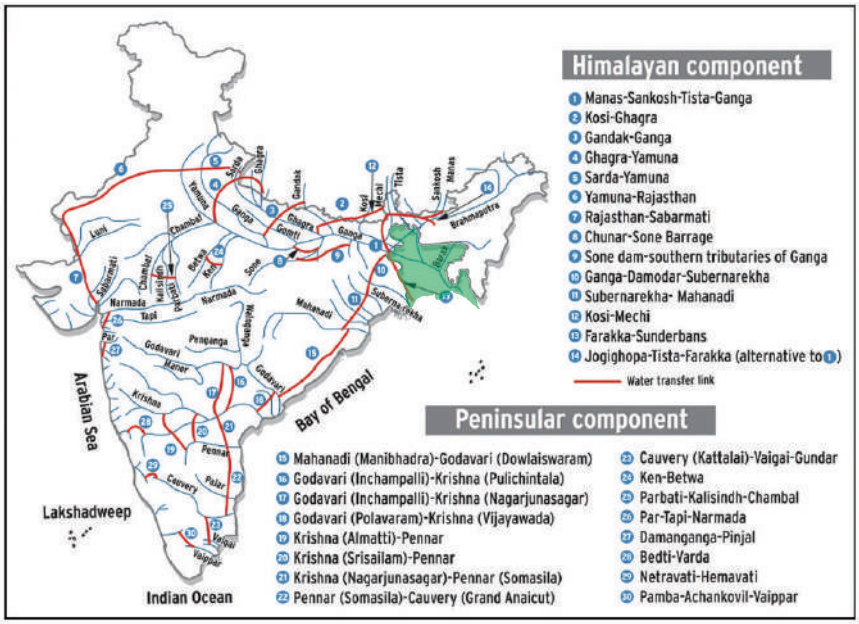
"14.5 million people in the coastal areas of Bangladesh are affected by storm surges, and the number will increase to 18.50 million by 2050 (World Bank, 2012). Impact of predicted climate change and India's Inter-linking of River Project on its 37 rivers will be disastrous."

Climate Change and Potable Water

The scientists of the world clearly came to an agreement that climate change is real and there is no hiding from it. While in some countries climate change might bring some positive changes, Bangladesh will be severely impacted in a negative way. Bangladesh is the sixth most vulnerable place on Earth to be affected by the adverse impact of climate change and the southwest coastal region of the country will be one of the worst victims of it (Eckstein, Künzel , & Schäfer, 2016). As a result of climate change, people leaving in the low-lying coastal areas of the country will suffer death, ill health, or disrupted livelihood due to storm surges, coastal flooding, and sea level rise (Medium Confidence) (IPCC, 2014). Climate change will also have direct impact on people who are socially, culturally, intuitionally, and politically marginalized (IPCC, 2014)Fourteen and a half million people in the coastal areas of Bangladesh are affected by storm surges, and the number will increase to 18.50 million by 2050 (World Bank, 2012). 5690 km2 of the coastal areas of Bangladesh are directly affected by coastal flooding caused by drainage shortage, high discharge rate, and backwater effect during storm surges (Ahmed & Diana, 2015). The coastal zone has witnessed 43 major tropical cyclones over the last 150 years with one major cyclone hitting the coastal area every three years (Dasgupta, et al., 2011). There is low confidence that climate change will increase the frequency of cyclones (IPCC, 2014).

In the last ten years, the country has witnessed some sever cyclones like SIDR in 2007, AILA in 2009, Mohasen in 2013, Komen in 2015, Roanu in 2016 which shows that the frequency of more intense cyclones in the Bay of Bengal is on the rise. The biggest threat of climate change comes from sea level rise. Models suggest that the sea level rise in South Asia will be around 25-98 cm based on different scenarios (IPCC, 2014). The Bay of Bengal and the coastal areas of Bangladesh are already witnessing an annual sea level rise of 15.8 to 17.2 mm which will inundate large part of the southwest coastal region including the Sundarbans mangrove forest. (Schiermeier, 2014) The National Adaptation Program of Action (NAPA) for Bangladesh stated that sea level rise of 14.32 and 88 cm will be observed by the country in the year of 2030, 2050 and 2100 (MoEF, 2005) Salinity in the coastal areas has also increased in the recent past mainly due to tidal surges, shrimp cultivation, and upstream withdrawal of water.

By 2050 around 2 million hectares of land will become saline in the coastal areas due to the impact of climate change and sea level rise (Ahmed & Diana, 2015). All these above mentioned problems will further increase the scarcity of water in the southwest coastal region.



Inter basin water transfer links

Inter River Linking Project in India

The river linking project undertaken by the government of India will be the largest infrastructure work ever undertaken in the world. The idea is to connect 37 Himalayan and peninsular rivers. So, water-surplus Rivers will be dammed, and the flow will be diverted to rivers that could do with more water. In all, some 30 canals and 3,000 small and large reservoirs will be constructed with potential to generate 34 Giga watt of hydroelectric power (Bansal, 2014). The canals, planned between 50 and 100 meters in width, will stretch some 15,000 kilometers. It will cost a staggering $168 billion and handle 178 sq cubic kms of inter-basin water transfer per year. Eighty-seven million acres of land will be added to the total irrigated area. It will also generate a substantial volume of navigation and fishery benefits (Bansal, 2014).

The project has raised concern in Bangladesh as diversion of water from common rivers through construction of barrage, particularly on the tributary and distributaries of river Brahmaputra, will have severe implication on the availability of fresh water. Experts estimate that diverting just 10 to 20 percent of water of the Brahmaputra River in India could cause 100 rivers in Bangladesh to dry. If the proposed activities under the project are implemented then the Brahmaputra River will lose around 30-40% of its water. This will hamper the life and livelihood of 100 million people on Bangladesh and will cause severe humanitarian crisis (Doshi, 2016). This will further result in losing the necessary depth of the rivers, intrusion of saline water from the sea into the inlands which will increase salinity and scarcity of fresh water. The waterways of Bangladesh will be dried up. Agricultural systems and river based economies will be under disastrous condition and fresh water will become further scarce.

The completion of this project would mean that water flow and velocity at the mouth of Meghna River would be significantly reduced. Saline water from the sea then would be able to force its way upwards along the Meghna River during high tide. Thus new areas will become saline. Moreover, the flow of Garai and Madhumati River will also significantly reduce which will result in increase in salinity in Boleshwar and Pashur river channel in Barisal and Khulna division (Daily Star, 2015). Thus drinking water crisis in not only the southwest coastal Bangladesh but also along the lower half of the country will increase and rich biodiversity of the area will be threatened.

One scheme of the project has already been completed. In Hariyana the Indian government excavated a canal to connect the Godavari and Krishna River. The Ken-Betwa river scheme is also under way which is expected to be completed by December. The Indian Government is yet to show any concern over the water problems that its neighboring countries Bangladesh and Nepal will encounter.

VULNERABILITY OF LIFE DUE TO SCARCITY OF SAFE DRINKING WATER

"In Southwest, people responsible for maintaining the household activities spend nearly 20-30% of their life span in searching and collecting fresh drinking water."

There is an acute shortage of safe drinking water in the villages of Shyamnagar, Assasuni, Kaliganj, Tala, Debhata, Koyra, Paikgachha, Dacope, Batiaghata, Dumuria, Mongla, Rampal, Chitalmari, Morelganj, Bagerhat and Sharankhola upazilas of districts of Satkhira, Khulna and Bagerhat. More than 5 million people of the region have been suffering from a crisis caused by a lack of safe drinking water. People from these regions, particularly women and children, have to wander from one village to another just in search of a jar of potable water. Not every village in these regions has a fresh water source. The reality is so harsh that sometimes only one fresh water option/pond is available for the villagers of three to four villages. In this part of Bangladesh, life is an extreme hurdle for the people particularly women and girl child who are responsible to maintain the household activities as they spend nearly 20-30% of their life span in searching and collecting fresh drinking water. The vulnerability is not a simple concept; rather it is a multi-dimensional issue which majorly includes social, ecological and health issues.

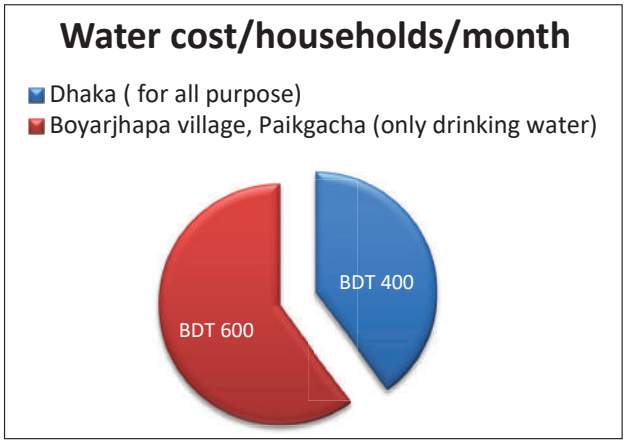
Social Vulnerability

As mentioned above, people who are responsible for maintaining the household activities spend nearly 20-30% of their life span in searching and collecting fresh drinking water. This statement is enough to portray the struggle of the local people for ensuring safe drinking water for their survival. Particularly women and children are burdened with the responsibility of managing potable water for their family. Every day people from this region have to travel an average of 2-3 KMs in search of safe drinking water and in some extreme, hard to reach areas, this distance increases to a staggering 7-8 KMs. This is a very hard labor. Often in the coastal areas female children or young adolescents are forced to quit their education just because they are burdened with the responsibility of collecting fresh water for their family. Additionally, if they are not collecting water then they must stay within the household to look after their younger brothers and sisters while mother goes to fetch water.

The problem sometimes can be so immense, that parents become reluctant to marry their young daughters. Families which live in those extreme areas where potable water is so hard to find, young women are responsible for collecting water. If they are married off then the family loses the person who is responsible

for collecting water. Besides, young unmarried women also have to go through a lot of teasing and harassment from local goons and eve teasers while they are collecting water.

The pie chart illustrates a case of Boyarjhapa village of Sholadhana Union of Paikgacha Upazila, where people pay BDT 20 for 1 case of water containing 20L of water from local van pullers. The van pullers collect this water from Paikgacha Sadar which is around 15 Km away from the village. On average these families are paying BDT 600 per month to meet their



Comparison of water cost (Source: Field study)

water needs. The figure compares this with the citizens of Dhaka city where a family has to pay only BDT 400 to the Dhaka WASA to ensure 24 hours water service for all domestic purpose. Out of this only around BDT 15-20 (0.025%) is spent on drinking water. This figure is enough to point out the inequality and discrimination faced by a lot people from villages like Boyarjhapa along the southwest coastal Bangladesh. (WASA, 2018)

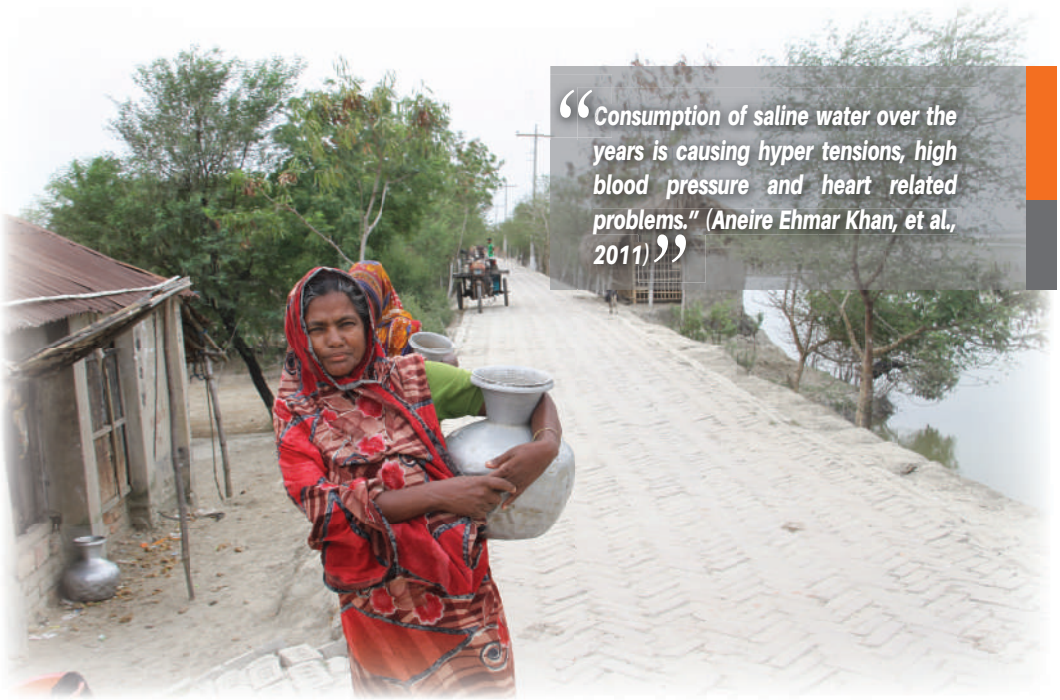
Health Vulnerability

Lack of fresh water can lead to a lot of health related issues. The most common one is diarrhea. Every year, particularly during the time of monsoon and water logging, thousands of children fall sick to diarrhea. During the time of water logging all the fresh water sources become contaminated with stagnant water mixed with human feces from those washed away rural sanitary toilets. 61% people in the coastal area suffer from skin diseases, diarrhea and dysentery and alarmingly 76% of the children were affected (Islam R. , 2015)

With not enough water, women and young girls are amongst the worst sufferers. And given the taboo related to menstruation in deeply conservative rural Bangladesh, they are silent too. Women have to deal with severe itching, soreness, and infections because of the unhygienic conditions brought on by the lack of clean water (Aneire Ehmar Khan, et al., 2011). Additionally, people from this region sometimes drink arsenic affected water as they do not want to take the burden of walking a few miles to collect water. Moreover, some water options are expensive and requires high maintenance or collection cost, so poor people cannot afford it. They are fully aware of arsenicosis, which is slow setting disease with minimum immediate impact. But since they are tired of their struggle against water and their financial position forces them not to think about the future.

Consumption of brackish water for a long time leads the users into permanent kidney and liver damage. A lot of the fresh water options available among people in the coastal zones are slightly saline and exposure to that much of salinity is causing kidney and liver related health issues. Additionally, the water coastal people use for cooking is more saline than their potable water but since their options are insufficient in number, they have no other alternatives for accessing safe water. During a survey, Rita Roy (29) from a very water scarce

village of Asasuni Upazila said, that "we do not need to drink oral saline when we have diarrhea, we can simply drink the water as it saline as well." While Md. Afsar Sheikh (43) a day laborer added that "even our cows do not want drink the water that we use for cooking". Moreover, consumption of saline water over the years is causing hyper tensions, high blood pressure and heart related problems." (Aneire Ehmar Khan, et al., 2011).



Ecological vulnerability

"Only sixteen years ago, I had fresh water ponds in my back yard from where my family and also other people from my community used to drink water. But those days are long gone, salinity is everywhere, in soil, in water and even in the air." Md. Abul Bashar said while helplessly looking at the vast shrimp farm land in Paikgacha upazila. Shrimp farming and salinity intrusion over the years have destroyed countless fresh water ponds, underground aquifers, and other fresh water options. Thus people living near the river embankments and surrounded by the shrimp farming became ecologically very vulnerable. Some may argue

that shrimp farming provides a lot of profit. But shrimp farming is done by only a handful number of people and requires a very minimum amount of labor thus creating livelihood shortage in the area as well. As a result people like Abul Bashar who cannot afford to pay for fresh water are living an inhumane life.

A number of environmental problems have emerged due to the lack of fresh water such as devastation of agricultural production, reduction in the number of species of fruit, timber and medicinal plants and trees, death of less saline-tolerant trees, destruction of indigenous species of fishes, closure of fresh water fish farms, reduction in soil fertility, destruction and loss of the bio-diversity of Sundarban forest (Uttaran; Committee, Paani; CEGIS; IWM, 2013). Besides, the once resource-rich southwest Bangladesh is losing its biodiversity, which is making the poor people more vulnerable as they are highly dependent on natural resources. Being a brackish water zone, both fresh water and saline water species co-existed in the open waters of the southwest (Kibria, 2011). But due to increased salinity some species are becoming locally extinct; thus, threatened people's livelihood opportunities. Additionally, due to excessive shrimp farming and water logging due to disaster like AILA, one will not be able to find a single standing shade tree. So women and children who are collecting water from long distances have to fight with a very high temperature as well. Particularly during April and May, the temperature here can reach above 40°C which makes it even harder thus making them vulnerable to heat strokes as well.

GOVERNMENT POLICIES AND STRATEGIES

"Water is an essential item for human lives, socio-economic development of the country and environmental protection. Over the years, the government of Bangladesh has passed several legislatives, policies, strategies, and national plans on safe drinking water and sanitation."

Over the years, the government of Bangladesh has passed several legislatives, policies, strategies, and national plans on safe drinking water and sanitation. National Policy for Safe Water and Sanitation 1998, the National Water Policy 1999, the National Water Management Plan 2004, National Policy for Arsenic Mitigation & Implementation Plan, 2004, Pro-Poor Strategy for Water and Sanitation Sector (PPSWSS), 2005, National Sector Development Programme (SDP) for Water Supply and Sanitation, 2010 etc are such examples of policies and strategies taken by the government of Bangladesh. But these policies and strategies were previously critiqued for not focusing on the very vulnerable southwest coastal Bangladesh. Finally in 2011 the Government of Bangladesh developed National Strategy for Water and Sanitation Hard to Reach Areas of Bangladesh. This strategy mainly followed the principles of all the mentioned policies but particularly focused on the National Policy for Safe Water and Sanitation 1998.

The paper highlights two of the main national policies for safe water which are a) The National Water Policy 1999 b) National Policy for Safe Water and Sanitation 1998. After critically analyzing these two policies the National Strategy for Water and Sanitation Hard to Reach Areas of Bangladesh was given particular focus as well.

National Water Policy 1999

The government of Bangladesh has already formulated a National Water Policy. It has been proclaimed in the introduction of the National Water Policy "as water is an essential item for human lives, socio-economic development of the country and environmental protection, Government has formulated a policy to adopt necessary strategy and programs with the aim of management of the water resources of the country on the basis of extensive coordination and equal distribution. The Government has formulated the policy for a continuous march forward in the accomplishments of the overall objectives of economic development, poverty reduction, self-sufficiency in food, public health and security, improvement in the standard of living style of the people and environmental protection."

In a review of the water policy the observation is that the issue of climate change has not been included in the policy. At present it is globally accepted that the temperature is gradually increasing and the sea level is also rising accordingly.

Bangladesh is one of the most vulnerable countries; in particular the southwest region of the country. It is feared that the whole region will go under water. This will not only cause scarcity of safe drinking water but also make the environment unfit for human habitation.

It is necessary to look into the following relevant sections of the policy to judge how far the policy made in the national perspective, and how it can contribute towards alleviating water scarcity, especially in the southwest region.

Section 4.1. River Estuary Management: Special emphasis has been given in this section to solving different problems in the river estuaries of the country. It has also been mentioned that the joint efforts would be taken with neighboring countries such as China, Nepal, India and Myanmar to solve the problems of the river estuaries originating from these countries and flowing through Bangladesh i.e. the Ganges, the Brahmaputra and the Meghna, so that Bangladesh can exercise its due water rights in the dry season and can undertake coordinated efforts for flood control and management. It has been mentioned in section 4.1 (e) that the government would take necessary steps to control chemical and organic pollution of water in the rivers through joint venture projects with the neighboring countries but there is no clear solution to the salinity issue. It is clear that an increase in the flow of water in the rivers would substantially decrease salinity in the river water but such initiatives are not mentioned in policy books. While the government is saying that construction of Ganges Barrage would reduce salinity in the surface waters of the southwest Bangladesh, that is only limited to the eastern side of khulna and Bagherhat district. Moreover, the inter river linking of project of India has already started, but no significant actions has been taken from the government yet.

Section 4.2. Water resource planning and management: This is the most important section which contains hopes and aspirations for a solution of all the problems (drought, flood, drainage, river siltation, river erosion, land reclamation from the seas and rivers, damage to lives, properties and infrastructure, preservation of land and water bodies). It mentioned that development efforts would be undertaken through identification of the different hydrological zones in course of the rivers. But still such study to find zones is not yet proceeding in the coastal belt.

Section 4.3. Water rights and distribution: This section proclaims that the ownership of water lies with the state. The state reserves the right to ensure equal distribution of water for skillful development and water use as well as poverty reduction. It has been mentioned in section 4.3 (b) that the government would take necessary steps for distributing water in the deficit zone on priority basis for domestic and municipal use. The section discussed reducing salinity from the river water and salinity management but did not mention the salinity problem of drinking water in village areas of southwest part of the country. Additionally while the government is providing almost free water all over the country, in the south-west coastal Bangladesh people are buying water from the technologies provided by the government (RO-Plant). So such inequality in the distribution of water persists.

Section 4.6. Water Supply and Health System: In this section it has been mentioned that there is salinity intrusion into ground water in the coastal zone. The section also contains measures for addressing the problem. Such as sub-section 4.6 (a) includes "provide necessary assistance to ensure supply of safe drinking water through rain water harvesting" and 4.6(b) has provision for preservation of natural sources of surface water in major urban areas to maintain the water level and management of rain water. Here rainwater is identified as the only source of fresh water. But other technologies are now available which are much more efficient than rain water harvesting. Besides, the section only talks about managing and preserving natural resources to ensure potable water only for urban areas whereas the majority of the population lives in the rural areas. This again contradicts with other sections of the policy and even with other policies where it says that Water is a basic human need and state should supply water to everyone without any discrimination.

Section 4.8. Water and Industry: In this section we could observe that the excessive salinity in the water is a main obstacle to industrial growth in the southwest region. But it is surprising to note that the section includes various steps to control water contamination but the salinity issue has not got the same importance respectively.

Section 4.12. Water for Environment: From this section we can quote "it is very important to protect the environment and its bio-diversity and the regenerative process under the national water resource development and

Unused rain water harvesting plant

management." The problems of salinity increased in agricultural land and the environmental problems for salinity intrusion have been duly mentioned in this section. But the sub-section 4.12 includes measures for water flow from the upper stream to maintain environmental balance in the coastal rivers and sub-section 4.12 (d) includes measures for protection of the lakes, ponds, wetlands, canals, reservoirs etc from environmental degradation and revival of its effectiveness. But contradictory policies, for example leasing out fresh water reservoirs for shrimp cultivation, has resulted in improper implementation of policy. Besides, no such actions to control ground water salinity have been mentioned here.

In the backdrop of the above review, it may be concluded that the National Water Policy has not appropriately included the effective measures to address the safe drinking water problem making situation much more challenging for the inhabitants of the southwest coastal region. The policy has clearly undermined the salinity problems and till to date no amendment has been done considering salinity. To add on climate change is now also a much bigger factor which requires immediate attention. While the policy clearly states measures for urban areas, rural areas have been ignored completely showing that state promotes inequality for drinking water.

National Safe Water Supply and Sanitation Policy:

The salinity issue was not properly incorporated in the National Water Policy. Just like the National Water Policy, the issue of salinity was also ignored here as well. In the Basic Needs section it is mentioned "it is necessary to improve the water supply and sanitation services in order to meet the basic needs of the citizens." The basic need of the people of the southwest region is saline-free drinking water. Although the policy contains provisions for supply of safe drinking water it has not properly incorporated in any place of the policy the issue of saline-free drinking water supply.

Regarding technology options the policy states "the process of technological development will continue for water supply and sanitation according to the specific local needs". The policy does not specify any technological options for supply of saline-free drinking water and how the specific needs of the people of the southwest region would be met.

Under the investment sections of the policy it is stated, "it is necessary to identify the weakness on emergency basis." No efforts have been taken in the past to discover or develop sources of safe drinking water. So it can be said for sure that none of major objectives of the National Water Policy or the National Water Management Plan would succeed due to lack of proper guidelines in these documents.

Under the section 8.1.2 the policy states "Local government bodies in village, union and thana level shall have a direct role in planning, implementation and maintenance of rural water supply." Through this section the policy gave the responsibility of maintenance of rural water supply to the local government but again in ***the section 8.1.4*** it states "User communities shall be responsible for operation and maintenance of water supply facilities and shall bear its total costs." Here a contradiction is created about who is actually responsible for maintaining the water options. Field visits suggest that there is no involvement of local government in maintaining the water options. Local people are maintaining it even though sometimes it becomes a burden for them. The options that are not being maintained properly are becoming unusable within a few years. Countless water option can be found in the southwest coastal areas which are currently dysfunctional due to lack of maintenance.

Under the section 8.1.11 the policy states "In each and every village of Bangladesh at least one pond will be excavated/re-excavated and preserved for drinking water. Necessary security measures will be undertaken to prevent water of the pond from contamination." But the government did not even care about such policies in the past. It leased out the reserve ponds for fresh water sources in almost all villages across the southwest Bangladesh to shrimp farmers to boost up and promote shrimp farming. The results are catastrophic as now we can able to find larges areas without any fresh water ponds.

National Strategy for Water and Sanitation Hard to Reach Areas of Bangladesh

The strategy for the first time developed a strategic framework for the coastal region of Bangladesh particularly the areas affected by high salinity and for which due credit should be given to government. The strategy discussed about the problems that the local people face regarding their access to safe drinking water, provided immediate and sustainable solution and also discussed about who and how a project will be implemented. These specific detailing out of the overall situations and solutions for the coastal region in particular saline water affected regions were laid out which will remain as a bench mark in ensuring fresh drinking water supply to around 20 million people living in the region. The coastal people hope that their long demand and struggle for drinking water will end through successful implementation of these strategies and they are very grateful to the government of Bangladesh. .

When this strategy is critically analyzed in the context of southwest coastal region, some gaps can be spotted which acts as hurdles in ensuring safe drinking water for the coastal people. ***In section 6.2.1*** of the strategy under Strategies for Sustainable Solution it says "Construction of reinforced houses in clusters on raised grounds along with individual or community type drinking water and sanitation infrastructures." First of all, because of the land ownership pattern of the local area, people will not leave their own properties to live in cluster. Besides people who own land in relatively raised ground will not accept others residing on their land. Thus this strategy will lead to unrest in the locality.

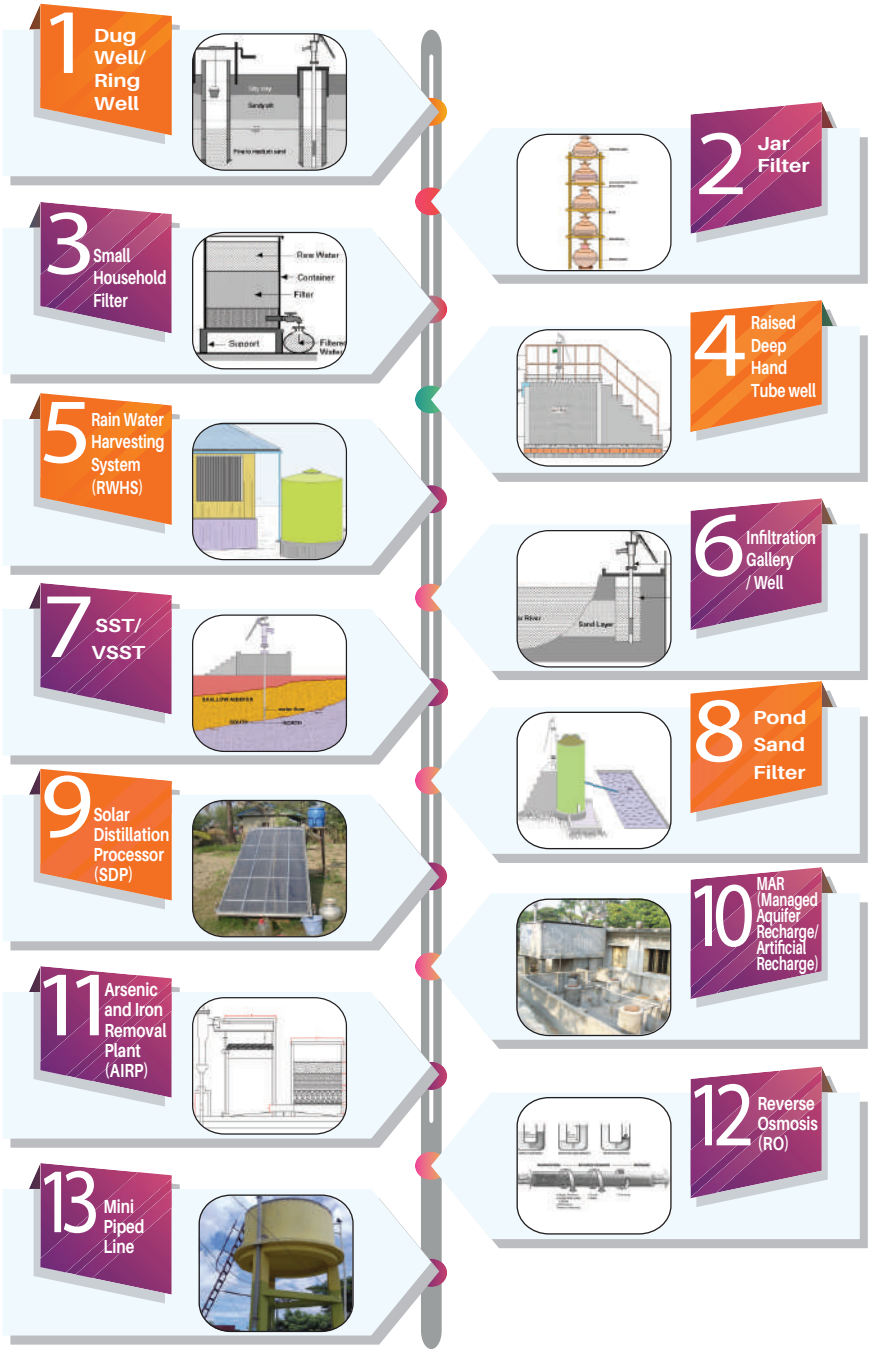
Under the same section the concerned strategy also states "Constructing desalination plants and rainwater harvesting with underground reservoirs to be located on highlands e.g., cyclone shelters, schools, madrashas, office buildings,

market places etc for community water supply." Both desalination plants and rainwater harvesting systems require high installation costs and involve regular high maintenance cost. The strategy paper under the same section in Design and Implementation states that "DPHE, LGED, Disaster Management Bureau and NGOs will provide technical assistance in design and installation of facilities while concerned LGI with effective participation of the community will implement." There are no clear guidelines about who will maintain or repair such expensive systems once they are installed. Over the years it has been found in the local area that, such expensive mechanisms stop working within a year or two of when the project ends. It is true that using rain water to recharge ground water is a new and innovative technology but it is very recent concept and yet to face any difficulties. Moreover, rain water harvesting systems for individuals is not highly accepted in places where other water options are available, even though those options are little far away from their households, because rain water harvesting need regular maintenance. Besides, families which are very poor cannot sustain rainwater harvesting system for long. So clearly, such expensive, untested, and socially unacceptable systems will not certainly become sustainable solutions.

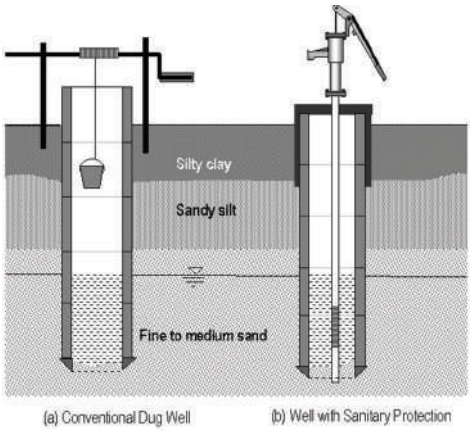
The sustainable solutions will only be installed in highlands. But most of the southwest coastal regions are basically low land areas where tidal actions take place. A higher percentage of extreme poor people live in these low lying tidal flood plains. Then clearly these people will be excluded from such sustainable solutions. Besides, people who reside far from the installation points will still have to travel a long way every day just to collect daily water. So the problems of the mass community will still remain with only few people getting the service.

The immediate solutions under the same sector stated that "Tube-wells with appropriate treatment units for arsenic, iron or salinity removal, desalination plants for treating saline surface water, rain water harvesting, PSFs with raised and lined ponds are 13 recommended drinking water technologies for application in coastal areas." Understanding the local context, these options would be more sustainable, considering that their maintenance costs are very less and are socially acceptable among the people. Moreover, in the local area, it can be observed that collecting water from desalination plants and rainwater harvesting systems requires some money.

FRESHWATER OPTIONS IN SOUTHWEST COASTAL REGION



DUG WELL/RING WELL



Conventional and Sanitary Protected Dug Wells

Dug well/ ring well is the oldest method of groundwater withdrawal for water supplies. The water of the dug well has been found to be free from dissolved arsenic and iron even in locations where tube wells are contaminated. Surface water infiltrates and purifies through several layers of the earth and pools at the bottom of the dug well. Digging earth well creates dug and placing about 2 to 2.5 feet diameter burnt mud rings one upon another for fulfilling the depth about 30 to 36 feet of the dug well. Brick walling or RCC rings well also can create dug. Some dug wells may be 40 to 45 feet deep and 3 to 10 feet in diameter. Therefore dug well has been recommended as a safe drinking water source by UNICEF.

User Group: Community

Advantages

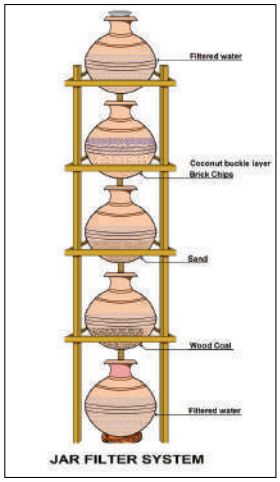
- *Mass people can afford the options as the installation cost is lower than other options.*
- *Easy installation procedure and the local mason can install it without higher technical skills or training; Water can be accessed by digging only 30-60 feet*
- *Larger population could be covered (At least 30-40 households can collect drinking and domestic water)*
- *Longevity is higher than other options because it can be used for about 50 years if maintained properly,*
- *Installation materials and masons are available at local level.*
- *Easy O&M and the user groups can efficiently repair the options after a simple orientation.*

Disadvantages

- *Excessive saline intrusion in the surface and sub-surface level of water;*
- *Water from dug-well is mixed with salinity which discourages people to drink.*
- *Salinity intrusion has destroyed the practice of dug well considering that most of the shallow aquifers in the southwest coastal areas are now saline. So dug/ring well now cannot be used any longer*
- *People are reluctant to use dug well because the water is from a shallow aquifer and local populations think this might have bacterial contamination.*
- *Additional water treatment required i.e chlorination for disinfection.*

HOUSEHOLD FILTERS

Surface water containing impurities can be clarified by a pitcher filter unit or a small sand filter at the household level. In the next few lines we are highlighting the two most effective household filters.



a) Jar Filter/Kalshi Filter

There was extensive use of jar filter system for purification of water in rural area of Bangladesh. In some areas it is still used. This system is more effective especially for clearing dirt and filth from water. It is an old method of water purification. Jar filters are constructed by stacking a number of jars (Kalshis), one above the other, containing different filter media. Raw water is poured in the top Kalshi and filtered water is collected from the bottom one. In this process, water is mainly purified by the mechanical straining and adsorption depending of the type of filter media used. This process is very cost efficient since it requires only BDT 500-700 for the complete process and also the maintenance cost involved is also minimal

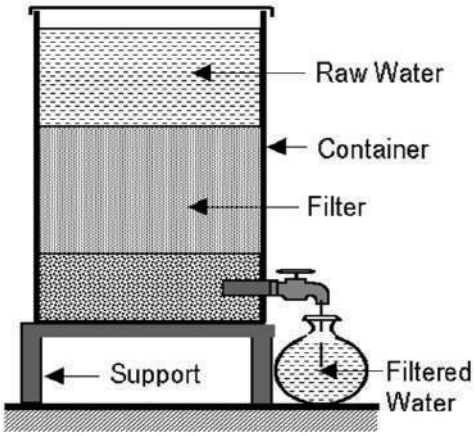
User Group: Household level.

Advantages

- *Lowest installation costs and the ultra poor people can easily afford the options.*
- *O&M is very simple and easy.*
- *Installation materials are available at local level.*
- *It needs smaller space and could be installed inside the dinning or sleeping room.*
- *Can be made at household level without any technical support*

Disadvantages

- *In some saline areas it is very difficult to find water that would be fit enough for this kind of filtration.*
- *It extracts small quantity of water. So, required drinking water for a family may not be met.*
- *As these options are made out of fragile materials, thus less durable.*
- *The introductions of cheap household-based moderated filters in market by private producers have driven this traditional method of water purification almost to extinction.*
- *Additional water treatment required for disinfection.*



Small Household Filter

b) Small Household Filter

Small household filters can be constructed by stacking about 300-450 mm thick well graded sand on a 150-225 mm thick coarse aggregate in a cylindrical. The container is filled with water and the filtered water is collected from the bottom. It is essential to avoid drying up of the filter bed. Full effectiveness of the filtration process is obtained if the media remain in water all the time. The small household filter has been able to offer much purified water. But being a household filter, the quality of water it offers is exemplary.

User Group: Household level.

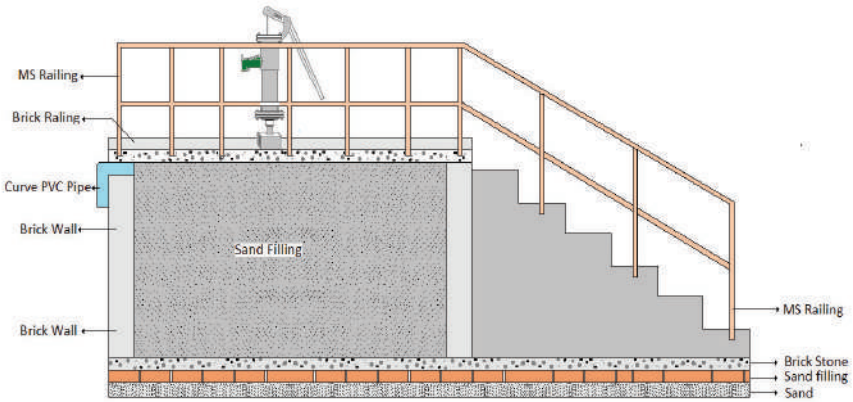
Advantages

- *Locally available in the market at an affordable/ minimum price.*
- *Maintenance is simple and affordable.*
- *It can filter adequate safe drinking for a single household at a very minimum cost.*
- *O&M costs are very nominal.*

Disadvantages

- *It does not work for desalination. Therefore, it is difficult to find out appropriate water in some of the high salinity areas in the coastal regions.*
- *Despite the option costs minimum prices, it seems to be expensive for the ultra poor households.*
- *It requires frequent cleaning if the raw ware is concentrated with turbid, iron or limited arsenic.*
- *Safe disposal of sludge might sometimes be a difficult if the users are not properly oriented.*

RAISED DEEP HAND TUBE WELL



Raised Deep Hand Tube well

Because of the geographical settings and unique climatic conditions of southwest coastal region in Bangladesh, safe drinking water is scarce in this particular region. Under these conditions the saturation zones, the underground sources of water, offers some fresh, safe and drinkable water. But the major hurdles in accessing water from this source are that the aquifers in this region are very deep down the surface. One of the most convenient processes of extracting this fresh water is by installing a deep hand tube well. In the southwest region, the tube wells need to reach almost around 700 feet to 1200 feet under the surface to get access to the fresh water source. The concerned regions are prone to natural disasters like floods and cyclones. Cyclones in these regions are

Advantages

- *The most popular and familiar water option among the locals.*
- *Required materials, spares and masons are available in the localities.*
- *Easy and convenient maintenance and durable.*
- *High quality water.*
- *Serves a greater community.*
- *As it is raised, so remains protected from flood and tidal surges.*

Disadvantages

- *It is more expensive and the poor households cannot afford the options without external assistance/subsidies.*
- *Sometimes, it is difficult and risky to install due to deeper aquifer.*
- *Lack of proper post management makes it dysfunctional.*
- *Water withdrawal rate is much higher than the aquifer recharge*

accompanied with tidal surges. Thus these regions become prone to water logging and it remains water logged for almost 6 to 8 months every year. While installing the tube wells we need to take into account the issues. To combat these challenges the hand tube well platform is raised above tidal surge or flood level. After setting up the tube well with this precaution, we name this water option as the raised deep hand tube well.

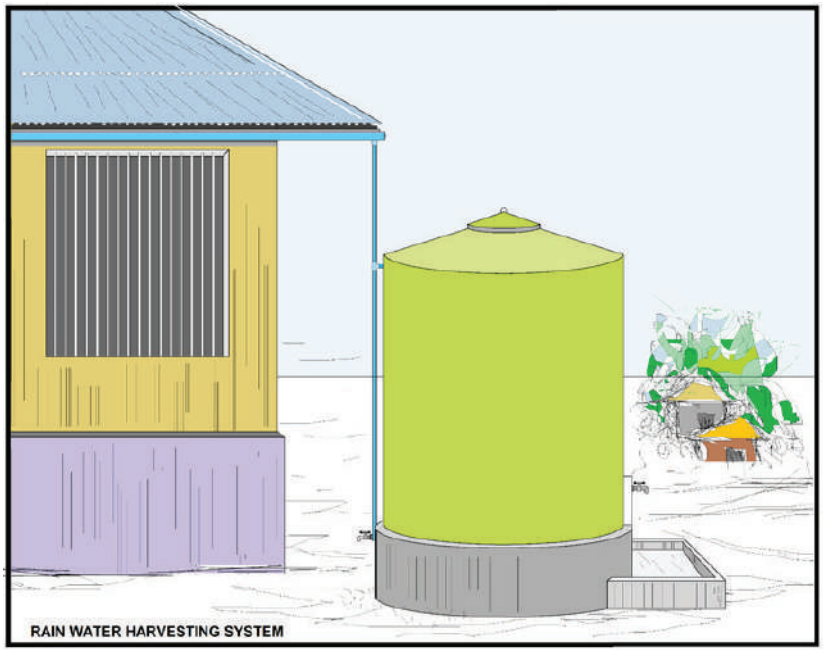
User Group: Community

Disadvantages

rate, thus the risk of running out of water from the aquifer remains.

- *Due to soil structure of the southwest coastal Bangladesh, in some areas deep tube well can be as deep as 1000-1500 feet, thus the expense increases.*
- *Salinity intrusion mostly due to seepage making some places unsuitable for deep well installations.*

RAIN WATER HARVESTING SYSTEM (RWHS)



Rain Water Harvesting System (RWHS)

Rain water is one of the alternative sources of safe drinking water and is particularly important for the southwest coastal region of Bangladesh. Both ground and surface water in some areas of southwest districts, particularly lower parts of Khulna and Satkhira district are saline, thus making it unusable. The system is particularly designed for those areas where there is scarcity of fresh water.

The monsoon season of Bangladesh provide plenty of rainfall which can be collected at individual household levels and stored throughout the year for drinking purpose mainly. Rain water has been identified as a safe source of

Advantages

- *Most effective water options where underground extraction of water is not required/impossible.*
- *It contributes in reducing pressure on underground water and keeping ecological balance.*
- *It serves a family of 5 for throughout the dry period.*
- *Good quality of water if properly and hygienically collected and stored;*
- *Highly durable if maintained properly.*

drinking water. Rain water harvesting is basically the accumulation and deposition of rainwater for reuse on-site, rather than allowing it to run off.

Design

Rain water can be collected from roofs, and in many places the water collected is redirected to a deep pit or reservoir with percolation. The system requires a very simple and cost effective technology. For individual household, rain water harvesting system is found to be sustainable. Generally, a 100 mm diameter outlet is set around edge of the roof of the house and is used a catchment for the rainwater. The outlet is directed to a 38 mm diameter down pipe that channel the water through an inlet pipe of 36 mm diameter into a plastic water tank placed on a platform for storing. The capacity of the tank may vary. The down pipe contains a valve to regulate the surface catch. The setup cost is around BDT 18,000-20,000 based on the size of the water tank. Within this cost the water tank can store up to 2800-3200 L of water. This system needs to be cleaned once a year and the maintenance cost is BDT 200 per year. In the recent years, rain water harvesting is being promoted in the community level as well, particularly in schools. Big water tanks are installed where at time 20,000L-25,000L of water can be stored so that it can serve a bigger community.

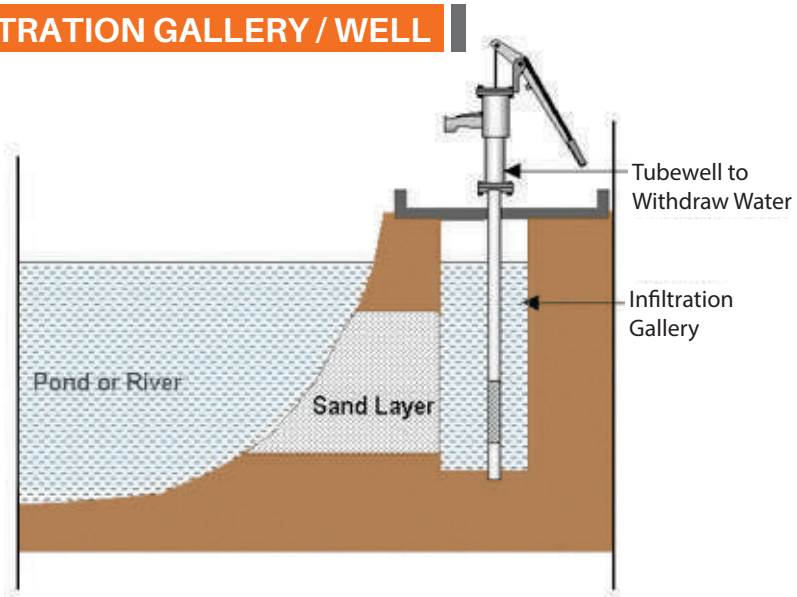
Disadvantages

- *It can stores very limited quantity of water and can be used only for drinking purposes.*
- *Stored water can be easily contaminated by bacteria which degrade the quality of water and increase the chances of water borne diseases.*
- *Due to bacterial contamination, people become unwilling to use the water for drinking purpose particularly during the latter half of the dry season.*
- *The setup cost for one RWHS is expensive when it is considered for an individual household in compare to other options which supports a whole community.*
- *Relatively well-off families can only install and maintain this option while the ultra-poor day laborers cannot install it without external assistance or subsidies and also it does not sustain it for long time.*
- *Places where other water options are available RWHS fails due to cultural construction of the local people.*

The rain water harvesting system is important for the dry season. Normally, November to April is the dry season in Bangladesh when water becomes scarce and water salinity increases. The RWHS is supposed to supply drinking water need for a family during this period. With 2800 L of water a family of 5 members can get water 3.1 L per day for the six months of dry season.

User Group: Household level

INFILTRATION GALLERY / WELL



Infiltration Gallery / Well

Infiltration Galleries (IG) or wells can be constructed near perennial rivers or ponds to collect infiltrated surface waters for all domestic purposes. Since the water infiltrate through a layer of soil/sand, it is significantly free from suspended impurities including microorganisms usually present in surface water. Again, surface water being the main source of water in the gallery/well, it is free from arsenic. If the soil is impermeable, well graded sand may be placed in between the gallery and surface water source for rapid flow of water as shown in the above figure. Experimental units constructed in the coastal area to harvest low saline surface waters show that water of the open infiltration galleries is readily contaminated. The accumulated water

Advantages

- *Easy availability of water as surface water is used as source.*
- *It is not too expensive and people can afford the options.*
- *It can supply sufficient water for 10-15 households consisting of 50-60 users.*
- *It is free from arsenic and other chemical contaminations;*
- *Materials and masons are available in the locality*

Disadvantages

- *After Cyclone AILA, most of the ponds in coastal Upazilas ofKhulna, Satkhira and Bagherhat have lost sweet water and turned into brackish/saline water. So, there are lacks in availability of suitable water for this option.*
- *Most of the rivers are saline due to tidal actions;*

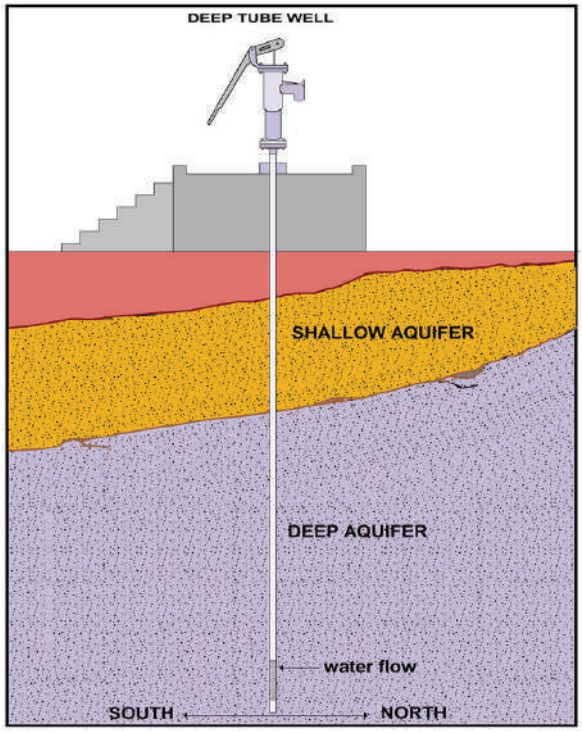
requires good sanitary protection or disinfection by pot chlorination. Sedimentation of clayey soils or organic matters near the bank of the surface water source interfere with the infiltration process and require regular cleaning by scrapping a layer of deposited materials

User Group: Community

Disadvantages

- *Its operations and maintenance is more difficult than that of other options.*
- *No post project management plan.*
- *Needs regular monitoring which is not possible for the community.*

SHALLOW / VERY SHALLOW SHROUDED TUBE WELL (SST/VSST)



Shallow Shrouded Tube Well (SST)/ Very Shallow Shrouded Tube Well (VSST)

In the high salinity coastal areas it has been found that fresh water is available in small pockets of shallow aquifers composed of fine sand at 15 to 20 m depth. This may be due to accumulation of rainwater in the topmost aquifer or dilution of arsenic contaminated groundwater by fresh water recharging each year by surface and rain waters. However, the particle size of soil and the depth of the aquifer are not suitable for installing a normal tubewell. To get water

Advantages

- *Easy availability of water as surface water is used as source.*
- *It is not too expensive and people can afford the options.*
- *It can supply sufficient water for 10-15 households consisting of 50-60 users.*
- *It is free from arsenic and other chemical contaminations.*
- *Materials and masons are available in the locality.*
- *The water source refills in every year.*
- *Good quality of water as the main source is rain water.*

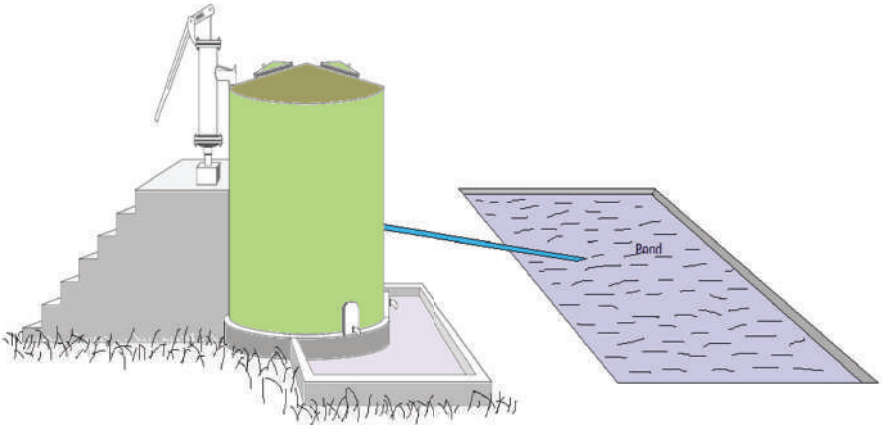
through these very fine-grained aquifers, an artificial sand packing is required around the screen of the tubewell. This artificial sand packing, called shrouding, increases the yield of the tubewell and prevents entry of fine sand into the screen. These low-cost hand pump tubewell technologies have been designed and installed in the coastal areas to collect water from very shallow aquifers formed by displacement of saline water by fresh water. The SST/VSSTs can be convenient methods for withdrawal of fresh water in limited quantities. Over-pumping may yield contaminated water. Installation of low capacity pumps may prevent over exploitation of shallow aquifers. The systems may be considered suitable for drinking water supply for small settlements where water demand is low. A shallow/very shallow tube well is shown in figure.

Disadvantages

- *Identification of accurate water level and installation of the options accordingly are challenging.*
- *Pumping can be done only in limited quantity.*
- *Over pumping results in contamination.*
- *Can only be installed in few locations where shallow fresh water aquifers are available as most of the shallow aquifers are becoming contaminated with salinity due to shrimp cultivation.*
- *Possibilities for failure.*

User Group: Community

POND SAND FILTER



Pond Sand Filter

PSF is a simple, low-cost technology with very high efficiency in turbidity and bacterial removal, constructed with locally available materials and trained masons. Its operation and maintenance is also simple and cheap. This is a surface water treatment plant where source of water is pond water. Generally a reserved pond with enough space on the bank is needed to install PSF. Generally a medium sized PSF can support 150-250 households and takes near about BDT 1, 50,000 -170,000 for installation.

PSF uses a tank with 5-6 chambers or layers. Each chamber is filled with gravels

Advantages

- *One of the most popular sources of water.*
- *Capacity to serve around 100-200 households. A single PSF can serve more than one village.*
- *Good quality can be ensured through regular maintenance.*
- *Construction materials, spares, and masons are available at local level.*
- *Users can have access to safe water with minimum costs.*

of different sizes to filter both coarse and fine sands and other materials such as bacteria from water. The pond water is channeled through a tube well to the tank. After passing though different filtering chambers the purified water settles at the last chamber which is then collected through a pipe or multiple pipes usually known as tap.

Disadvantages

- *Without post project management PSF become unsustainable.*
- *Cyclones, water logging, and tidal surges over the years have left a lot of fresh water ponds unusable.*
- *Aquaculture and other activities like bathing and washing cloth have limited the number of fresh water ponds in the coastal region.*
- *Humus in the form of falling leaves and surface runoff makes the water contaminated.*

Conventionally, pond water is pumped through hand tube well. But it can also be pumped through a solar pump or a fuel run motor. It has been found that hand tube well system is most cost effective but time consuming while the fuel run motor is more efficient but expensive to run. The solar motor is cost effective, takes less time than tube well to pump water, and most importantly is able to serve 24 hours a day. Therefore, it is found to be the most suitable option of PSF under the economic and climatic context of Southwest region. In addition, if there is a possibility to install a large tank, the purified water can be distributed through multiple mini pipe system which will reduce the hurdle of the households to fetch water from the tank especially for those who live relatively far from the pond.

The committee involvement in operation and maintenance is absolutely essential to keep the system operational. It has been found from the field that due to lack of cooperation and planning community people are less willing to bear the cost of maintenance of PSF. A proper planning and local government cooperation is essential for community maintenance of PSF. In addition, it should be kept in mind that the pond is not connected with any other drainage system which may contaminate it and spread water borne diseases as locals complain about the quality of water. They mostly use it for cleaning and shower purpose.

User Group: Community

SOLAR DISTILLATION PROCESSOR (SDP)

Solar Distillation Processor (SDP)

A solar distillation processor can be an effective method for desalination. This simple distillation technique is used in a process through which saline water can be distilled and converted into fresh water. Here, the water is first evaporated and then condensed, thus removing dissolved solids form the solution. A black metal fabric is used to filter raw water and generate heat from sunlight. An aluminum sheet is placed at the beneath of metal fabric to carry the filter water. This system is placed 45 degree angle to regulate the water flow. Thus the water produced by this system can only meet the drinking water requirement of one family of five members. Areas where the water scarcity is really high and are highly saline, this option is a good one considering that there are no other alternative.

User Group: Household level.

Advantages

- *Very cheap method of desalinization.*
- *Very useful for small family.*
- *Minimum maintenance cost.*
- *No physical labor involved.*

Disadvantages

- *The amount of water produced by this process is very limited and is totally dependent on solar energy.*
- *Cloudy days lead in producing very limited water.*
- *Will not work if other options are available.*

MAR (MANAGED AQUIFER RECHARGE/ ARTIFICIAL RECHARGE)

MAR (Managed Aquifer Recharge/ Artificial Recharge)

The application of the MAR concept is simple: water is collected from ponds and roofs and, after passing through a sand filter, is then injected into the shallow saline aquifer through a ring of infiltration wells, creating a lens of fresh water. After the turbidity of the infiltrated water has improved to an acceptable level, water can be abstracted using a standard hand pump yielding water of improved quality (reduced levels of turbidity, coli forms, iron and arsenic). Importantly for Bangladesh, storage of fresh water in the ground offers significant flood protection during the regular cyclonic surges and MAR system provides safe water when other traditional sources have been damaged by the floods. In coastal Bangladesh MAR is comparatively a very new concept and currently it is in piloting stage. So far field visits in MAR sites helped to understand that it is slowly gaining popularity.

Advantages

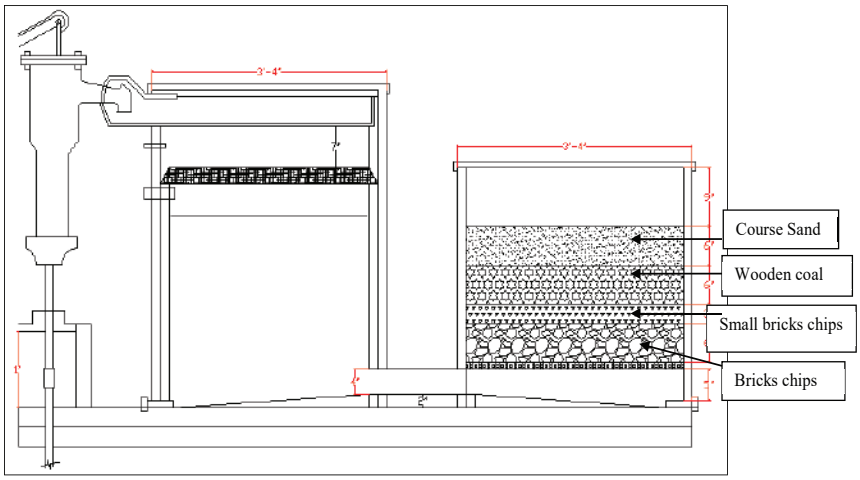
- *Multiple water options are being used to recharge aquifers.*
- *Reduces contamination and salinity of water down to a considerable amount.*
- *Can serve a large community.*
- *Construction materials and masons are available in the locality.*

Disadvantages

- *The technology is comparatively new so major limitations are still to be found out.*
- *Post project management can be an issue.*
- *As it is using multiple water source for recharge so complication regarding maintenance may arise.*

User Group: Community

ARSENIC AND IRON REMOVAL PLANT (AIRP)



Arsenic and Iron Removal Plant (AIRP)

Apart from salinity intrusion, underground aquifers in the southwest coastal region of Bangladesh are also highly affected with arsenic and iron. To overcome this threat arsenic iron removal plant (AIRP) is found to be a good alternative technology to ensure arsenic and iron free water. AIRP is capable of removing 90-98 % iron and 70-75% arsenic from water. Similar to PSF, this plant also requires tube well to pump the water inside the tank after which purified water can be collected through a tap. This technology is sustainable for a small community as one AIRP can support around 10 families. Its maintenance and installation cost is affordable.

Advantages

- *Very good quality of water.*
- *Low installation cost of the AIRP technology (without the tube well).*
- *Arsenic affected tube well can also serve fresh water through this technology.*
- *Serves a greater community.*

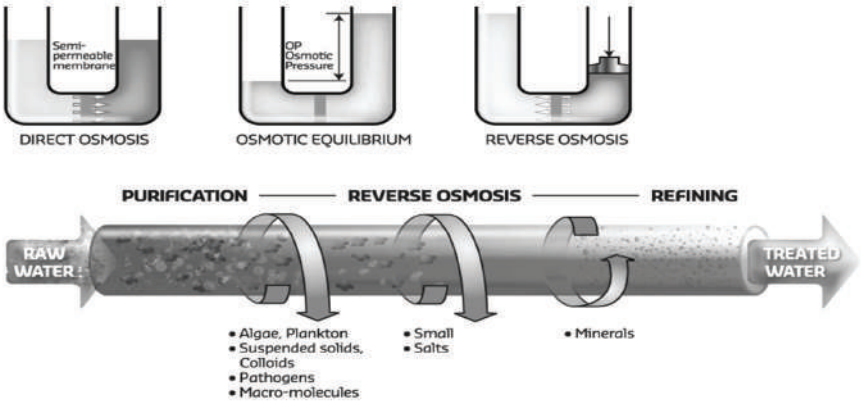
Disadvantages

- *Operations and Monitoring is almost complex.*
- *High maintenance cost.*
- *Post project management is absent.*

AIRP uses similar technological principle as PSF. Water is pumped inside and passed through several layers of sand, coal and brick chips and the purified water is collected through pipe or tap. Pipe line can be added with the outlet tank so that water can be distributed to households through pipes. The total plant except the tube well will cost BDT 22,000 – 25000 to install. Like PSF, AIRP needs deep community involvement and association from local Govt. for sustainable maintenance and functioning.

User Group: Community

REVERSE OSMOSIS (RO)



Reverse Osmosis (RO)

Reverse osmosis is a water purification technology which is used to remove dissolved solids and larger particles from drinking water. The technique uses a semi permeable membrane through which a solution is passed by applying high pressure. After applying the pressure, the solute (salt) is retained on the pressurized side of the membrane and the solvent (water) is allowed to pass through to the other side for

collection as fresh water. To be selective the membrane is set to not allow large molecules and ions to pass through the pores but it should allow smaller component of solutions (such as the water) to pass through. Underground saline water as the source is recommended to ensure less turbidity and lasting of the membrane but saline surface water can also be used due to easy availability.

Advantages

- *Offers best quality of water among all the options.*
- *Can product huge of fresh water in every hour.*
- *Social acceptability is very high*
- *Potentially a very good business sector.*
- *Very important for the coastal areas if we were to achieve the SDG.*

Disadvantages

- *Very high installation cost.*
- *In almost 3-4 years, the membrane needs to be changed which is very expensive.*
- *One liter of water can cost up to BDT 0.60 which some time is expensive for very poor people.*
- *Electricity is still not readily available in the remote areas.*
- *Operations and Monitoring is not easy and the spares are not available in the localities.*

In coastal Bangladesh, this process can be very effective considering that most of the areas are saline. The setup cost of this process can be quite expensive considering modern technologies are being used. The maintenance cost is also quite expensive as well as it requires electricity. Solar energy can be used as an alternative source of electricity and thus will help to reduce the running cost. The water produced from this plant can also be piped through a mini piped water supply system to meet the demand of the community.

This system has now also become a strong SME. Many people in the coastal areas have established small scale RO plant from where they are able to supply fresh water for 200-600 families depending on the size. The setup cost for such RO plant is around BDT 400,000-500,000.

User Group: Community

MINI PIPED LINE

Advantages

- *Best options for hard to reach areas and can serve more households.*
- *One source of fresh water can be supplied to multiple villages and thousands of households at a time.*
- *No physical labor involved and people can easily have access to safe water at their household level.*
- *Good quality of water ensured.*

Disadvantages

- *Proper management is an issue which will ensure water availability in all the collection points.*
- *Higher installation cost and the users cannot install the options without external assistance or subsidies.*
- *Operation and maintenance is complicated and costly.*
- *The options could be non-functional in lack of proper operation and management.*
- *No effective post project management plan.*

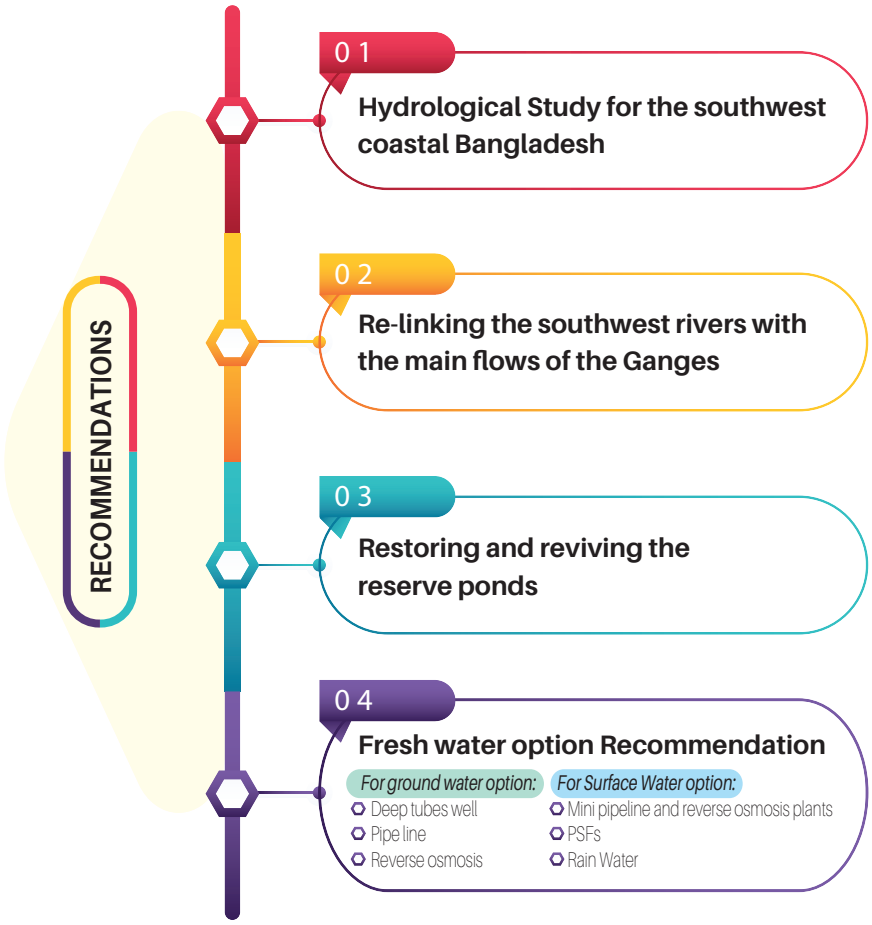
Mini Piped Line:

In some hard to reach areas of southwest coastal Bangladesh, mini piped line system is the best option to provide fresh water supply for the locals. In areas where there is no fresh water supply, water from other nearby areas can be supplied using this system. Mini piped line can be connected to a lot of different water options. For example, In Koyra and Asasuni upazila of Satkhira district ground water is supplied to the people through mini piped lines, where as in Mongla Upazila surface water is treated and then supplied. Pipe lines are connected to the water supply and then several connection points are installed in some community places for the people to collect water. The system has electricity/solar run water pump, an overhead tank, long pipelines to cover large area and collection points.

User Group: Community

RECOMMENDATION

Based on the field visits, focused group discussion (FGD), interviews with key stakeholders, long term experience of Uttaran and Paani Committee and secondary data collected to prepare this paper, the following recommendations should be considered to ensure drinking water for the people of the southwest region



Hydrological Study for the southwest coastal Bangladesh

A hydrological study is necessary to pinpoint the sources of fresh water, both surface and ground water. This study will help the government and other organizations who are installing fresh water options in the concerned area. Through this study, we will be able to know what kind of options will be suitable for a particular place. This study will then serve this part of the country for the next few decades.

Re-linking the southwest rivers with the main flows of the Ganges

Fresh water flow of the southwest coastal region needs to be increased in order to ensure fresh water supply for the people and ecosystem of the area. The Mathabhanga is the only river which provided water for the main rivers of the southwest coastal Bangladesh. So the Mathabhanga River needs to be reconnected with the main flow of the Ganges in order to ensure a constant supply of upward flow in the southwest rivers throughout the year. The government says that Ganges Barrage project will ensure fresh water flow for the rivers of the southwest. The proposed location to construct the barrage at Pangsha Upazila under Rajbari district (98 KM down of Farakka) will supply enough water to the Garai and Madhumati River.

But the Satkhira, Jessore and some part of Khulna district will not be benefited from this Barrage, since Mathabhanga will not be benefited at all. This will still leave most of the rivers of the southwest coastal region without any fresh water flow. Particularly, Kabodakh and Betna, two of the biggest river in the region will not get any benefit out of this. Thus most of the people without access to fresh water supply will still have no access to it. Therefore the government of Bangladesh and its water experts should immediately think of something to reconnect the rivers of the southwest with the main flow of the Ganges.

Restoring and reviving the reserve ponds

The fresh water ponds in the southwest coastal region of Bangladesh provides fresh water supply for a huge population and in some areas it is the only water options. But due to shrimp culture, aquaculture and other uses, these ponds are becoming unusable day by day. Besides, a lot of government owned ponds has already been leased out for aquaculture. These ponds needs to be restored and should be strictly used for potable water supply. The government of Bangladesh has already taken a few steps to ensure that the fresh water reserve ponds are

restored and revived. Prime Minister Sheikh Hasina declared that reserve ponds will be constructed in every village of Bangladesh in order to ensure potable water and she also passed down instructions that reserve ponds for fresh water shall not be used for aquaculture. But still field visits in some of the saline areas suggested that implementing authorities are reluctant to do so as some of the reserve pond particularly state owned are still being used for aquaculture.

Fresh water option Recommendation

All the fresh water options that were visited during the preparation of this paper had some strengths and limitations. The strength and limitations were discussed above. Based on the above strengths and limitations and opinions of the locals, government and non-government officials and our field surveys, FGDs and interviews the following options were found best and most suitable for the hard to reach southwest coastal Bangladesh. The options are ranked according to the source

For ground water: Deep tube well, mini piped line and reverse osmosis plan, all these can be considered as ground water source.

- Among the three deep tubes well is highly socially accepted. Interviewers and study has pointed out that deep tube well is peoples' favorite source of water and other water options do not work well in those areas where there is an accessible deep tube well even when the water quality is not the best. This technology can be used for both long term and short term solution for mitigating drinking water crisis
- Areas where deep tube well installation is not possible due to salinity and lack of aquifers, pipe line is found to be a sustainable solution. Underground water can be pumped from places where there are good aquifers and then piped to the areas where there is acute shortage of potable ground water. Although our study found that there are some management issues about the collection point but that is very limited and can easily be overcome. This is long term solution for mitigating drinking water crisis in the hard to reach areas
- Reverse osmosis provides the best quality of water. Saline ground water is purified into potable water. This could have been the best option for the costal people but high cost is involved here for collecting drinking water

and as well as for maintenance. Since the RO is becoming a privatized water option for the area so the maintenance cost can be covered from this. The extreme poor people will not gain the benefit of it since the water from this option is still expensive. Nonetheless this option has the potential to become a permanent solution for mitigating drinking water crisis for the locals and will be key strategy for ensuring that Bangladesh reaches the SDG targets.

For Surface Water: We recommend both mini pipe line and reverse osmosis plant as surface water technologies as well. Along with these two PSF can also become a short term fresh water solution

- Mini pipeline and reverse osmosis plants can source its water the surface and can operate in the same manner. Fresh surface water can be treated and supplied through mini pipe lines. Saline surface water can be treated through RO plant. But due to high turbidity it is better to use ground water for Reverse osmosis plants.

- PSFs are commonly used here by the local people and fairly a common water supply technology for government and NGOs. But most of PSFs do not last long period after when a project completes mainly due to lack of maintenance. Besides, it is very difficult to find freshwater ponds in some of the villages of the coastal districts. Additionally as the area is highly disaster prone so ponds have a high risk of being contaminated. Thus PSF is identified as a short term water option

Rain Water: Some experts like to believe that rain water is perhaps the best water source for those highly saline areas as the rainfall in monsoon is huge. So far two technologies have been identified to use rain water in the area.

- Managed aquifer recharge: This is comparatively a new technology introduced in these areas in 2009. Further research and more piloting are needed to identify its full potentials. This option though has the potential to become a sustainable water option for the area.
- Rain water harvesting system: Only and the best solution where no other potable water source is available. This is one of the most common ways to collect rain water. But further innovation is needed to ensure the sustainability of the option

Capacity Enhancement of DPHE

Potable water scarcity of the southwest region is more than any other places of Bangladesh. Its ecosystem is completely different than overall Bangladesh and is complex. A generalized plan of action or policy can never be effective in overcoming the fresh water crisis. But until today, our government is yet to take any specific measure to combat this crisis. Since DPHE is the responsible government body for ensuring fresh water supply throughout the country, so enhancing the institutional capacity of the DPHE is necessary in order to bring effective solution in this region. Staffs of DPHE working in the southwest coastal Bangladesh should receive specialized trainings so that they can understand this unique and complex ecosystem and then work accordingly.

Currently, most of DPHE's plan of action is project based which is limited to only the installation of a water option and service for a very limited time. As a result the installed water options can only serve for a limited period of time. Once the project duration is over, the water options are not maintained properly, thus becoming dysfunctional. But previously DPHE's plan of action was not confined to only installing the water options but at the same time they used to maintain and provide other service in order to ensure the longevity of the water options. To overcome the

current institutional crisis of DPHE, program based actions, which will include installing, monitoring, maintenance and repairing of water options rather than current trend of project based initiative, is required.

Policy Recommendation:

Water scarcity is a stark reality for the people of southwest Bangladesh where fresh water crisis is at the most extreme point. In no other parts of Bangladesh such harsh reality prevails. Therefore the Bangladesh government should offer special emphasis and needs to be extra vigilant towards polices and strategic plans regarding the fresh water supply in its southwest region. The issues of southwest has been incorporated in the most recent national strategic plan where the issues of salinity has been highlighted. But still these policies and strategic plans are not effective enough to combat the overall water crisis of this region.

Even though the government has published strategies to ensure safe drinking water for hard to reach areas, the policies are still unchanged. That is why policies and strategies are not functioning effectively. Additionally, the water options suggested in the strategy for hard to reach areas are very limited. The government should think about including the suggested recommendations in this paper as it directly comes from the root level of the concerned region. More water options and technologies should be explored and promoted and thus according policy or strategy support is required.

Second, the government of Bangladesh should adopt pocliy for providing emergency water supply during disasters and water logging. During water logging, majority of the sources of fresh water remain unusable leading to massive scaricy of potable water. At the moment government has no special measures to deal with this crisis. Union Parishad, NGOs and government's relief program provide some water purifying tablets and water options during the time of disasters, which however is not adequate. The demand from the local community is to have a special measure for ensuring fresh water supply during for the mass during the time of disaster. This paper recommends that the government should take policy measures for ensuring fresh water supply during the time of humanitarian crisis and meet the demand of the community.

Conclusion

The combined effort of the government, national and international NGOs, research organizations, civil society committees and the effort of the local people are required to ensure easily accessible potable water for every household in the southwest region of Bangladesh.

The government of Bangladesh has done brilliantly to ensure safe drinking cost free water for almost all over Bangladesh claiming that it has covered 84% of the population. But this excellent achievement of the government has not equally benefited every region of the country. Amidst these successes, the southwest region still remains ignored. Here the surface water is saline; ground water is saline and is also arsenic contaminated. People here are travelling miles after miles, wasting hours after hours just in order to collect potable water. People here are also paying for water where as in the rest of rural Bangladesh government has provided it for free.

A lot of organizations along with government bodies are encouraging this unjust business. It's like 2 policies for 1 nation where everyone pays an equal amount of tax and every one is a citizen of Bangladesh. Then why is this injustice prevailing? Not only that, people of this region is poorer than the rest of the country and paying for every drop of water turns out to be a huge burden on them. To make the situation even worse, these people are fighting regularly with deadly cyclones, water logging, flood, tidal surges and many other natural calamities. On top of that climate change induced problems will further aggravate the hardship of the southwest coastal people compared to any other regions of Bangladesh.

Water scarcity persists here mainly because of natural causes and wrong policy implementation. The government promoted shrimp farming and excessive farming has resulted severe salinity. Not only that, but the government also leased out its fresh water reservoirs and ponds in this area to shrimp farmers, destroying fresh water sources. Now the government is saying and taking policies to sell drinking water which is again very unfair for the poor of the area.

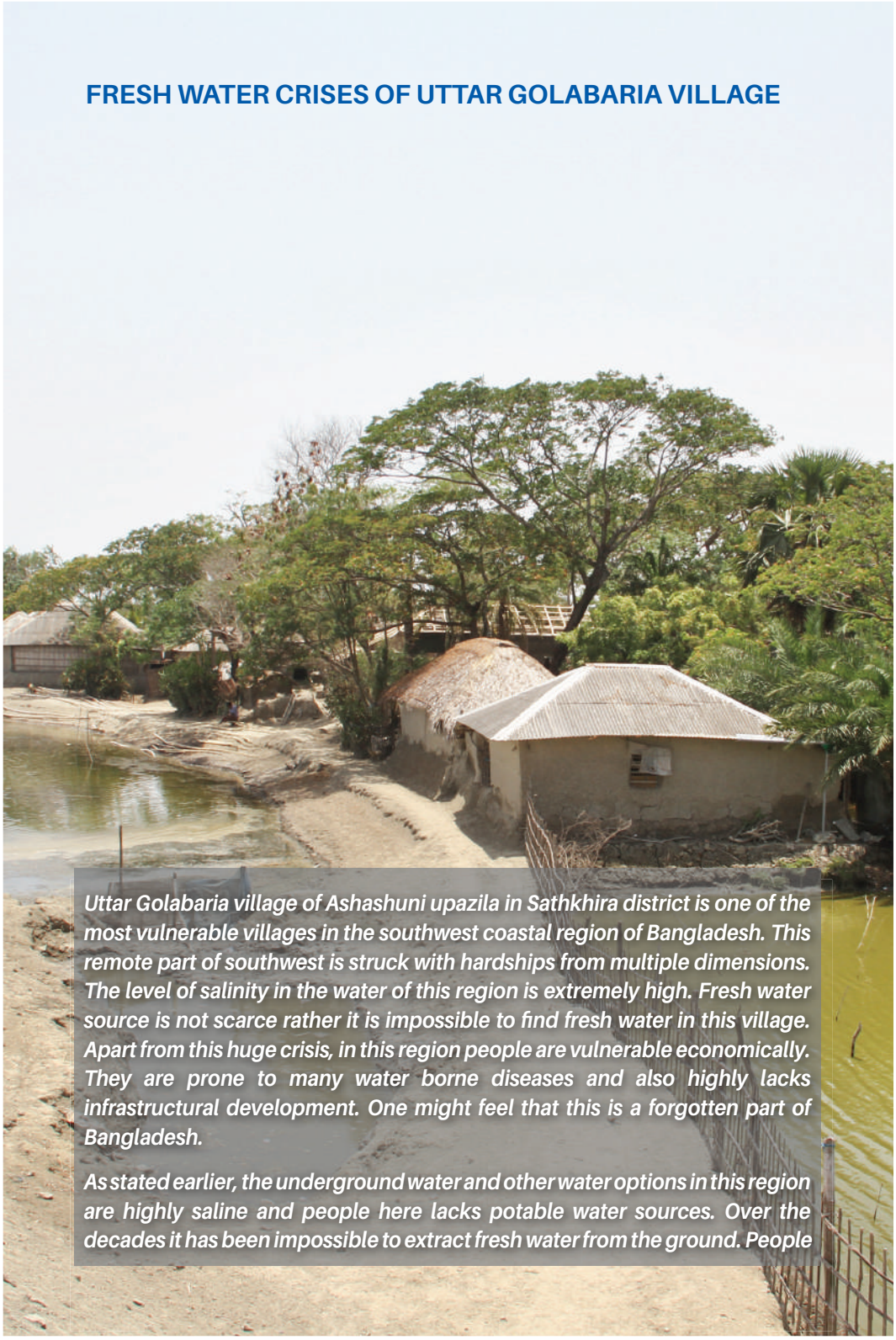
Southwest region is the most vulnerable region of Bangladesh. People here struggle in every aspect of their life. Water scarcity in this region is something which can be easily mitigated. All it requires is a true will of the government. As the people of Bangladesh, is it too much to pray to the government to offer some support to the people of southwest? As the representative of the southwest Bangladesh, we plead to the government to offer us some support so that at least the water scarcity of this region is seriously taken into consideration. The combined effort of the government, national and international NGOs, research organizations, civil society committees and the effort of the local people are required to ensure easily accessible potable water for every household in the southwest region of Bangladesh.

STORIES FROM THE FIELD

THE DAILY STRUGLE OF JAHANARA

Struggling for safe drinking water has been a regular routine of Jahanara's life. Jahanara, a 26 year old woman, mother of two daughters is a resident of Boyarjhapa village of Sholadhana union under Paikgacha upazila of Sathkhira. In her village, there is no source for fresh drinking water. Her life is dependent on water brought from Paikgacha Sadar which is then sold to the villagers. For every liter of water she needs to pay Tk.1. To maintain her family she needs around 30 liters of drinking water per day and spending Tk. 30 everyday behind water is highly an expensive issue for her family. She cannot afford to even think of using clean water for any other purpose, not even for cooking. All the villagers here encounter this same problem. As a result, the villagers are very often affected by water borne diseases. There are few ponds in this village which offers the least saline water from where she collects the water for cooking. But, even the nearest pond is 1 KM away from her home. Since her younger daughter is only 1 year old, she cannot fetch water when her elder daughter is away from home. The elder sister needs to look after her younger sister when their mother is away to collect water.

FRESH WATER CRISES OF UTTAR GOLABARIA VILLAGE



Uttar Golabaria village of Ashashuni upazila in Sathkhira district is one of the most vulnerable villages in the southwest coastal region of Bangladesh. This remote part of southwest is struck with hardships from multiple dimensions. The level of salinity in the water of this region is extremely high. Fresh water source is not scarce rather it is impossible to find fresh water in this village. Apart from this huge crisis, in this region people are vulnerable economically. They are prone to many water borne diseases and also highly lacks infrastructural development. One might feel that this is a forgotten part of Bangladesh.

As stated earlier, the underground water and other water options in this region are highly saline and people here lacks potable water sources. Over the decades it has been impossible to extract fresh water from the ground. People

from this village need to walk around 8 to 12 KMs to collect fresh water from the adjacent villages with fresh water options. Walking miles after miles with water requires extreme physical labor and are the root cause of body aches. The family members responsible for ensuring fresh drinking water spends around 20% of their life span in searching and collecting fresh water. One family member has to dedicate his or her life for collecting water from the family. Mainly the female members are forced to make this sacrifice. There have been many cases where the girls are denied the opportunity of going to school only because she is the lone member of the family who is responsible to collect the fresh water.

There were efforts made to change the situation and many technologies to extract fresh water were introduced in the Uttar Golabaria village but all of them failed, until technological innovation has brought the use of rain water harvester, which the people can use to store the potable rain water. But the major problem with the rain water harvesting system is that the installation cost of this technology is high compared to economic conditions of the villagers. In this village, there were several rain water harvesters installed by the government and NGOs. But none of these were installed in the community level rather these were installed in the household level. In this village, there are around 100 households and only around 25 households have the rain harvesting option installed in their houses, i.e. almost 80% of the population cannot afford to install a rain water harvester on their own. Again, the rain water stored during the rainy seasons is consumed within 5 to 6 months. The rest of the year the people are forced to walk long distances in search of safe water. So the rain water harvesting system is never a complete solution for this region.

In many other regions of the southwest, there are extreme scarcities of fresh water but due to proper infrastructural development, a strong communication network of roads were established and thus these regions were connected to different parts of the southwest. It allowed vans and other vehicles to bring water from various different parts and sell water in these water scarce regions. Where as in Uttar Golabaria village there are no single paved concrete roads. Some of the unpaved mud roads are so narrow that only a two wheeler can move on it. Therefore it becomes impossible for the vans to get to this village. Thus, the

villagers of the Uttar Golabaria are denied of the opportunity of buying fresh potable water. Also this village is prone to getting drowned during the rainy seasons.

Collecting fresh water from different villages requires huge physical labor and consumes huge amount of time. The villagers spend around 4 to 5 hours a day for collecting fresh water. Therefore they cannot afford to think of using fresh water for any household purpose except for drinking. They use the saline contaminated water for every other purpose required for their survival. The use of saline water in their daily life is giving rise to many health issues. The villagers are prone to high blood pressures, strokes, allergies, stomach pain, diarrhea, menstrual problems etc. All these issues are the impact of using saline water in their daily life purposes.

Since the salinity increased, the lands became futile for agricultural products. Also increased salinity hampered the marine life and many fishes cannot be grown in their ponds. The increased level of salinity forced the villagers to be economically crippled. The loss of productivity of their lands forced them to become day laborers.

Many of us cannot even imagine that there can be situations where water will be scarce. They always have the access to bountiful of water supply and waste a lot of it. They can never realize the statement "WATER IS LIFE". But after gaining an in depth knowledge about the Uttar Golabaria village of Sathkhira, people will definitely come to realize that water is the most valuable resource of this earth. From the experience of Golabaria village, we came to know, how the absence of fresh water created all the miseries of life. Now, hopefully we will understand, the supply of fresh water can make life a lot more beautiful.

THE DILEMMA OF SATHI MODOL WATER OR SCHOOL?

Sathi Mondol, a 14 year old girl, is leading a life amidst the struggle over the search of some fresh water. Sathi is a student of class 10 and resident of Uttar Galabaria village of Ashashuni upazila in Sathkhira district. In her village, there is no single source of fresh water except some rain water harvesters. However there the rain water harvesters are installed and used at the household level. There are around only 20 rain water harvesters installed in this village while there are more than 100 households in this village. Like majority of the houses of the village, her house is not equipped with the rain water harvester. All these families collect fresh water from their adjacent village named Halishpur. But for that they need to walk for hours.

Sathi's childhood is ruined because of her responsibility of managing fresh water for her family. During the evening when every other child plays, she has to walk miles after miles to collect fresh water. Her mother usually collects water in the morning time when she is away for school. But after her school is over, it is her

responsibility to collect the water. At times, when her mother gets sick, she was bound to skip school, since she was forced to collect water in the morning during her school timings. The journey from her village to halishpur and back is of almost 3 hours. According to Sathi, carrying a jar full of 20 liters of water and walking few miles is an extremely agonizing task.

Since managing fresh water was so difficult, the residents of Uttar Golabaria usually used the fresh water only for drinking purpose. Life is so harsh for them they had to use the available saline water for all other household purposes. This gave rise to serious health issues. Since the villagers used the saline water for bathing, cooking etc. people here had severe issues of allergies. They quite often suffer from stomach aches and diarrhea. Girls of this village encounter menstrual problems. All this are the effect of using the saline water in their daily life.

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