KAP BASELINE STUDY REPORT

Development and Implementation of Climate Resilient Water Safety Plan in Vulnerable Rural Communities: WHO-WSP Project

Practical Action Bangladesh

January 2017

PRACTICAL ACTION
Technology challenging poverty

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RWHS	Rain Water Harvesting System
SI	Sanitary Inspection
STW	Shallow Tube Well
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WSP	Water Safety Plan

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Government	DPHE, DAE, Weather and meteoroidal department, Health department, Union Parishad, Upazilla Parishad and District Administration
Community	Community dwellers, Religious leaders,

Executive summary

Practical Action, Bangladesh with support of World Health Organization designed and conducted the KAP Baseline Study to find out situation of water safety and effects of climate changes in the flood, saline and drought prone areas of Bangladesh. Information was collected from literature review, secondary sources, FGD, KII, water quality test, sanitary inspection and HH survey. From the study the summary findings are stated as follows:

Climatic and Environmental setting: Around three fourth of the respondent mentioned that the temperature is gradually increasing due to the climate change which creates adverse impacts on excessive rainfall, drought, depletion water table and cold become less. Around 50% respondent replied that the level of ground water depleting in drought prone area. 49% Water technologies are non-functional due to different reasons like lack of repair and maintenance of the systems, seasonal variations. Around 50% respondents replied that water is not available round the year.

Diseases outcome situation: 56.9% respondent replied that most prevalent diseases is diarrhea, followed by skin diseases 33.8% and cold and fever 6.9%. According to Upazila Health Officer, total 963 people were affected by diarrheal diseases last one year and 73 people were affected by diarrheal diseases in 1st week of January 17 where children are the mostly affected in both the cases. According to union information of last one year, Balipara was the highest affected union, followed by Pathorghata Sadar and Sapahar Union. Whereas the union information of 1st week of January 17, Sapahar is the highest affected, then Aliabad and Balipara union.

Technologies, water quality and sanitary inspection: 59% PSFs were in either the medium to very high risk categories, followed by RWHS and SHTW. The possible reasons that PSF and RWHS are not a popular option to the community. AIRP demonstrates good sanitary integrity, with all supplies in the 'low risk' category. The E.coli count in source water is 100% low in Charduani and Patharghata sadar union, 90% low and 10% medium in Aliabad union, 80% low and 20% medium in Balipara union, 70% low, 20% medium and10% high in Pattashi union and 70% low, 10% medium,10% high and 10% very high in Sapahar union. Whereas the E.coli count in storage water is 70% low, 20% medium and 10% high in Charduani and 60% low, 30% medium and 10% high in Patharghata sadar union, 70% low and 30% medium in Aliabad union, 45% low, 20% medium and 35% high in Balipara union, 45% low, 15% medium and 40% high in Pattashi union and 70% low, 10% medium, 10% high and 10% very high. As per the technology, E.coli count is100% low in AIRP, DHTW and RWHS. In SHTW, it is 65% low, 18% medium and 17% high, in RW, it is 34% low, 33% medium and 33% high, in PSF it is 62% low, 12%

medium,13% high and 13% very high, in pond, 63% low, 32% high and 5% very high and in river, 40% low, 40% medium and 20% high. The most contaminated option is SHTW, then Pond and PSF. However, all technologies showed at least some examples of contamination except DHTW, AIRP and RWHS. Regarding Arsenic, highest 71% TW is contaminated in Aliabad union, 22% contaminated in Pattashi union and there is no arsenic contamination in remaining 4 unions. Other parameters like turbidity, pH, Chloride, Chlorine, Iron, Manganese and Nitrate were also found in some source water and to some extent in storage water in all working unions beyond the Bangladesh standard. The project will give attention to improve the situation through the promotion of WSP.

Summary findings of KAP study: Regarding water quality test 30% respondent replied that they have tested water. 43% people are facing problem for collecting safe water and majority of them from distant place. About more than 50% people (Multiple answer) have the knowledge on safe water mean boiled water. **People's perception regarding contamination of water source** is that around 63% respondents answered that surrounding wastes of the water sources and more than 77% respondents replied that the use of insecticides in the surrounding paddy field of water sources are the reason of contamination. **Regarding collection**, around 32% respondents replied that they do not clean pot, 40% people not clean their hand and 41% people not clean the spout of the tube well while collection. **Regarding transportation**, 65% respondents replied that they do not use cover and 20% people use their cloth during water transportation. **Water storage,** 41% respondents replied that they store water without cover and 32% people put their water pot in the place which is not clean. **Water Use,** 23% respondents do not clean pot during consumption, 37% people do not wash hand and 27% people use mug, glass or other small size pot inside the vessel of stored water lifting for consumption.

Considering climate change and environmental impact, a hazard matrix along with their pathways to entry in each technology in each geographical locations is developed that will guide the project to improve the changes by introducing climate resilient WSPs.

The responses from the community and other stakeholders are very positive and encouraging towards the WSP approach. WSPs executing by the caretakers will improve the safety of the drinking water which includes repairs to damaged water facilities, operation and maintenance of the water facilities, reducing sources of contaminants such as latrines and animal pens, wastes, use of pesticides and cleaning of the surroundings of the water supplies

Background

Introduction

The KAP baseline study of Climate Resilient Water Safety Plan aims to understand the impacts of climate variability and extreme weather events on each type of water technologies in each geographical location such as costal, drought and flood prone areas, people's perception regarding the knowledge and practice water safety from source to consumption, climate change and environmental hazard and its effect on water supply and safety, impact on health, Water Quality (bacteriological, chemical and physical) situation at source and household level.

For achieving it objectives, the study conducted both qualitative and quantitative methods for data collection. For the quantitative method, Household (HH) survey and Observation Method was applied. For qualitative data KII and FGD was used. Sanitary risk of the sampled water sources was done by using SI form and tested water quality as well by using field test kits. The study was also utilized secondary data of the respective locations to understand the context and to do the sampling more accurately.

The project has conducted water quality testing in 10% of the surveyed household's water sources 81 like TW-90%, RW-2%, PSF-2%, PWS-3%, DW-2%, SDP-1% in project locations and same10 % of the Household's storage water (Total HH for test- 81) to see the situation of water status, probable sources of contamination and variations of contaminants considering climatic and environmental impacts in different geographical context. The testing will be done by using two modalities includes laboratory testing only for pesticides and field test kits for all other parameters.

WSP project and operational areas

The place of performance of the work under the contract will be in following selected unions where the climate variability and extreme weather events are flood, saline intrusion and drought.

SL	Union	Upazilla	District	HH	Population
1	Pattashi	Zianagar	Pirojpur	8,156	40,779
2	Balipara			7,562	37,810
3	Charduani	Patharghata	Barguna	6,131	30,654
4	Patharghata			7,502	37,512
5	Sapahar	Sapahar	Naogaon	5,440	27,200
6	Aliabad	Sadar	Faridpur	7,906	39,530
			Total	**42,697**	**213,485**

Objective of the survey

The baseline study broadly views to understand what are impacts of climate variability and extreme weather events on each type of water point sources in each of the geographic areas and climatic zones (such as costal and saline, drought and flood prone areas). It also aims to know the measures that communities have been taking to adapt with the impact of climate change.

Specific objectives:

1. To know impacts of climate variability and extreme weather events on water point sources.
2. To know the measures that communities have been taking to adapt with the impact of climate change.
3. To know quality of water through conduction of water quality testing (10% of total surveyed households) both at source (Arsenic, Iron, NO3, Manganese, Chloride, Turbidity, Residual Chlorine and commonly used pesticides) and at HH storage (E.coli and NO3).
4. To contribute through data generation on climatic and environmental hazards matrix for each type of technology in each geographic location.
5. To contribute through data generation on climatic and environmental hazards pathways to entry into water supply system/pint sources.
6. To identify and analyze present control measure and suggest new control measures

Methodology

The project has conducted water quality testing in 10% of the surveyed household's water sources 81 like TW-90%, RW-2%, PSF-2%, PWS-3%, DW-2%, SDP-1% in project locations and same 10 % of the Household's storage water (Total HH for test- 81) to see the situation of water status, probable sources of contamination and variations of contaminants considering climatic and environmental impacts in different geographical context. The testing will be done by using two modalities includes laboratory testing only for pesticides and field test kits for all other parameters.

Methods	Respondent/ Source	Approach	Special focus
HH Survey	Sample HH in the 6 UP	Interviewing Head of the HH	Knowledge level of the respondents
HH Observation	Sample HH in the 6 UP	Physical observation	Practice level of the respondents
Water sources inspection	Sample water sources in the 6 UP	Application of SI format	WSP related risk factors of the water sources
Water Quality Testing	Water at source and storage	Scientific	Water Quality
FGD	Selected respondent (inter-sectional categories)	Group discussion	Knowledge, Practice and Attitude of respondents
KII	Thematic expert and relevant key officials	Individual interview	Practice and Attitude of the respondents

Summary of findings

Literature review (Salinity, flood and drought)

As per the review of the report titled “climate of Bangladesh” published in 20016 where three climatic parameters were considered and analyzed like temperature, rainfall and surface wind in 7 divisions of the country was developed by BMD, humidity report for 28 years (1981-2008) 2014 by BMD and WSP-Climate –Change –V10 by WHO 2014 . Bangladesh is located in the sub-tropical monsoon climate regime. Based on the analysis of pressure, rainfall and temperature, the climate of this country can be described under four seasons which are Winter or Northeast Monsoon (December – February), Summer or Pre-Monsoon (March - May), Southwest Monsoon (June - September) and Autumn or Post-Monsoon (October – November). Project study contexts are coastal, flood and drought and from the review where variability and changes of these parameters during 1981-2010 are calculated and compared with 1971-2000, the major changes in climate and extreme weather events are;

Coastal area (Barisal Division) - Annual maximum temperature increased is 0.5ºC and highest increment of minimum temperature is 0.3ºC. The trend of maximum temperature increasing and minimum temperature decreasing which is 0.113/decade and -0.046/decade respectively. The significant rates of increment per hundred years 3.7°C. The significant trends of minimum temperature per hundred years are decreasing which is 3.8°C. Significant negative deviations of rainfall are found at Barisal (-38%). Which consequences reduced freshwater flows combined with increased sea levels have led to the results being anticipated like increased salinization of surface and ground waters, increased inundation of coastal freshwater wetlands and lowlands, and reduced quality of water supply.

Salinization was expected to increase in coastal belts for two reasons. Firstly, rising sea levels was expected to lead to upcoming of sea water in coastal aquifers, threatening the use of those aquifers for drinking water supplies. Secondly, drought reduces the flow of water to river mouths allowing seawater to intrude further inland. For these situations, desalination is considered to cope with future seawater intrusion events, exacerbated by climate change. These effects have the potential to change risk profiles and increase treatment costs.

Flood prone area (Faridpur region)- Annual maximum temperature increased is 0.5ºC and highest increment of minimum temperature is 0.3ºC. The trend of maximum temperature increasing and minimum temperature decreasing which is 0.138/decade and 0.259/decade respectively. The significant rates of increment per hundred years are 3.6°C. The significant trends of minimum temperatures per hundred years are increasing 2.6°C. Significant negative deviations of rainfall are found at Faridpur (-14%). Issues associated with flooding will become more significant with the anticipated result including increased inflows to and pressure on water storage infrastructure, more intense storms, increased sediment and nutrient concentrations, disrupting drinking water supplies and sanitation systems and cutting off towns.

The effects of climate change on water quality; one of the greatest challenges for water supply systems is floods. Floods drive hazardous pollutants into water sources through erosion and overwhelming wastewater containment systems as well as potentially inundating and overwhelming drinking water treatment systems and their power supplies. There is evidence from records that climate change is already increasing the frequency of extreme wet days and addressing the resultant water quality impacts under these conditions have not been undertaken, it is likely that increased pollutant loads would be found.

Drought prone area (Rajshahi Division)- The amounts of rainfall decreased and highest increment of minimum temperature is 0.3ºC. The trend of maximum temperature increasing and minimum temperature decreasing which is 0.068/decade and -0.008/decade respectively. The significant trends of minimum temperatures per hundred years are decreasing 2.3°C. Significant negative deviations of rainfall are found -14%. These changes in temperature and rainfall are predicted to continue and will result in the increased occurrence of drought with the anticipated results including reduced inflows to water storage, reduced recharge of ground water, increased risk of algal blooms, increased flooding during more intense precipitation events, reduced stream flows in major catchments.

Water quality was negatively influenced by summer droughts with respect to parameters such as water temperatures, algae, major ions and those heavy metals primarily transported in the dissolved phase. Under these circumstances, the chloride concentration would exceed the 200 mg/l threshold (assuming the current chloride load to remain constant) in coastal belts, forcing the drinking water companies to stop the intake of river water for drinking water production. Most significant impact of droughts is the increase in raw water temperature, which will lead to higher temperatures in the distribution network. In addition, water temperature in the distribution network may increase due to external warming, especially in urban areas. Increased water temperatures in the distribution network may lead to increased microbiological activity and increased health risks to consumers. This is particularly important as final chlorination for disinfection purposes is no longer applied on a regular basis.

Humidity -The annual average humidity of 30 meteorological stations of Bangladesh has been studied over the period (1981-2008). Trends, periodicities and frequency distribution of the annual average humidity are found by the standard statistical techniques. The test of normality of the frequency distribution of the annual average humidity is done by the method suggested by Geary (1935, 1936). It is seen that the frequency distribution of most of the stations of Bangladesh follow normal distribution. Positive trends are shown for the data of Rajshahi & Patuakhali, while Dhaka the capital of Bangladesh has negative trend. Humidity (atmospheric moisture) is an important component of environment. Both very low and high relative humidity may cause some physical discomfort mainly indoor diseases as the relative humidity of the air directly affects temperature. Therefore, there is a great relation among humidity, temperature and rainfall that have great influence in the environment.

Wind -During summer season (March to May) heating belt shifts northward due to apparent northward movement of the sun. The summer months experience high temperature and falling of air pressure over the country. Circulation of air begins to set in around these low pressure area results strong gusty, hot, dry winds blowing the day. Thunderstorms are very common during this season over the country. In this season, localized thunderstorms associated with violent winds, torrential downpours and occasionally hail occurs. These are locally known as the 'Kalbaishakhi' are the common weather phenomena.

Bangladesh climate normal 1981 – 2010

Temperature

Table 3.1: Monthly normal maximum temperature (°C) for different observatories of BMD

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Period
Faridpur	24.5	28	32.5	34.4	33.7	32.5	32	31.8	32	32	29	25.9	1981-2010
Rajshahi	24.1	27.9	33.1	36	35.1	33.8	33	32.8	33	32	29	25.8	1981-2010
Patuakhali	25.6	28.7	32.3	33.4	33.4	31.8	31	31.3	32	32	30	26.8	1981-2010

Figure 1: Monthly normal maximum temperature
Bangladesh climate normal 1981 – 2010

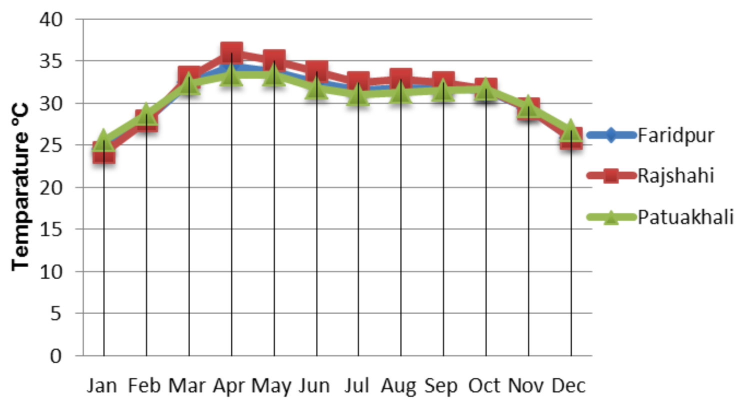


Table 3.2: Monthly normal minimum temperature (°C) for different observatories of BMD

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Period
Faridpur	12.2	15.1	19.7	23.4	24.5	25.8	26	26.2	26	24	19	14.2	1981-2010
Rajshahi	10.6	13.2	17.9	22.8	24.4	25.8	26	26.2	26	23	18	12.6	1981-2010
Patuakhali	13.6	16.7	21.2	24.2	25.4	26.2	26	26.1	26	24	20	15.2	1981-2010

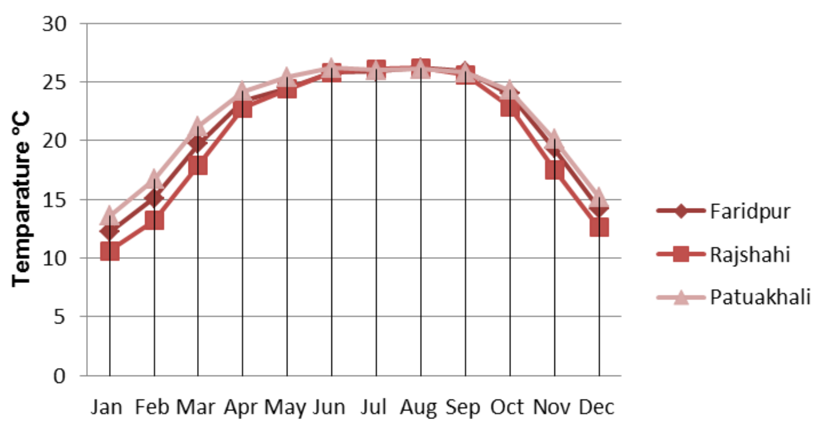


Figure 2: Monthly normal minimum temperature
Bangladesh climate normal 1981 – 2010

Rainfall

Table 3.4: Monthly normal rainfall duration: 1981-2010

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Period
Faridpur	7.2	27.9	49.8	114.5	222	318	328	285	265	155	35	12.1	1981-2010
Rajshahi	8	15.1	23	56.5	137	244	303	241	272	115	13	9.8	1991-2010
Patuakhali	8.8	26.6	42.5	111.3	227	538	579	439	379	218	47	4.3	1991-2010

Figure 3: Monthly normal rainfall duration Bangladesh climate normal 1981 – 2010

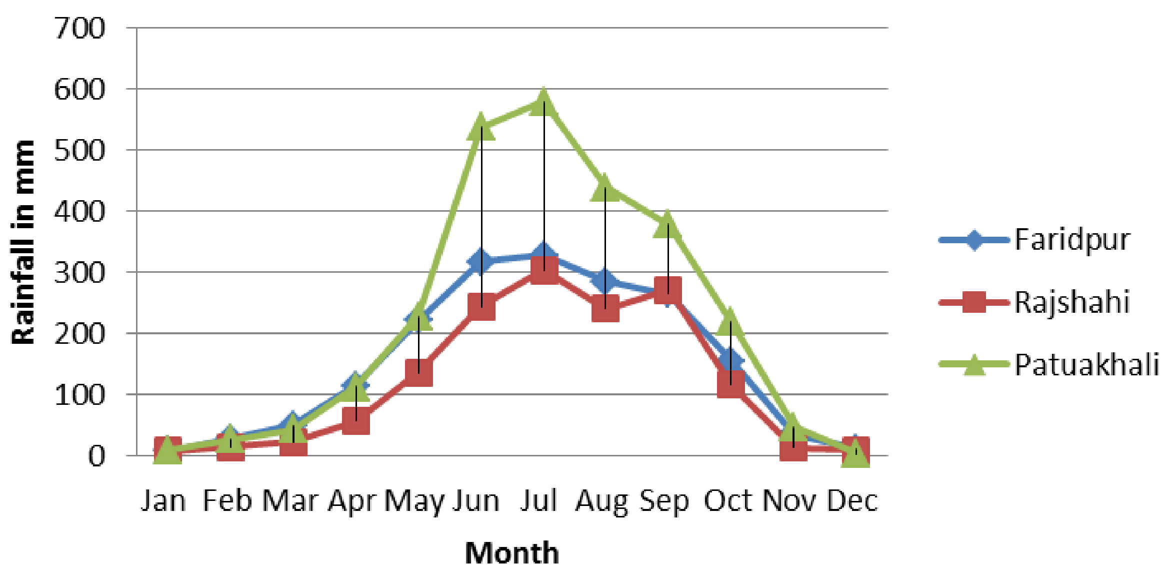


Table 01: Climatic hazards in each geographic location

<table>
<tr><th>Sl.</th><th>Climate Change Impact</th><th>Geographical Location</th><th>Climate change impacts on WSP</th></tr>
<tr><td>1</td><td>More intense Precipitation</td><td>Flood prone</td><td>Reduced short-term water quality. Turbid, due to upstream soil erosion and failure of wastewater containment systems. Pathogens, nutrients, and hazardous chemicals may in principle be more diluted by higher flows. Floods can overwhelm storm water and wastewater containment systems and potentially overwhelm water treatment and distribution systems.</td></tr>
<tr><td>2</td><td>Decreased Precipitation</td><td>Drought prone</td><td>Longer-term poorer water quality. Low flows and reduced water levels tend to increase the concentration of pollutants and nutrients. Pollutant concentrations increase when conditions are drier. So, particular concern for groundwater sources that are already of low quality, where concentrations of arsenic, iron, manganese, chloride and nitrate are often problems. In areas with less freshwater, there will be increased competition for those resources. Further, drought often leads to increased dependence on potentially less safe alternative water sources.</td></tr>
<tr><td>3</td><td>Sea level rise</td><td rowspan="2">Saline prone</td><td>Any saltwater intrusion into drinking water can increase water treatment costs for salt removal, and intrusion into wastewater management infrastructure can create problems for wastewater pollution control systems.</td></tr>
<tr><td>4</td><td>Changed wind speed and direction</td><td>Coastal wave overtopping, Flooding of treatment works with saline water, Raised dam failure risks, disruption of operation of water supply infrastructure</td></tr>
<tr><td>5</td><td>High Temperature</td><td colspan="2">Increased demand, interrupted supplies, alternative less -safe source being used, changes in water temperature in reservoirs and other water bodies that leading to proliferation of bio-hazards (Algae, Pathogens)</td></tr>
</table>

Table 02: Environmental hazards in each geographic location

<table>
<tr><th rowspan="3">Sl</th><th rowspan="3">Type of Hazards</th><th colspan="3">Water quality hazards</th></tr>
<tr><th colspan="3">Geographical location</th></tr>
<tr><th>Flood</th><th>Drought</th><th>Salinity</th></tr>
<tr><td>1</td><td>Microbial</td><td colspan="3">Bacteria, algae, pathogens</td></tr>
<tr><td>2</td><td>Chemical</td><td>As, iron, manganese, Nitrate, pesticides</td><td>As, manganese, Nitrate, pesticides</td><td>As, chloride/salinity, manganese, Nitrate, pesticides</td></tr>
<tr><td>3</td><td>Physical</td><td colspan="3">Turbidity, odor, color</td></tr>
</table>

Pathways and hazard matrix –option and context wise (Salinity, flood and drought)

Pathways to entry of hazards for each type of technology in each geographical location

The pathways and Hazard matrix is prepared on the basis of the findings from the sanitary inspection and water quality testing. Also collected information from related stakeholders like DPHE, Union parishad, agriculture department, weather and meteorological department, community, NGOs through consultation, interview and literature review. The climatic and environmental hazard and ***pathways to Physical, Chemical & Biological hazard matrix for each type of technology in each geographic location are as follows***:

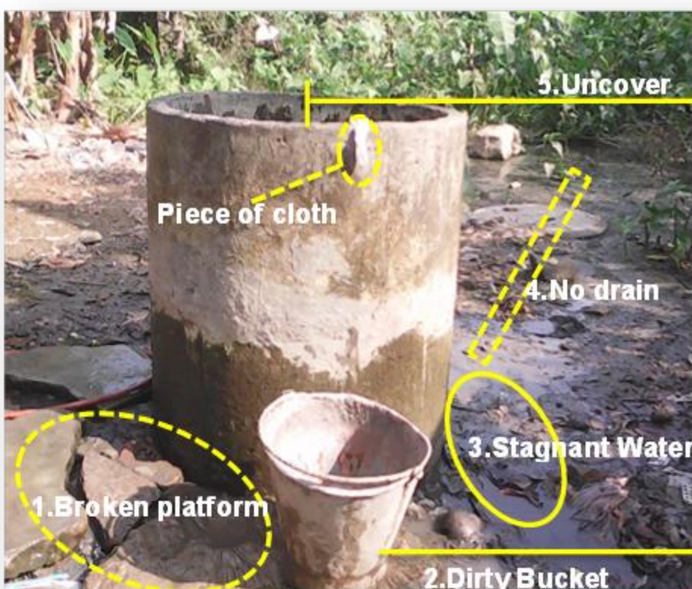
Picture: Source Contamination – Tube well

TABLE: 3 (Tube wells)

Sl.	Type of water source	Type of Pathways	Pathways to entry Physical, Chemical & Biological Hazards		
			Geographical Locations		
			Flood	Drought	Coastal
1	SHTW	Common	Absence of platform, cover on head of the TW, drainage system, leakage of pipe, safe separate distance from toilet, nearby contaminated ditch, agricultural field, sediment release into the water		
		Individual	Below flood level and frequency of flood increasing, longer time water logging		Inundated during high tide and tidal surges/cyclone, saline concentration increasing due to seasonal variation
2	DHTW	Common	Absence of platform, cover on head of the TW, drainage system, leakage of pipe, safe separate distance from toilet, nearby contaminated ditch, agricultural field, sediment release into the water		
		Individual	Below flood level and frequency of flood increasing, longer time water logging	Water depletion increasing and become worse in peak dry season, lack of recharge, less rainfall, over abstraction, increased temperature influence microbial growth and water demand	Inundated during high tide and tidal surges/cyclone, saline concentration increasing due to seasonal variation
3	Deep Set TW	Common	Absence of platform, cover on head of the TW, drainage system, leakage of pipe, safe separate distance from toilet, nearby contaminated ditch, agricultural field, sediment release into the water		
		Individual		Water depletion increasing and become worse in peak dry season, lack of recharge, less rainfall, over abstraction, increased temperature influence microbial growth and water demand	

TABLE: 4 (AIRP & Ring Well/Dug Well)

Sl.	Type of water source	Type of Pathways	Pathways to entry Physical, Chemical & Biological Hazards		
			Geographical Locations		
			Flood	Drought	Coastal
4	**AIRP**	Common	Improper silling of cover, operation and maintenance of filter media, Increase concentration of sediments at source, nearby contaminated ditch, Toilet, agricultural field		
		Individual	Below flood level and frequency of flood increasing	Water depletion increasing and become worse in peak dry season,lack of recharge, less rainfall, over abstraction, increased temperature influence microbial growth and water demand	Inundated during high tide and tidal surges/cyclone, saline concentration increasing due to seasonal variation
5	**Ring Well**	Common	Side leaching and sediment intrusion, no /faulty cover, clogging of filter media and fine sand intrusion due to lack of operation and maintenance, nearby contaminated ditch, Toilet, waste, agricultural field		
		Individual	Below flood level and frequency of flood increasing	Water depletion increasing and become worse in peak dry season, lack of recharge, less rainfall, over abstraction, increased temperature influence microbial growth and water demand	



Picture: Ring well: Source contamination

Picture: Source Contamination - AIRP

TABLE: 5 (PSF, RWHS, HH based filter)

<table>
<tr><th rowspan="3">Sl.</th><th rowspan="3">Type of water source</th><th rowspan="3">Type of Pathways</th><th colspan="3">Pathways to entry Physical, Chemical & Biological Hazards</th></tr>
<tr><th colspan="3">Geographical Locations</th></tr>
<tr><th>Flood</th><th>Drought</th><th>Coastal</th></tr>
<tr><td>6</td><td>PSF</td><td>Individual</td><td></td><td></td><td>Not protected i.e. no fencing, toilt, agricultural land, inundation during high tide and cyclone, drainage connection, bathing, washing, fish cultivation; Pond capacity- less, water depth become low during peak dry season due to lack of re-excavation, become more turbide; Filter material became clog and dry due to lack of operation and maintenance and saline concentration increase in summer, low and no rainfall</td></tr>
<tr><td>7</td><td>RWHS</td><td>Individual</td><td></td><td></td><td>Catchment i.e. not clean, overhanging branch of trees, different materials -asbestos; Improper flushing before storing; Inner side of the reservoir not properly clean; Sunlight passing into the reservoir; Leak between manhole cover and body of reservoir and uneven rainfall cause operation and maintenance problem</td></tr>
<tr><td rowspan="2">8</td><td rowspan="2">HH based filter</td><td>Common</td><td colspan="3">Lack of operation and maintenance of the filter materials, spare parts; sediment release, agricultural interventions</td></tr>
<tr><td>Individual</td><td>Seasonal variation and increasing trend of flood frequency</td><td></td><td>High tide, tidal surges, increasing trend of salinity at water source</td></tr>
</table>

Picture: Source Contamination - PSF

Picture: Source Contamination – RWH

TABLE: 6 (Pond, River, Pipe water supply, HH level stored water)

Sl.	Type of water source	Type of Pathways	Pathways to entry Physical, Chemical & Biological Hazards		
			Geographical Locations		
			Flood	Drought	Coastal
9	**Pipe water Supply (Source-GW)**				
10	**Pond**	Individual			Not protected; Inundated by tidal surges during cyclone; Temperature increase influence microbial growth; more salinity in summer
11	**River**	Individual			Thousands of contaminated sources; Saline concentration become high during peak dry season, low and no rainfall, high tide, tidal surges or cyclone; Temperature increase influence microbial growth
12	**HH level stored water**	Common	Irregular and improper cleaning inside the pitcher or pot; no cover use during transportation; Pitcher/water pot place at wet and swampy place without any cover; temperature increase that leads to Microbial growth and increase demand during summer and improper dosing of chlorination/Alum coagulation		

Picture: Unsafe pond water

Pathways of source contamination

Considering the climate change and environmental impacts mentioned in the above tables (5 & 6), a hazard matrix is given below:

HAZARDS MATRIX

Technology	Location	Location & Technology wise water quality hazards								
		Chloride	As, Mn	Iron	Cl	E.Coli	NO3	pH	Turbidity	Pesticides
STW										
	Costal									
	Flood Prone									
	Drought Prone									
DTW										
	Costal									
	Flood Prone									
	Drought Prone									
RWHS										
	Costal									
	Flood Prone									
	Drought Prone									
PSF										
	Costal									
	Flood Prone									
	Drought Prone									
PSW when source is deep aquifer										
	Costal									
	Flood Prone									
	Drought Prone									
PSW when source is surface water										
	Costal									
	Flood Prone									
	Drought Prone									
AIRP										
	Costal									
	Flood Prone									
	Drought Prone									

HAZARDS MATRIX (continue..)

Technology	Location	Location & Technology wise water quality hazards								
		Chloride	As, Mn	Iron	Cl	E.Coli	NO3	pH	Turbidity	Pesticides
Ring Well										
	Costal									
	Flood Prone									
	Drought Prone									
HH Based Filter										
	Costal									
	Flood Prone									
	Drought Prone									
Pond										
	Costal									
	Flood Prone									
	Drought Prone									
River										
	Costal									
	Flood Prone									
	Drought Prone									

Water quality and Sanitary Integrity (Flood, coastal and drought)

Sanitary Integrity

Sanitary inspections and limited water quality testing were undertaken at all types of water facilities exist in the said geographical locations and 10% of the surveyed household's water sources. Similar percentage water quality test were performed at the household's stored water for consumption. The below classification were used for interpretation and analysis of sanitary inspection (SI) form applied for each type of water facility. There were 9, 10 and 13 questions in the SI forms. On the basis of the surveyed forms, the answer of the questions were fallen into the below risk categories that guided us to take decision about the contamination of the sources.

Sanitary risk categories	Risk score
Low risk	0-3
Medium risk	3-5
High Risk	6-8
Very High risk	9-10

Sanitary inspection survey results revealed that about 59% water options were in either the medium to very high risk categories (Figure 1, 2, 3).

Figure 1: Union wise sanitary risk score for PSF

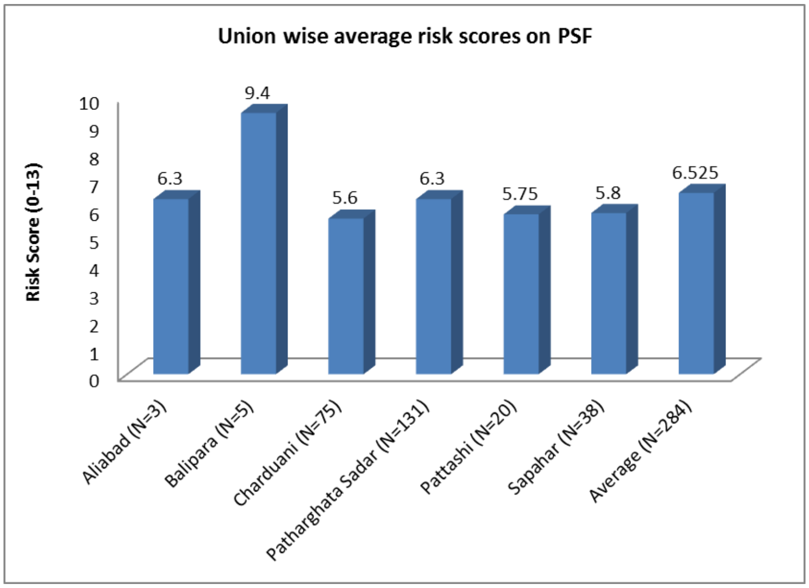


Figure 2: Union wise sanitary risk score for RWH

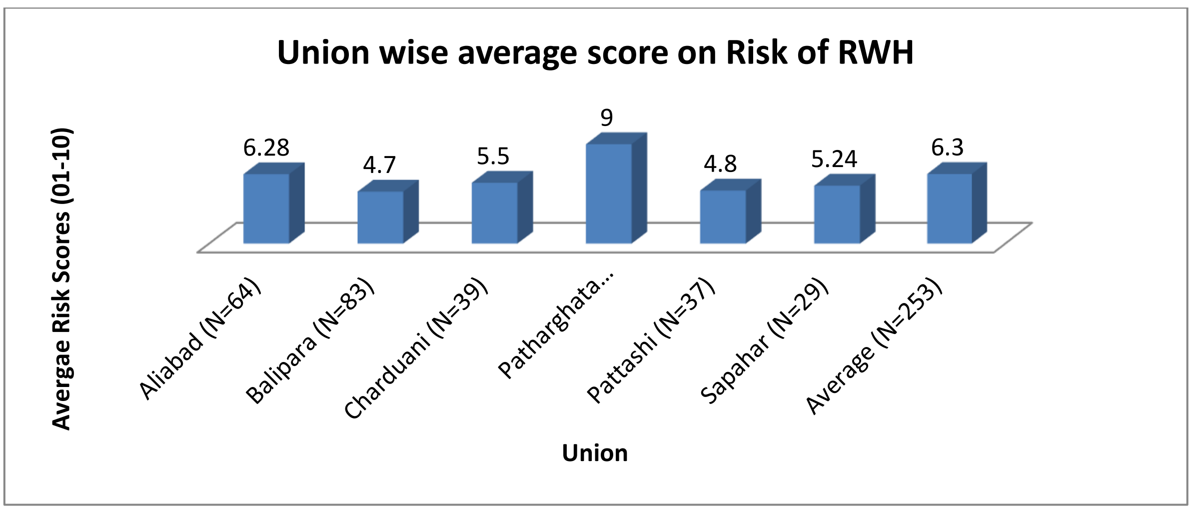
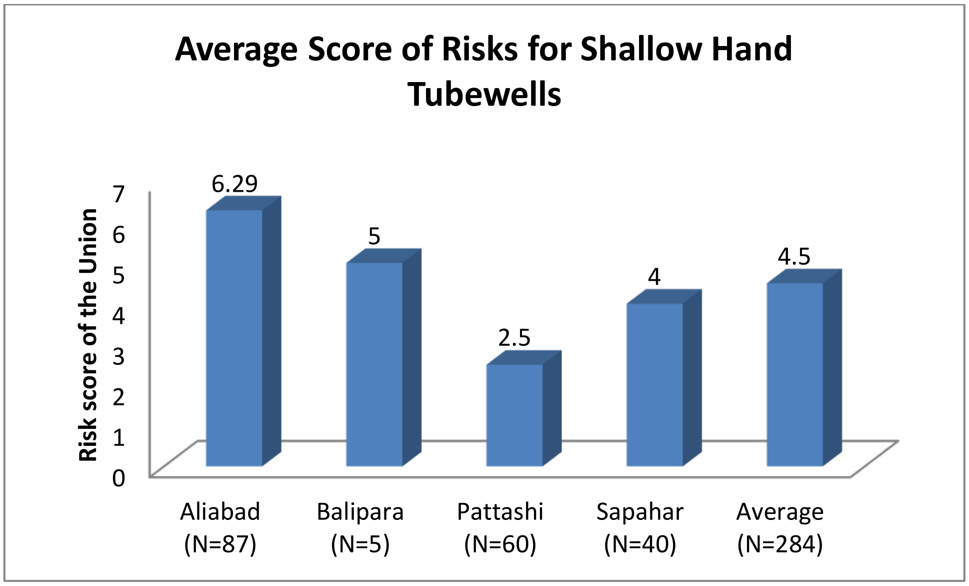


Figure 3: Union wise sanitary risk score for SHTW



During the baseline survey PSF water option had the highest numbers of scores in medium to very high risk, followed by RWHS and SHTW. It was unexpected for the RWHS to be the score with the highest numbers at medium to high risk. The possible reasons for this are identified including PSF were as this was done in the dry season, equally, it may also reflect that PSF and RWHS are not a popular option. AIRP demonstrates good sanitary integrity, with all supplies in the 'low risk' category.

Water Quality Test

Table 7: Area wise sample for water quality test at sources and HH water storage

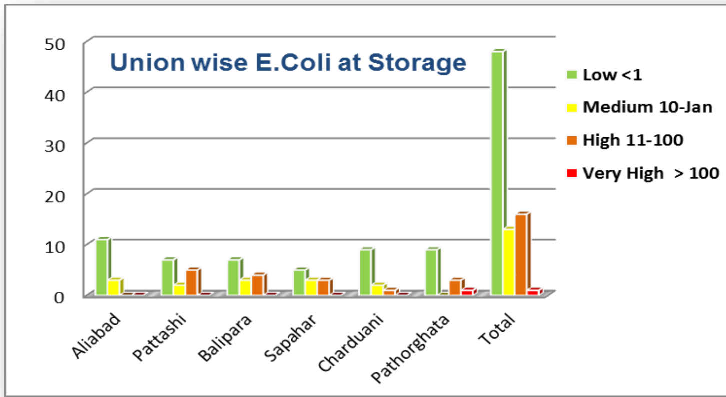
SL	Union	Upazilla	District	HH	Population	Selected sample	Sample at HH water storage	Sample for Water source
1	Pattashi	Zianagar	Pirojpur		40,779	155	16	16
2	Balipara			7,562	37,810	144	14	14
3	Charduani	Patharghata	Barguna	6,131	30,654	116	12	12
4	Patharghata			7,502	37,512	142	14	14
5	Sapahar	Sapahar	Naogaon	5440	27,200	103	11	11
6	Aliabad	Sadar	Faridpur	7,906	39,530	150	15	15
Total				**42,697**	**213,485**	**810**	**82**	**82**

Table 8: Option wise sample distribution

Union	Upazilla	STW/ DHTW	PSF	RWHS	Pipe water Supply	Pond/ River	AIRP/ Ring well	HH based Arsenic filter	Total
Pattashi	Zianagar	7	1	1	-	4	1	2	16
Balipara		8	1	-	-	5	-	-	14
Charduani	Patharghata	1	3	2	1	5	-	-	12
Patharghata		1	2	1	-	10	-	-	14
Sapahar	Sapahar	9	-	-	1	-	1	-	11
Aliabad	Sadar	7	-	-	-	-	7	1	15
Total		**33**	**7**	**4**	**2**	**24**	**9**	**3**	**82**

Microbial

Microbial quality was assessed in 79 water sources and in 78 HH level storage water. The E.coli count in source waters found 89% low, medium 4%, high 6% and very high 1%. Whereas at HH storage water, the E.coli count low 64%, medium 15%, high 19% and very high 1%. The E.coli counted only low both in water source and HH storage water in Charduani and Patharghat Sadar union. The E.coli content highest in Pattashi union, followed by Sapahar and Balipara at water source. The option most likely to be contaminated is the PSF, then ring well and SHTW. However, all technologies showed at least some examples of contamination except DHTW, AIRP and RWHS.



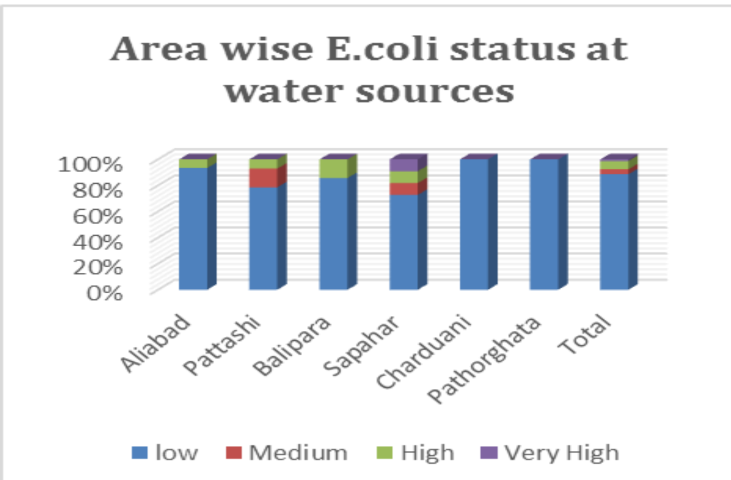


Figure 5.1: Union wise E.coli status

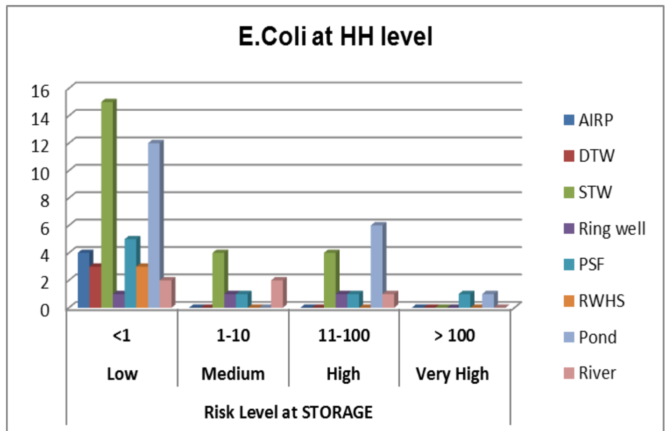


Figure 4: Option wise E.Coli at storage

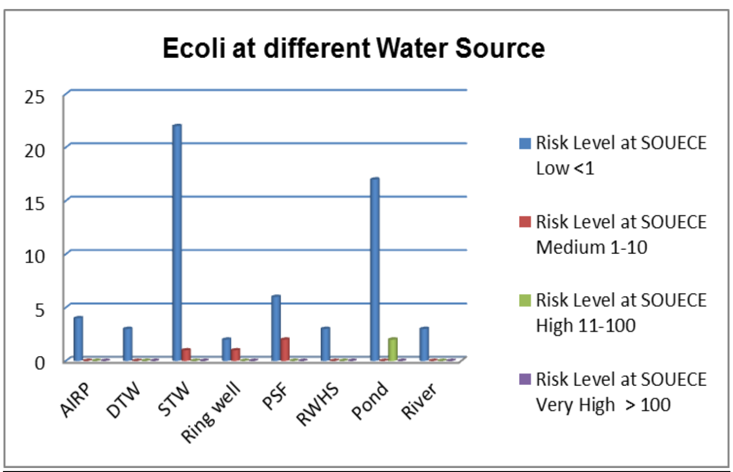


Figure 5: Option wise E.Coli at Source

The reference Table WQ.E below gives the critical water quality definitions and references to E.coli MICS risk categories as cfu/100 ml.

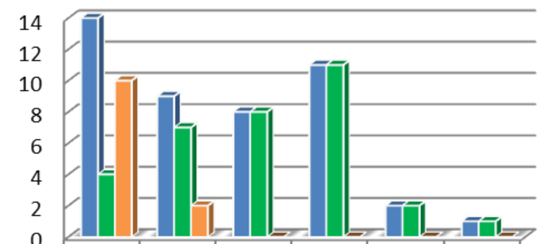
Table 9: Description of E.coli Risk Categories

E.coli (cfu /100ml)	Risk Level	Priority for Action
∠1	Low	None
1 - 10	Medium	Low
10 - 100	High	Higher
> 100	Very High	Urgent

Arsenic (As+)

45 water options were tested where 73% option within the acceptable limit of Bangladesh standard (0-0.05 mg/l). Out of 3 geographical locations, highest arsenic contamination was found in Aliabad union of Faridpur district where 71% TWs are AS contaminated, followed by 22% in Pattashi union of Pirojpur district. TW of remaining 4 unions have no AS contamination.

Figure 6: Union wise Arsnic contamination



	Aliabad	Pattashi	Balipara	Sapahar	Charduani	Pathorghata
Option Tested	14	9	8	11	2	1
SOUECE 0-0.05	4	7	8	11	2	1
SOUECE >.05	10	2	0	0	0	0

Iron (Fe)

44 water options were tested where 68% options were found beyond the acceptable limit of Bangladesh standard (0-1.0 mg/l). Out of 3 geographical locations, highest Iron contamination was found in Pattashi union of Faridpur district where 100% water options were iron contaminated, followed by 79%options in Aliabad and 78% in Balipara union.

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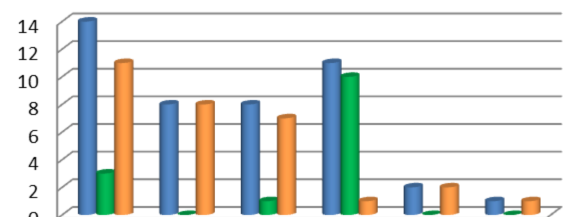
Figure 7: Union wise Iron contamination



	Aliabad	Pattashi	Balipara	Sapahar	Charduani	Pathorghata
Option Tested	14	8	8	11	2	1
SOUECE 0 -1	3	0	1	10	0	0
SOUECE >1	11	8	7	1	2	1

Manganese (Mn)

44 water options were tested where 98% options were found within the acceptable limit of Bangladesh standard (0-1.0 mg/l). Out of 3 geographical locations, highest 7% options were found beyond the limit in Aliabad union of Faridpur district. Remaining 5 unions have no Mn contaminations in water options.

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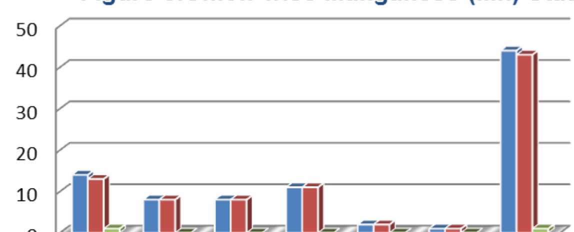
Figure 8:Union wise Manganese (Mn) Status



	Aliabad	Pattashi	Balipara	Sapahar	Charduani	Pathorghata	Total
Option Tested	14	8	8	11	2	1	44
SOUECE 0-0.1	13	8	8	11	2	1	43
SOUECE >.1	1	0	0	0	0	0	1

Chlorine (residual)

79 water options are tested where 99% options were ound within the acceptable limit of Bangladesh standard (0-0.2 mg/l). Out of 6 unions, contamination was found only in Patharghat Sadar union of Barguna district where 7% water options were found beyond the limit.

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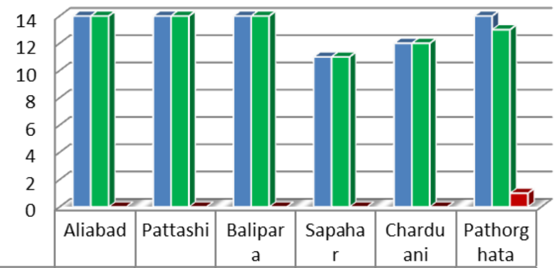
Figure 9: Union wise Chlorine status

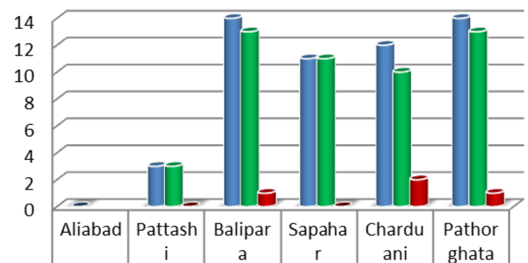


	Aliabad	Pattashi	Balipara	Sapahar	Charduani	Pathorghata
Option Tested	14	14	14	11	12	14
SOUECE 0 -0.2	14	14	14	11	12	13
SOUECE >0.2	0	0	0	0	0	1

Chloride (NaCl)

54 water options were tested where 93% options were found within the acceptable limit of Bangladesh standard (150-600 mg/l). Out of 6 unions, Chloride contamination was found in Charduani and Pathorghata sadar union of Brguna district and Balipara of Pirojpur district where highest contamination was found in Charduani union around 17% options

Figure 10: Union wise chloride status at source

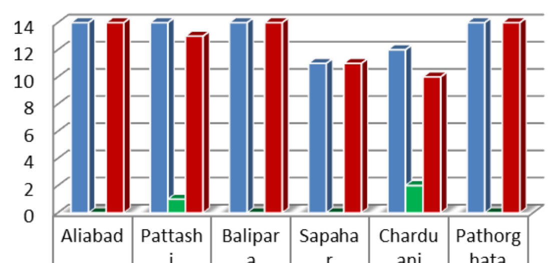


	Aliabad	Pattashi	Balipara	Sapahar	Charduani	Pathorghata
Option Tested	0	3	14	11	12	14
SOUECE 150-600		3	13	11	10	13
SOUECE >600		0	1	0	2	1

pH

79 water options were tested where 100% found within the acceptable limit of Bangladesh standard (6.5-8.5).

Figure 11: Union wise pH status

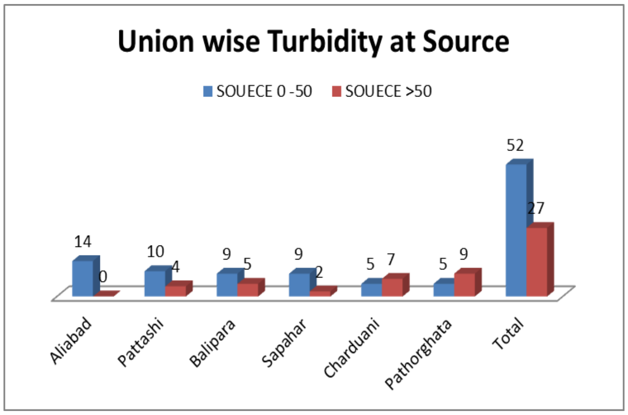


	Aliabad	Pattashi	Balipara	Sapahar	Charduani	Pathorghata
Option Tested	14	14	14	11	12	14
SOUECE 6.5 - 7	0	1	0	0	2	0
SOUECE > 7	14	13	14	11	10	14

Turbidity

79 water options were tested where 66% water options were found within the acceptable limit of Bangladesh standard (0-5 NTU). Out of 3 geographical locations, highest contamination found in Pathorghat Sadar union, followed by Charduani union of Barguna district and according to storage water highest contamination was found in Pattashi in Pirojpur district.

Figure 12 & 13 : Union wise Turbidity in different water source



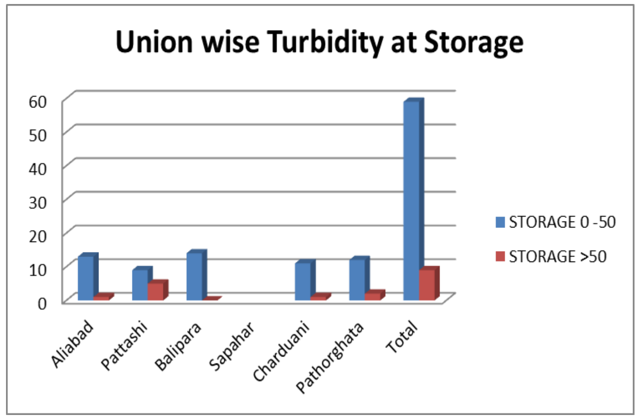
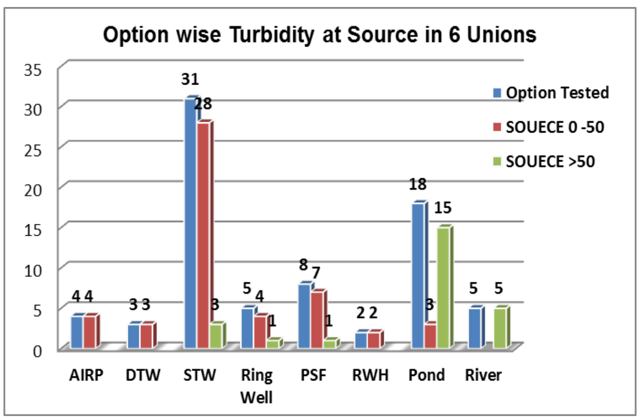
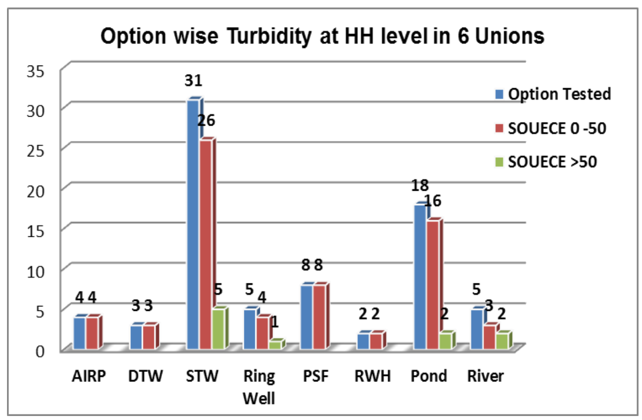


Figure 14 & 15: Option wise Turbidity in 6 Unions

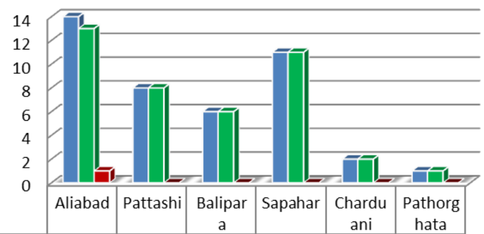




Nitrate (NO3)

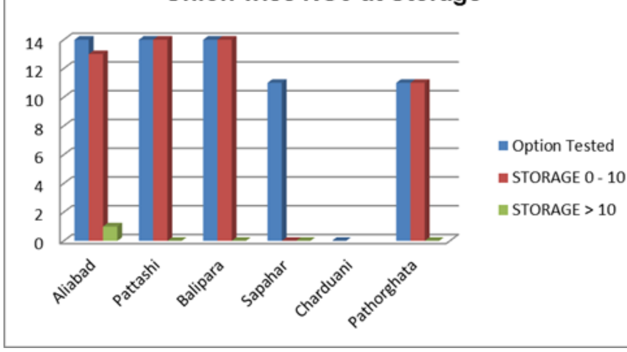
42 water options were tested where 98% options were found within the limit 0-10 of Bangladesh standard. Only 7% NO_3 concentration was found above the limit at source and storage level in Aliabad union of Faridpur

Figure 16: Union wise NO3 status at source



	Aliabad	Pattashi	Balipara	Sapahar	Charduani	Pathorghata
Option Tested	14	8	6	11	2	1
SOUECE 0 - 10	13	8	6	11	2	1
SOUECE > 10	1	0	0	0	0	0

Union wise NO3 at Storage



Pesticides

Test is under processing

KAP findings and Social Factors
Perception (Knowledge, Attitude and Practice)

Water (Sources, collection, transportation, storage and use)

In the safe water value chain, 5 steps from water source to consumption are important to consider by the users or caretakers otherwise in each steps there is a chance of contamination if the WSP tools not properly be followed. From the survey data analysis, it is revealed that 50% respondent have the knowledge about the meaning of safe water like boiled water. The step wise scenario is as follows

Source

Around 63% respondents answered that surrounding wastes of the water sources and more than 77% respondents replied that use of insecticides in the surrounding paddy field of water sources are the reasons of contamination

Collection

10-12 types of water pot are used by the respondents for collection of water from the water sources. Around 39% respondents use jar, followed by 27% use pot and 24% use pitcher. Around 32% respondents do not clean pot, 40% not clean their hand and 41% not clean the spout of the tube well during water collection.

Transportation

65% respondents replied that they do not use cover and 20% use their cloth during water transportation.

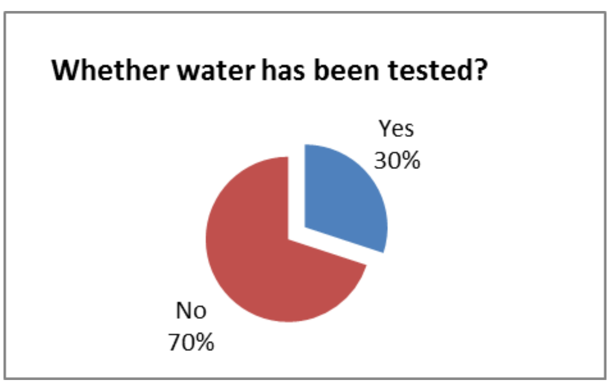
Storage

41% respondents replied that they store pot without cover and 32% put their water pot in the place which is not clean.

Water Use/Consumption

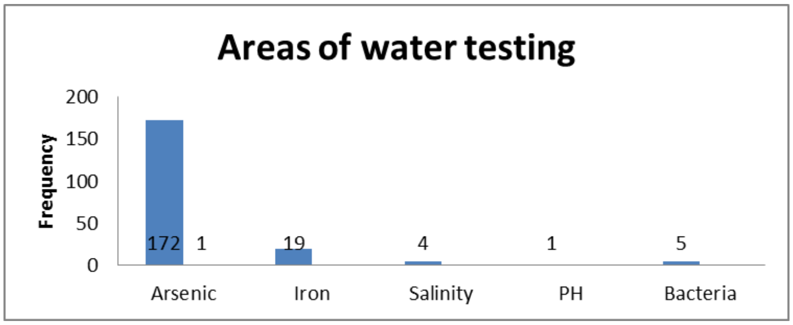
23% respondents replied that they do not clean pot during consumption, 37% not wash hand and 27% use mug, glass or other pot inside the pot of stored water for lifting water for consumption.

Regarding water quality test

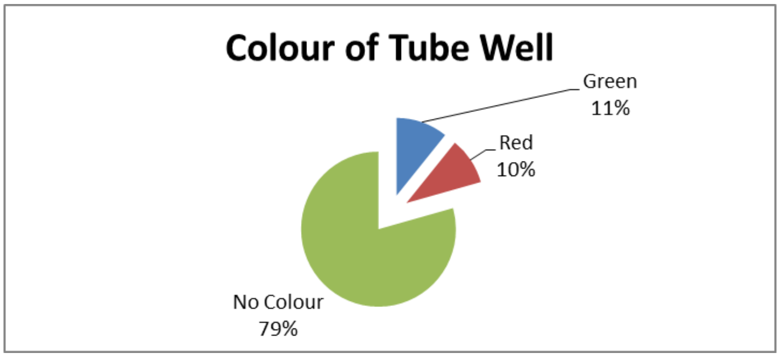


During survey question was asked on water quality test 30% respondent replied that they have tested

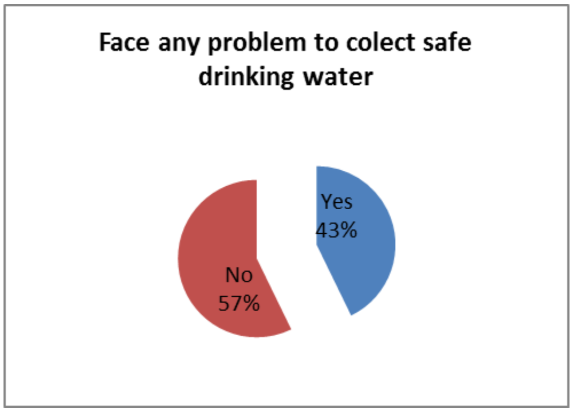
Respondent answered multiple testing like 172 times tested of arsenic of their water sample which is the highest, followed by Iron 19 times and bacteria 5 times.



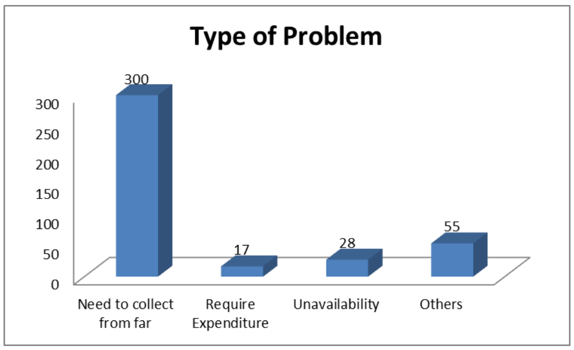
Regarding the marking of tube well, 79% respondent replied that their tube well marked no color, 11% replied marked with green color and 10% replied marked with red color.

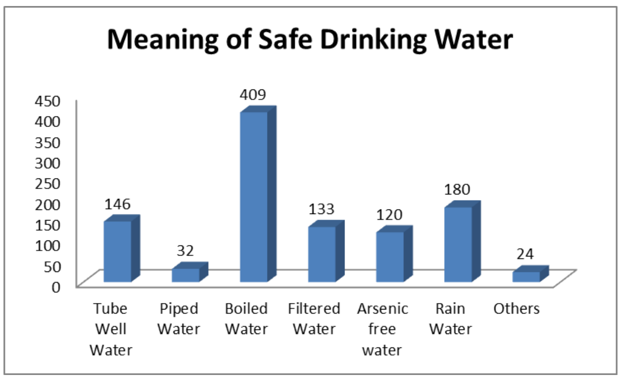


43% responded are facing problem to collect safe water for their drinking purposes



Majority people responded that they need to collect water from distant place, followed by others and unavailability (Multiples answer)

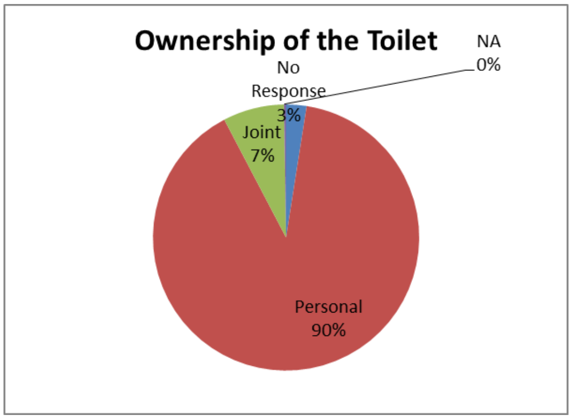




Majority responded replied boiled water is safe water, followed by rain water and tube well water (Multiple answer)

Sanitation

90% respondent have toilet of their own, 7% have shared toilet and 3% had no response during survey.



- **Vulnerabilities - Climate variability and extreme weather events (Flood, Salinity and drought)**

Around 76% respondent mentioned that the temperature is gradually increasing. Due to the climate change, the impacts are mentioned like 27% respondent replied high temperature, 24% mentioned excessive rainfall, 18% mentioned drought,17% mentioned depletion of water table and 11% mentioned cold become less.

75.6% respondent mentioned that color, odor and taste of water change in certain period of the year of which 45% mentioned April to June, 37% mentioned January to March and 18% mentioned July to August. 52% respondent replied that their water points are inundated during flood.

42% respondent opined that their water point become non- functional during pre- monsoon period.

Around 63% respondent replied that the intensity of salinity is gradually increasing both in ground and surface water in coastal areas which is horizontally moving towards inland.

Around 52% respondent replied that the iron smell increasing in ground water in flood prone area.

Around 52.3% respondent replied that the level of ground water depleting in drought prone area.

Around 52.3% respondent replied that the level of ground water depleting (Run down) in drought prone area.

▪ Functionality, accessibility, availability and quality of drinking water facilities

Around 49% water sources are nonfunctional due to different reasons like lack of repair and maintenance of the systems, seasonal variations.

Around 50% respondents replied that water is not available round the year.

Maximum 22% people face water problem 2 months of the year, 17% face 3 months and 9% face 5 months of a year. In January to march 60% people face the water problem and 40% people face problem in April to June

Around 59% respondents mentioned that they have no improved water source (As JMP definition) of which 58% people use Arsenic contaminated water, 14% people use purified pond water and 1.2% people use purchase water to meet their demand.

Table 10: Seasonal functionality, Accessibility and Availability of water points

Sl	Name Unions	Type of Water Point	Total Number of Water Point	% of total water points											
				Dec Jan Feb			Mar Apr May			Jun Jul Aug Sep			Oct Nov		
				Functional	Accessible	Available	Functional	Accessible	Available	Functional	Accessible	Available	Functional	Accessible	Available
1	Aliabd	DTW	3	100	100	100	100	100	100	100	100	100	100	100	100
		STW	141	100	100	100	100	100	100	100	100	100	100	100	100
		Ring well	4	50	50	50	0	0	0	100	100	100	100	100	100
		Pipe water Supply	2	100	100	100	100	100	100	100	100	100	100	100	100
2	Sapahar	Pipe water Supply	39	100	100	100	70	70	70	100	100	100	100	100	100
		STW	5	20	10	10	0	0	0	35	10	10	100	40	40
		Irrigation pump	14	0	0	0	100	100	100	0	0	0	0	0	0
		Ring well	45	45	45	45	0	0	0	100	100	100	100	100	100
3	Balipara	STW	104	100	100	100	47	47	47	100	100	100	100	100	100
		Pond/River	40	100	100	100	100	100	100	100	100	100	100	100	100
		PSF	1	100	100	100	100	100	100	100	100	100	100	100	100
4	Charduani	STW	1	100	100	100	0	0	0	100	100	100	100	100	100
		Water Supply	3	100	100	0	0	100	100	100	100	100	100	100	100
		RWH	19	50	50	0	0	0	0	65	65	100	100	100	100
		Pond/River	66	50	50	50	0	0	0	100	100	100	100	100	100
		PSF	26	25	25	25	0	0	0	25	25	25	25	25	25

NOTE: Based on KAP baseline survey on 813 water option (DTW 24; STW 357; Ring well 48; RWH 24; Water Supply 45; PSF 57 & Pond/River 258)

Sl	Name Unions	Type of Water Point	Total Number of Water Point	% of total water points											
				Dec Jan Feb			Mar Apr May			Jun Jul Aug Sep			Oct Nov		
				Functional	Accessible	Available	Functional	Accessible	Available	Functional	Accessible	Available	Functional	Accessible	Available
5	Pathorghata	STW	16	100	100	100	50	50	50	100	100	100	100	100	100
		Supply	1	100	100	100	50	50	50	100	100	100	100	100	100
		RWH	5	50	50	0	0	0	0	65	65	100	100	100	100
		Pond/River	95	80	80	80	50	50	50	100	100	100	100	100	100
		PSF	24	40	40	40	30	30	30	40	40	40	40	40	40
6	Pottashi	STW	91	100	100	100	92	92	92	100	100	100	100	100	100
		Pond/River	57	100	100	100	100	100	100	100	100	100	100	100	100
		PSF	6	50	50	50	30	30	30	50	50	50	50	50	50

- **Water borne diseases (Generic and during emergency period)**

According to the field survey 56.9% respondent relied that most prevalent diseases is diarrhea, followed by skin diseases 33.8% and cold and fever 6.9%.

22% respondent mentioned that the trend of water borne disease is increasing.

According to Upazila Health Officer Percentage of diarrheal episode is 8-10% in Aliabad and 15-20% in Sapahar Union occurred in last week of December 2016

Diarrheal episode occurred in working unions of Pathorghat and Zianagar Upazillas in 2016 and 1st week of January 17 has been mentioned in the below table (Ref. Upazilla health office)

Table 11: Union wise status of diarrhoeal Episode

Diarrhoea Information							
Upazilla	Union	Affected people in #					
		2016			1st week (Jan 17)		
		M	F	C	M	F	C
Patharghata sadar	Patharghat	56	52	81	1	2	3
	Charduani	44	49	58	0	1	3
Zianagar	Pattashi	35	70	23	1	3	2
	Balipara	55	105	45	3	5	3
Faridpur	Aliabad	31	47	52	4	9	6
Sapahar	Sapahar	47	38	75	8	6	13
Total		**268**	**361**	**334**	**17**	**26**	**30**

Key Findings, Challenges, Future Needs and Conclusion

Key Findings

The KAP baseline survey conducted based on the different indicators including climate change and extreme weather events. The collected information regarding the people's perception on water safety, related diseases, emergency situation and water crisis, hygienic practice of water value chain (Catchment to HH storage), water quality through testing and sanitary risks of the water options will guide the project to develop and implement climate resilient WSP project. The way of facilitating the survey process for information collection and its future implications was well accepted by the communities, LGIs, DPHE, department of health and agriculture. A number of good suggestions were found for WSP.

The microbial water quality varied between the water facilities, with particularly deep tube wells being the best microbial quality, as would be expected.

PSF and Rainwater harvesters showed a less performance and acceptability by the users due to the lack of water availability during dry period, water quality (Aesthetic reasons compare with Tube well water)

Still people are using arsenic contaminated water for their drinking and cooking purposes specially in Aliabad Union where arsenic problem is high and lack of alternative sources.

Residual chlorine was found at HH stored water mostly in Barguna district due to use of pond and river water for drinking and cooking purposes as ground water is saline.

Other parameters like turbidity, pH, Chloride, Manganese, Nitrate were also tested and found in some cases beyond the Bangladesh standard where the project will give attention to improve the situation with time through the promotion of WSP.

The responses from the community and other stakeholders are very positive and encouraging towards the WSP approach. WSPs by caretakers will improve the safety of the drinking water which includes repairs to damaged water facilities, operation and maintenance of the water facilities, reducing sources of contaminants such as latrines and animal pens, wastes, use of pesticides and cleaning of the surroundings of the water supplies. These all point to the accessibility and usefulness of these tools.

It will be important to find the most appropriate ways of transferring these tools and WSP concepts to caretakers and others to ensure effective implementation, monitoring and dissemination.

The existing community groups, health workers, religious leaders, DPHE tube well mechanics and CBOs can play important roles in the implementation of WSP through supervising and cross-checking caretaker's activities.

The sanitation and hygiene campaigns will make the implementation process easier to promote WSPs. It will be important for projects and programmes implementing WSPs to integrate training about WSPs with hygiene promotion, caretaker training and awareness-raising.

Challenges

During conducting survey it was revealed that to improve the situation it is important to undertake some support for the poor people of the community which is limited in this project.

Renovation of water facilities and relocation of hazardous sources/contaminants only through motivation, linking and networking may be challenging.

Maintaining of safe separation distance between latrine and tube well will be difficult in the areas where space constraint is acute.

Within the limited time frame, the project will have to achieve the improvement and changes through the effective implementation of WSP.

Future Needs

Demonstrate some WSP into the community for creating awareness, capacity and skill development.

Undertake effective communication tools for the promotion of WSP

Strengthening of linkage, networking and relationship between community and Govt. line departments to allocate fund for implementing WSP and its mainstreaming.

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(Only water quality test related annexure are attached here and remaining annexure will be provide with the final version)

Union wise water quality test result tables

Parameters: E.Coli

Parameters: E-Coli		Risk Level at SOUECE				Risk Level at STORAGE			
Union	Option Tested	Low	Medium	High	Very High	Low	Medium	High	Very High
		<1	1-10	11-100	> 100	<1	1-10	11-100	> 100
Aliabad	15	14	0	1	0	11	3	0	0
Pattashi	14	11	2	1	0	7	2	5	0
Balipara	14	12	0	2	0	7	3	4	0
Sapahar	11	8	1	1	1	5	3	3	0
Charduani	12	12	0	0	0	9	2	1	0
Pathorghata	13	13	0	0	0	9	0	3	1
Total	**79**	**70**	**3**	**5**	**1**	**48**	**13**	**16**	**1**

Parameters: Turbidity

Parameters: **Turbidity**					
Union	Option Tested	SOUECE		STORAGE	
		0 -50	>50	0 -50	>50
Aliabad	14	14	0	13	1
Pattashi	14	10	4	9	5
Balipara	14	9	5	14	0
Sapahar	11	9	2		
Charduani	12	5	7	11	1
Pathorghata	14	5	9	12	2
Total	**79**	**52**	**27**	**59**	**9**

Parameters: Nitrate

Parameters: **NO3**					
Union	Option Tested	SOUECE		STORAGE	
		0 - 10	> 10	0 - 10	> 10
Aliabad	14	13	1		
Pattashi	8	8	0		
Balipara	6	6	0		
Sapahar	11	11	0		
Charduani	2	2	0		
Pathorghata	1	1	0		
Total	**42**	**41**	**1**	**0**	**0**

Parameters: Manganese

Parameters: **Mn**					
Union	**Option Tested**	**SOUECE**		**STORAGE**	
		0-0.1	>.1	0-0.1	>.1
Aliabad	14	13	1		
Pattashi	8	8	0		
Balipara	8	8	0		
Sapahar	11	11	0		
Charduani	2	2	0		
Pathorghata	1	1	0		
Total	**44**	**43**	**1**	**0**	**0**

Parameters: Iron

Parameters: **Fe**					
Union	**Option Tested**	**SOUECE**		**STORAGE**	
		0 -1	>1	0 -1	>1
Aliabad	14	3	11		
Pattashi	8	0	8		
Balipara	8	1	7		
Sapahar	11	10	1		
Charduani	2	0	2		
Pathorghata	1	0	1		
Total	**44**	**14**	**30**	**0**	**0**

Parameters: Chloride

Parameters: **Chloride**					
Union	**Option Tested**	**SOUECE**		**STORAGE**	
		150-600	>600	150-600	>600
Aliabad	0				
Pattashi	3	3	0		
Balipara	14	13	1		
Sapahar	11	11	0		
Charduani	12	10	2		
Pathorghata	14	13	1		
Total	**54**	**50**	**4**	**0**	**0**

Parameters: pH

Parameter: **pH**					
Union	**Option Tested**	**SOUECE**		**STORAGE**	
		6.5 - 7	> 7	6.5 - 7	> 7
Aliabad	14	0	14		
Pattashi	14	1	13		
Balipara	14	0	14		
Sapahar	11	0	11		
Charduani	12	2	10		
Pathorghata	14	0	14		
Total	**79**	**3**	**76**	**0**	**0**

Parameters: pH

Parameters: **Residual Chlorine**					
Union	**Option Tested**	**SOUECE**		**STORAGE**	
		0 -0.2	>0.2	0 -0.2	>0.2
Aliabad	14	14	0	14	0
Pattashi	14	14	0	14	0
Balipara	14	14	0	14	0
Sapahar	11	11	0	11	0
Charduani	12	12	0	12	0
Pathorghata	14	13	1	13	1
Total	**79**	**78**	**1**	**78**	**1**

Parameters: Arsenic

Parameters: **As+**					
Union	**Option Tested**	**SOUECE**		**STORAGE**	
		0-0.05	>.05	0-0.05	>.05
Aliabad	14	4	10		
Pattashi	8	6	2		
Balipara	8	8	0		
Sapahar	11	11	0		
Charduani	2	2	0		
Pathorghata	1	1	0		
Total	**45**	**33**	**12**	**0**	**0**