CLIMATE RESILIENT WSP DOCUMENT WITH HAZARDS ANALYSIS REPORT

Reporting period: 10 Oct. to 23 Nov. 17

Development and Implementation of Climate Resilient Water Safety Plan in Vulnerable Rural Communities of Coastal Areas

DPHE জনস্বাস্থ্য প্রকৌশল অধিদপ্তর

PRACTICAL ACTION
Technology challenging poverty

World Health Organization
Bangladesh

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EXECUTIVE SUMMARY

The project areas are located in coastal belts which are always susceptible to climatic effects which accelerate the vulnerabilities of safe water facilities and become unsafe. Extreme weather events like cyclone with storm surges and tidal surges contribute to saline intrusion and microbial contamination. Sea level rise also contributes to saline intrusion in ground water. Lack of capacity, awareness and traditional practice of the community make the safe water unsafe. The wide gap between access and drinking water quality (Source to consumption) will cause short and long term detrimental effects on human health.

Considering this climate change impacts on improved water facilities, context **specific comprehensive c**limate resilient **WSP** has been developed and implementing with a view to create more sense among rural community, users, caretakers, mechanics, development practitioners, LGIs, CBOs, UDMC, WatSan committee, water supply staff and others. Hazard types, their sources, risks rating, control measures, monitoring system, supporting programme and plan of improvement, emergency management plan has been considered to develop a climate resilient WSP.

The project locations are 8 unions of 3 upazillas under Pirojpur, Khulna and Cox's Bazar districts that are susceptible to high saline intrusion because of geographical location and climatic effect. People are using water sources for their drinking purposes which are 5 types including SHTW, DHTW, RWHS, PSF and direct pond. Out of these water facilities, SHTW is more dominating in the working unions and then DHTW.

A correlation has been made considering the E.coli test results of the sample water sources and SI risk score collected from observation of the same water sources through which category of risk (Low to very high) has been identified which is guided to develop and implement climate resilient WSP. The report also explains the hazards vs risk rating from low to very high based on likelihood, severity and potential effects of climate change. It led the users, caretakers and other stakeholders to undertake priority action.

Union wise control measures against risk have been prepared including operational monitoring, improvement plan and emergency management plan for each type of water facilities. Also some alternative solutions have been proposed that will guide people to undertake decision before the installation or renovation of water facilities. For example, reverse osmosis, RWHS or PSF are suggested as suitable water option for this context.

Supporting programmes like community mobilization, demonstration of renovation of water facilities, facilitation of training and campaign for climate resilient WSP have been done with a view to build local capacity and skill, create demand and improve the situation of climate resilient WSP. Ensure the engagement and participation of community, in/formal community based organizations, mass people, caretakers, technician, mason, project staff, watsan committee and related public and private staff, development partners to understand climate resilient WSP and influence decision makers for mainstreaming and leveraging resources.

1. Introduction

This report describes the process of hazard analysis, risk prioritization, control measures, improvement plan and operational monitoring, supporting programme and management plan for each geographical location. The focus of attention has been given on the impacts of climate change and environment and seasonal variations like cyclone, tidal surges, storm surges, saline intrusion on water sources. According to WHO guidelines for drinking water quality in 2004, it is recommended that Water Safety Plans (WSPs) should be introduced in all water supplies as a key component of water safety management. With general WSP, the requirement of climate resilient WSP came forward. With the support from WHO and related stakeholders, climate resilient WSP has been developed and implemented to increase the water security and safety by engaging community, DPHE, LGIs, department of health and education, NGOs, private sector and local entrepreneurs.

The analysis has been done based on the findings of water options exits in 8 unions of 3 upazillas under 3 districts. The information's have been collected through consultation, workshop, site visit, interview, sanitary inspection, water quality test, desk work and literature review with main focus on bacteriological, chemical and physical hazards influenced by environmental and climatic parameters.

From the water quality analysis, it is revealed that excessive saline intrusion and microbial contamination in water facilities was found dominating compare to other parameters like Arsenic, nitrate in coastal areas.

The operational monitoring of control measures and improvement plan has been developed digitally and information collection by applying mobile Aps by engaging relevant stakeholders like DPHE, Department of education, health, NGOs, entrepreneurs. This experience provides the sector an understanding on how to conduct the hazardous analysis, develop and implement a climate resilient WSPs including its required modifications and scaling up.

This will also support and guide practitioners, academia, implementers, researchers, private entrepreneurs and policy makers to understand the importance of climate resilient WSPs and the steps required to develop and implement it in different geographical locations. They will also able to interpret the advantages and challenges including the areas of improvement. The technology vs climate specific hazards and risks analysis, control measures, improvement and operational monitoring plan has also been developed in details and reported as Annex (1).

2. Objectives

- To identify and analyse all potential biological, chemical and physical hazards associated with each steps of the water supply system (Source to consumption) in different geographical locations that affect the water security and safety.
- To assess risk and its prioritization with possible control measures (New)
- To develop an improvement and monitoring plan for each type of water facility

3. Methodology

Hazardous analysis, risk analysis and control measures is consisted of site visit, water quality test, sanitary inspection, consultation, desk analysis and literature review. Visual inspection and observations of areas (Cultivable land) surrounding to the drinking water facilities has been done to find out any hazards that may be generated. Hazard identification has also been included assessment of historic information and events.

4. Area Wise Climate Resilient WSP Guidelines with Hazard Analysis

The project has been dealt with common context salinity in three different coastal locations. There are 5 types of water options are being used by the users. Their hazards, risks and impacts are being happened due to the environmental, climatic and extreme weather events. According to baseline study, there are 647 water options of which 65 DHTW; 338 SHTW; 02 Ring well; 22 RWH; 25 PSF & 196 Pond are being used by the 810 sampled HH. Sanitary inspection of the said sources has been done and water quality of around 17% water sample both from sources and HH storage has been tested by using field test kits.

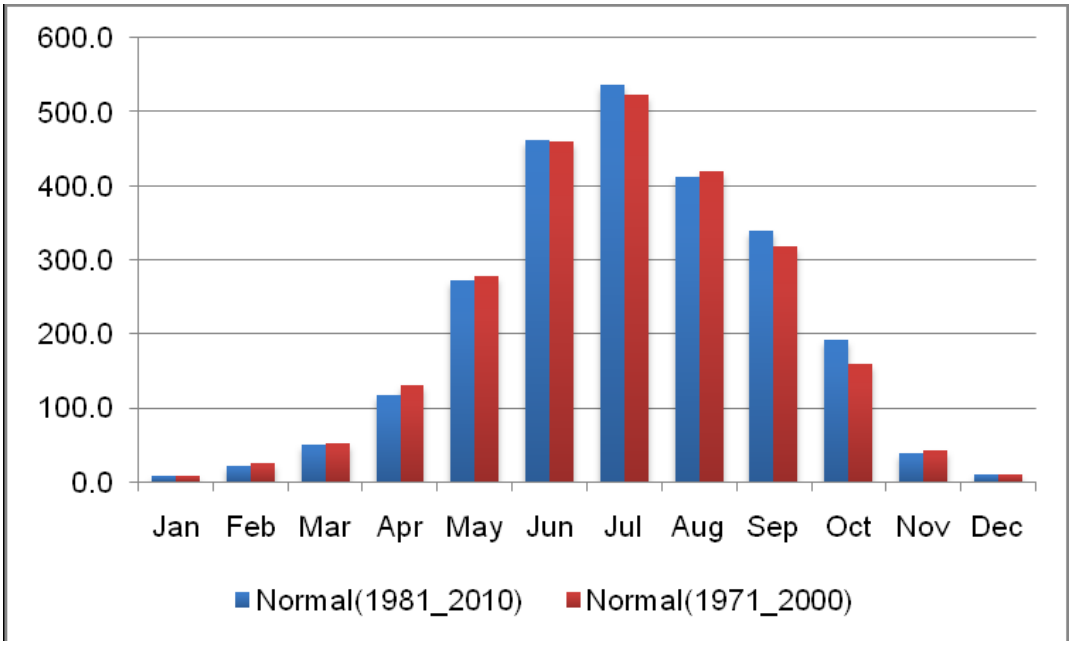
4.1 Coastal Area: Climatic Factors

a) Temperature

Annual maximum temperature increased is 0.5ºC and highest increment of minimum temperature is 0.3ºC. The trend of maximum temperature is increasing and minimum temperature decreasing which is 0.113/decade and -0.046/decade respectively. The significant rates of increment per hundred years are 3.7°C. The minimum and maximum temperature variation per thirty years among the working districts is not significant.

b) Rainfall

Comparison monthly normal rainfall over Bangladesh based on 1981 – 2010 and 1971-2000 respectively, average rainfall is increased highest in July compare to September and October. The rainfall pattern of the remaining months is decreasing.



c) Saline intrusion

The consequences due to the temperature and rainfall variation, 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 predicted 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 **(Ref. KAP baseline survey report).**

Increased saline concentration leads to increase treatment costs for salt removal that make the water source abandoned for using drinking and cooking purposes. Also tidal surge overwhelm saline water, faecal sludge and waste water containment system that influence the saline and pathogenic contamination of the susceptible water sources.

Due to the lack of accessibility and availability of safe water sources, people somewhere are using water direct from pond for their drinking purposes. Out of that, very few people are using water after alum coagulation as treatment in their HH storage.

4.2 Union wise Hazard Analysis: Correlation between SI vs E.coli risk score

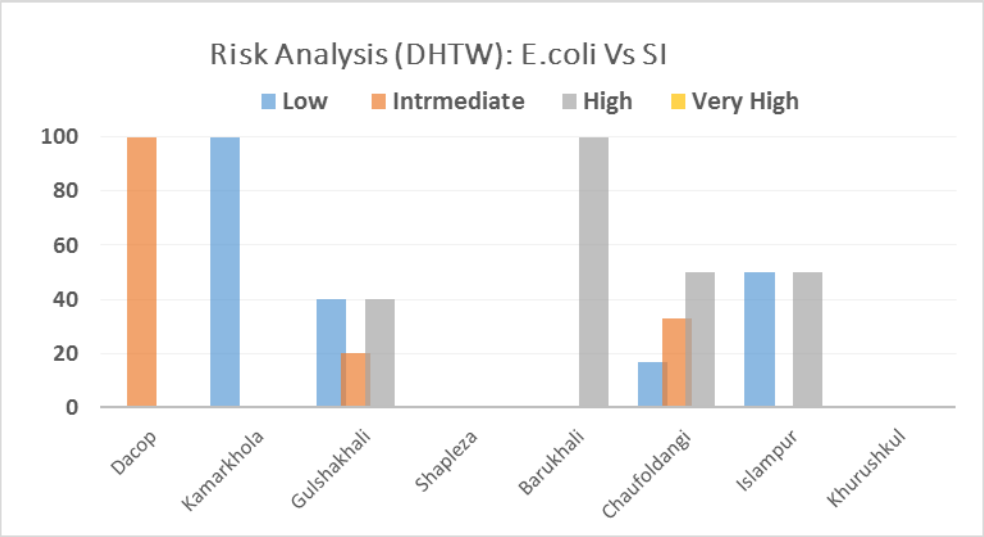
On the basis of the sanitary inspection risk score and E.coli test result, a correlation (Annex-2) was made and shown in the below table. It is revealed that 100% DHTW of Kamarkhola union, Khulna is in low risk and 100% SHTW of Shapleza and Dacop Sadar union are within the intermediate risk category. 100% RWHS of Gulshakhali union, Pirojpur are within the low (67%) to intermediate (33%) risk category. 100% pond in Kamrkhola union, Khulna and 80% pond in Shapleza union, Pirojpur are within the intermediate risk category. 50% PSF of Kamrkhola union, Khulna is within the intermediate risk category. Th details are shown in the below table -1

Table-1: Union wise risk analysis for the available drinking water facilities

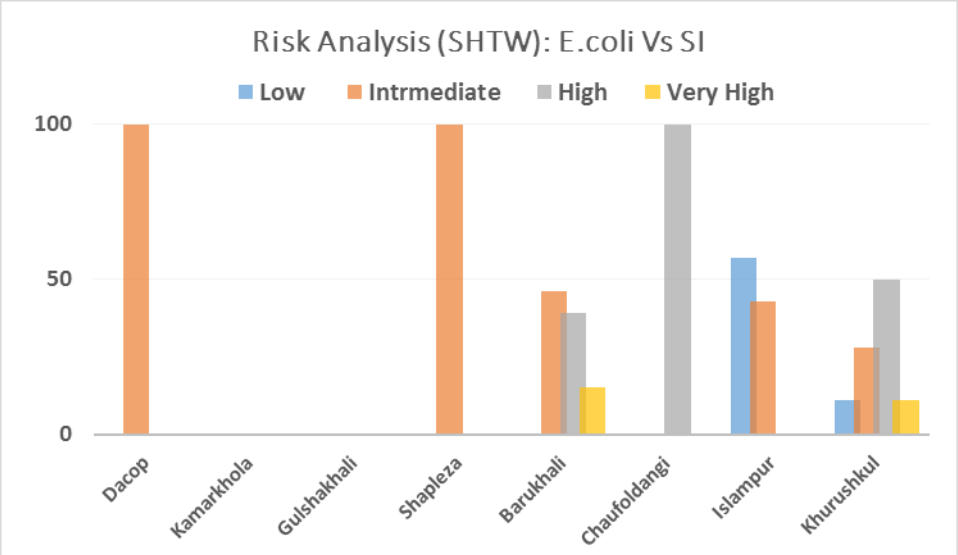
Risk in %	Pirojpur					Khulna						Cox's Bazar						
	Mathbaria					Dacop						Cox's Bazar Sadar						
	Union																	
	Gulshakhali		Shapleza			Dacop Sadar		Kamarkhola				Baruakhali		Chaufaldangi		Islampur		Khuru shkul
	DHTW	RWHS	SHTW	PSF	Pond	SHTW	RWHS	DHTW	RWHS	PSF	Pond	DHTW	SHTW	DHTW	SHTW	DHTW	SHTW	SHTW
Low	40	67	0	0	0	0	0	100	0	0	0	0	0	17	0	50	57	11
Intermediate	20	33	100	17	80	100	33	0	0	50	100	0	46	33	0	0	43	28
High	40	0	0	50	20	0	33	0	50	50	0	100	39	50	100	50	0	50
Very High	0	0	0	33	0	0	34	0	50	0	0	0	15	0	0	0	0	11

4.2 a) Water Option Wise Hazard Analysis: Correlation between SI vs E.coli risk score

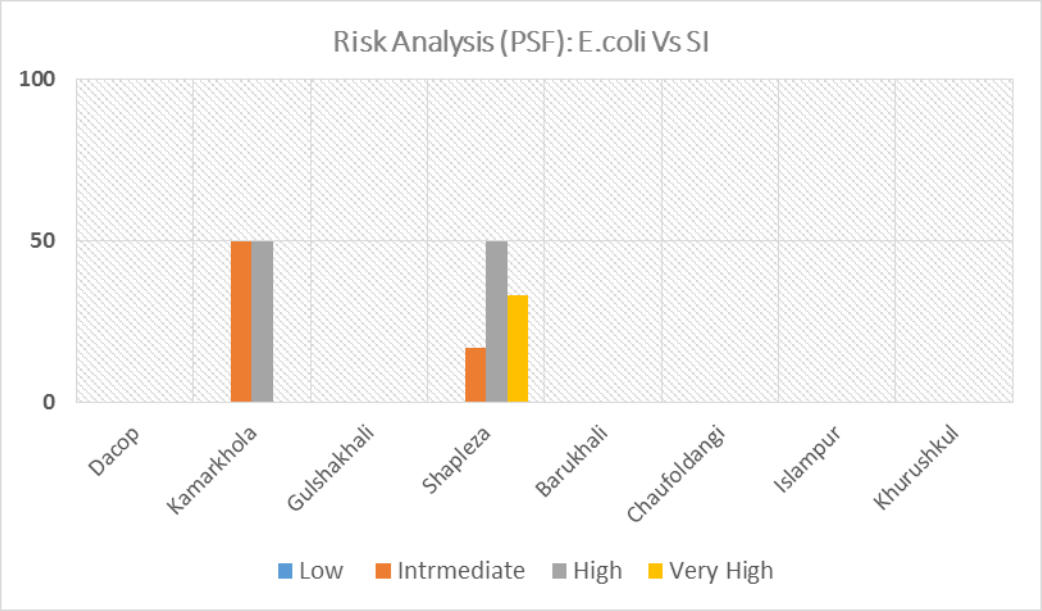
a.1) Risk Analysis: DHTW



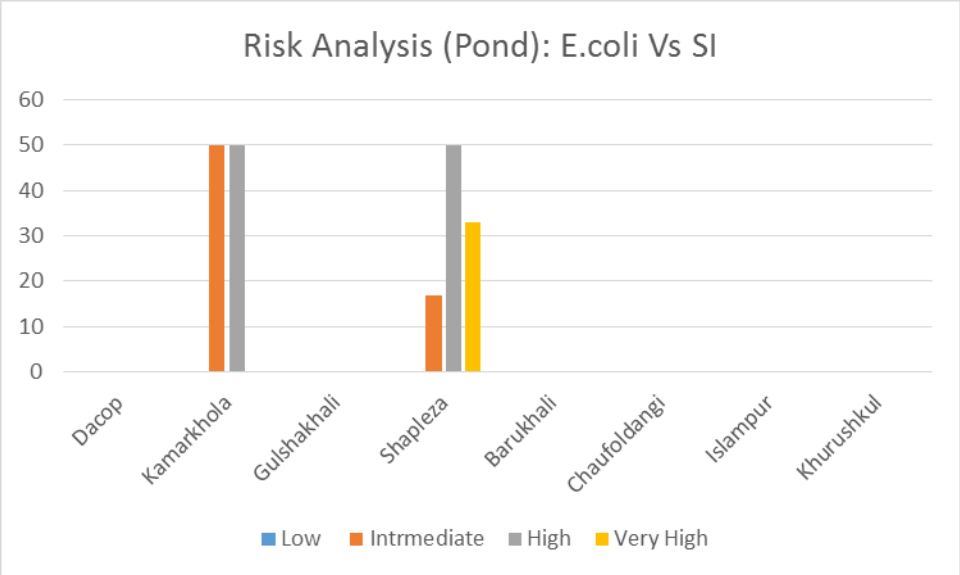
a.2) Risk Analysis: SHTW



a.3) Risk Analysis: PSF



a.4) Risk analysis: Pond



a.5) Risk Analysis: RWHS

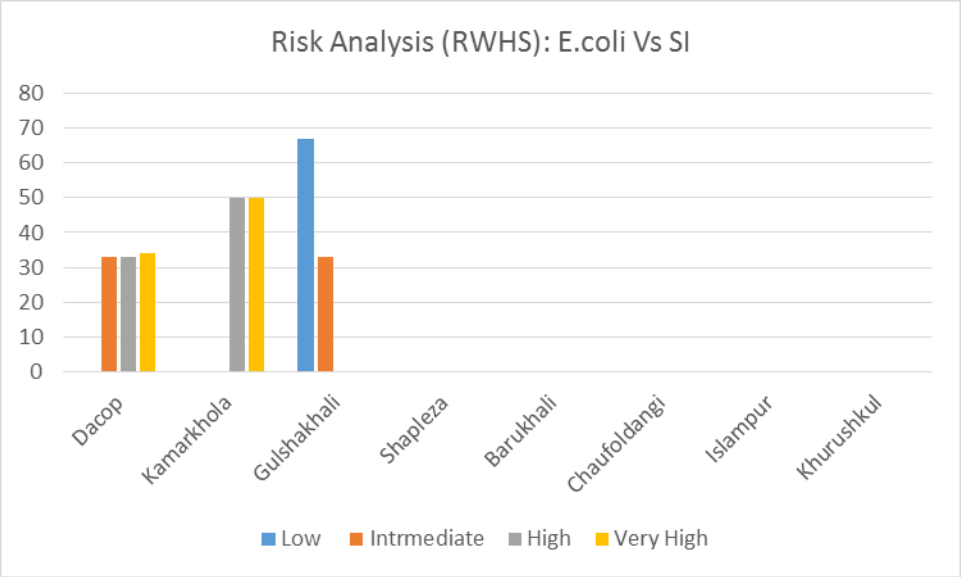


Table 1: Resilience of water technology to climate change: applicability by 2030

Category	Water Supply Technology
Category 1: Potentially resilient to all expected climate changes	Reverse Osmosis Tube wells both SHTW and DHTW
Category 2: Potentially resilient to most of expected climate changes	PSF Small piped water supply Systems
Category 2: Potentially resilient to only restricted number of climate changes	Rain water Harvesting system Solar desalinization plant

4.3 Hazard Analysis and Control Measures

In coastal area, there are 5 types of water sources (Annex-1) are being used by the people which are given in the below table 2.

Table 2: Type of water sources

Sl. No.	Type of water option	Broad category of water source
1	SHTW	Ground water
2	DHTW	
3	PSF	Surface water
4	Pond	
5	RWHS	Rain water

Table 3: Causes behind the contamination of water sources

	A. PSF water		
Steps towards safe water pollution	**Surrounding areas of pond**	1	Presence of cowdung and waste
		2	Presence of pit latrine in nearby or higher place
	Pond	3	Fish culture and connected with agriculture land
		4	Entering flood or waste water
		5	Bathing and washing of cloth
		6	Algal growth due to increase temperature
		7	Increase evaporation rate of water due to increase temperature
	PSF	8	Unlocking cover and entering waste
		9	Dry of filter bed and priming with waste water
		10	Displacing sand from filter bed
		11	Increase pressure on filter media with frequency of cleaning due to increase temperature
	Water Collection	12	Water collection in unclean pot
		13	Touch hand with the mouth of the tube well
	Transportation	14	Pot without cover
	Storage	15	Without cover and touch water by domestic animals
		16	Placing of pot in wet and dirty place
	Use	17	Lifting of water by using dirty Mug
		18	Drinking water by using dirty mug

B. TW water			
Steps towards safe water pollution	Surrounding areas of TW	1	Presence of cowdung and waste `
		2	Presence of pit latrine in nearby or higher place
		3	Presence of Arsenic in underground water
	TW	4	Entrance of waste water into aquifer through faulty platform
		5	Increase salinity and microbial contamination of TW due to inundation during cyclone with storm surges
		6	Standing of waste water close to TW
		7	Priming with waste water
		8	Increase salinity due to sea level rise
	Water Collection	9	Water collection in dirty pot
		10	Touch hand with the mouth of the tube well
	Transportation	11	Pot without cover
	Storage	12	Without cover and touch water by domestic animals
		13	Placing of pot in wet and dirty place
	Use	14	Lifting of water by using dirty Mug
		15	Drinking water by using dirty mug

C. Rain water			
Steps towards safe water pollution	Catchment or roof	1	Bird stool on catchment
		2	Hanging branch, waste, dust on catchment
		3	Toxic materials from air
	Reservoir	4	Entrance of first and filthy rainfall
		5	Unlock cover and entrance of waste
		6	Collect water from reservoir by using dirty pot
		7	Waste water enter into the reservoir through faulty wall of reservoir
		8	Entering waste and insects through inlet and overflow pipe without mosquito net
		9	Scarcity of rain water during dry period due to the erratic rainfall
	Delivery Tap	10	Surrounding of Tap and floor not clean and dry
	Water Collection	11	Water collection in dirty pot
		12	Touch hand with the mouth of the tube well
	Transportation	13	Cover not use
	Storage	14	Cover not use and touch water by domestic animals
		15	Pot place in wet place
	Use	16	Lift water by using dirty Mug
		17	Drink water with dirty mug

In the coastal area, due to the climate change impact (Annex-3) and common practices on the existing water sources, a risk assessment has been done and accordingly control measures/additional control measures, Improvement opportunities and other activities for utilities/communities are explained in the below table 4.

Table 4: Climate Change impact on risk assessment by using semi-quantitative approach and Control Measures

Hazardous event (Source of Hazards)	Hazard Type	Risk (Without Control) L=Likelihood, S = Severity, R = Risk Score	CC Impact	Risk with climate factors L=Likelihood, S = Severity, R = Risk Score	Control /Additional Control Measures	Improvement Opportunities	Other activities for utilities/communities
Increase salinity of ground water source due to sea level rise and seasonal variations	Chemical	**L=2; S = 4 R = 8 (Medium)**	Gradual intrusion of salt for longer period	**L=2; S = 5 R = 10 (High)**	• Mixing safe water with the sources of high chloride content	• Installation of alternative water source i.e. RO, desalinization, rain water harvesting, PSF	• Training on operation and maintenance of alternative water sources to the caretakers or users • Establish a cost recovery mechanism for managing the water supply system
Contamination of ground water and surface water due to Cyclone, high tide, storm surges	Physical, Chemical, Microbial	**L=1; S = 5 R = 5 (Low)**	More frequent cyclone and storm surges	**L=2; S = 5 R = 10 (High)**	• Protection of pond through repairing embankment considering highest peak of the storm surges • Raised TW considering highest peak during cyclone • Introduce individual water purification/disinfection • Chlorination of water	• Cyclone resilient option installation like Rain water, RO, desalinization plant	• Training on cyclone resilient water option and its operation and maintenance for the users and caretakers

Contamination of water sources due to faulty / without platform in TW	Physical, microbial	**L=4; S = 3 R = 12 (High)**	Inundation during high tide causing microbial contamination through faulty platform	**L=3; S = 5 R = 15 (High)**	• Platform exists that has no crack or fault • Installation of platform during construction of TW	• Installation of New Tube well	• Training on quick fault detection and platform installation for the users and caretakers • Awareness raising for improving the situation
Contamination of pond water due to inadequate protection	Physical, microbial	**L=4; S = 3 R = 12 (High)**	Increased temperature causing microbial contamination And Algal growth	**L=4; S = 5 R = 20 (Very High)**	• Re-excavation and bank repair and maintenance considering erosion • Prohibit bathing, washing and fish culture • Chlorination or use of lime in pond water	• Installation of PSF • Use of filter materials	• Training on pond protection, liming and renovation and operation and maintenance of PSF • Awareness raising for improving the situation
Scarcity of rain water in RWHS due to less rainfall during monsoon	Physical	**L=3; S = 3 R = 9 (Medium)**	Gradual decreasing of rainfall causing abandoned the system during dry period	**L=3; S = 4 R = 12 (High)**	• Integration with other safe water sources like PSF • Increase the capacity of the reservoir	• Establish surface water supply system	• Emergency plan for responding during crisis and scarcity of water • Provision of using water purification tablet boiling of water and use of filter while using unimproved water
Contamination of PSF water due to inadequate operation and maintenance	microbial	L=3; S = 3 R = 9 (Medium)	None	L=3; S = 3 R = 9 (Medium)	• Chlorination • Regular washing of filter materials • Pond protection and fencing • Always considering the biological layer on top of the filter media	• Lining of pond using durable materials	• Training on operation and maintenance of the PSF for the users and caretakers • Raise awareness among the people on its use and importance

Contamination of rain water due to improper flushing and cleaning of catchment and reservoir, hanging branch	Physical, microbial	L=3; S = 4 R = 12 (High)	None	L=3; S = 4 R = 12 (High)	• Chlorination • Proper flushing and cleaning of catchment and reservoir • No hanging branch	• Introduce filter materials with inlet or gate valve for regulating water collection	• Training on operation and maintenance of the plant for the users and caretakers • Awareness raising
Waste water enter into the reservoir through faulty wall of reservoir and use of dirty pot inside reservoir for water collection	Physical, microbial	L=3; S = 4 R = 12 (High)	None	L=3; S = 4 R = 12 (High)	• No fault in reservoir and use of clean pot inside it • Chlorination		• Awareness raising • Training on operation and maintenance of the plant for the users and caretakers
Entering waste and insects through inlet and overflow pipe without mosquito net	Physical, microbial	L=3; S = 4 R = 12 (High)	None	L=3; S = 4 R = 12 (High)	• Mosquito net is in place with inlet and overflow pipe		• Awareness raising
Presence of cowdung and waste surrounding of Pond and TW	Microbial	L=4; S = 3 R = 12 (High)	None	L=4; S = 3 R = 12 (High)	• No cowdung and waste surrounding of the water source		• Awareness raising for improving the situation
Presence of pit latrine in nearby or higher place especially for Pond and TW	Microbial	L=5; S = 3 R = 15 (High)	None	L=5; S = 3 R = 15 (High)	• Shifting of latrine • Lining of pit • Chlorination	• Installation of TW and PSF	• Awareness raising for improving the situation • Training on lining and chlorination to the users or caretakers

Presence of Arsenic in underground water i.e. TW	Chemical	L=3; S = 3 R = 9 (Medium)	None	L=3; S = 3 R = 9 (Medium)	• Installation of arsenic removal filter	• Installation of alternative water source like RO, PSF, RWHS	• Training on operation and maintenance of alternative water option and arsenic removal filter to the users and caretakers
Priming with waste water i.e. TW	Microbial	L=3; S = 3 R = 9 (Medium)	None	L=3; S = 3 R = 9 (Medium)	• Priming with safe water • Repair and maintenance of TW like washer • Chlorination		• Awareness raising for improving the situation
Fish culture, bathing and washing of cloth and connected with agriculture land	Physical and microbial	L=5; S = 4 R = 20 (Very high)	None	L=5; S = 4 R = 20 (Very high)	• Pond is fully protected from fish culture, domestic works and agriculture land	• Installation of alternative water source like RO, PSF, RWHS	• Awareness raising • Training on operation and maintenance of alternative water option to the users and caretakers
Unlocking cover and entering waste i.e. PSF, RWHS	Physical	L=4; S = 2 R = 8 (Medium)	None	L=4; S = 2 R = 8 (Medium)	• Cover always will be in place		• Awareness raising
Dry of filter bed and displacing sand from filter bed i.e. PSF	Physical and microbial	L=4; S = 3 R = 12 (High)	None	L=4; S = 3 R = 12 (High)	• Always maintain water head in the filter bed and filter materials • Chlorination		• Awareness raising • Training on operation and maintenance
Un improved hygiene Practice from collection to use	Physical and microbial	L=5; S = 3 R = 15 (High)	None	L=4; S = 3 R = 12 (High)	• Cleaning of pot with safe water during collection • Use cover during transportation and storage • Storage reservoir and place will be neat and clean, dry and elevated place	• Chlorination • Change of collection and storage pot or reservoir	• Orientation on hygienic practice for the users • Awareness raising

Table 5: Control measures, operational monitoring and corrective action for water sources (General)

Control measure	Operational limit	Monitoring					
		What	How	When	Where	Who	Corrective Action
Mixing safe water with the sources of high chloride content like TW	Drinking water standard for chloride in Bangladesh 150-600 mg/L	Chloride content	Field test	Quarterly	TW	Caretaker, community	Control of Chloride by meeting with caretaker, community, neighbors, owner
Protection of pond through repairing embankment considering highest peak of the storm surges, re-excavation of pond	Safe height of the pond i.e. 5-6ft height from land	Embankment height	Physically	Yearly	Catchment area	Caretaker, community	Repairing of embankment and re-excavation of pond by meeting with caretaker, community, neighbors, owner
Prohibit bathing, washing and fish culture	Protected pond i.e. no fish culture and domestic works	bathing, washing and fish culture	Physically	Monthly	Pond	Caretaker, community	Protection of pond by meeting with caretaker, community, neighbors, owner
Introduce individual water purification/ Chlorination of water	Residual Chlorine 0.2 mg/L	Residual Chlorine	Field test	Monthly	Water source like pond, PSF,TW, RWHS	Caretaker, community	Chlorination of water by meeting with caretaker, community, neighbors, owner
Integration with other safe water sources like PSF	Design period of the RWHS	RWHS	Physically	Six monthly	RWHS	Caretaker, community	Integration of PSF by meeting with caretaker, community, neighbors, owner
Increase the capacity of the reservoir of RWHS	Design period of the RWHS	RWHS	Physically	Six monthly	RWHS	Caretaker, community	Increase capacity of RWHS by meeting with caretaker, community, neighbors, owner
Regular washing/maintenance of filter materials like PSF	Standard of filter materials	Filter materials	Physically	Monthly	PSF and other filters	Caretaker, community	Maintenance of filter materials by meeting with caretaker, community, neighbors, owner
Proper flushing	Before entering into the reservoir during rainfall	Flushing system	Physically	During rain	RWHS	Caretaker, community	Proper Operation of Flushing system by meeting with caretaker, community, owner

Control measure	Operational limit	Monitoring					
		What	How	When	Where	Who	Corrective Action
cleaning of catchment and reservoir for RWHS	Before starting and ending of rainy season	Roof top and Reservoir	Physically	During rainy season	Catchment and reservoir	Caretaker, community	Proper Operation and maintenance of catchment and reservoir by meeting with caretaker, community, owner
No fault in reservoir and use clean pot inside it	No fault and clean pot	Reservoir	Physically	Monthly	RWHS	Caretaker, community	Proper Operation and maintenance of reservoir and use of clean pot by meeting with caretaker, community, owner
No hanging branch on top of the catchment like RWHS	No hanging branch	Hanging branch	Physically	During rainy season	Catchment	Caretaker, community	Cutting of hanging branch by meeting with caretaker, community, neighbor, owner
Mosquito net is in place with inlet and overflow pipe	Clean Mosquito net	Mosquito net	Physically	Quarterly	inlet and overflow pipe	Caretaker, community	Use of mosquito net by meeting with caretaker, community, owner
No cowdung and waste surrounding of the water source	Surrounding clean	cowdung and waste	Physically	Monthly	Water source	Caretaker, community	Cleaning of cowdung and waste form the surrounding of water source by meeting with caretaker, community, owner
Shifting of toilet or transformation of toilet	Safe separation distance more than 10 meters	Toilet	Physically	Monthly	Catchment area	Caretaker, community	Shifting or transformation of toilet by meeting with caretaker, community, neighbors, owner and sanitation worker
Use of arsenic removal filter/treatment plant or use alternative water source	0.05 mg/Lt.	Arsenic	Field test	Six monthly	TW	Caretaker, community	Control of arsenic by meeting with caretaker, community and neighbors
Priming with safe water	Safe water	Priming	Physically	Monthly	TW	Caretaker, community	Priming with safe water by meeting with caretaker, community and neighbors
Repair and maintenance of TW like washer	Washer is in function	Washer	Physically	Quarterly	TW	Caretaker, community	Repair and maintenance of washer by meeting with caretaker, community and neighbors
Cover always will be in place	Cover is in place	Man hole cover	Physically	Quarterly	TW	Caretaker, community	Maintenance of cover by meeting with caretaker, community and neighbors
Always maintain water head in the filter bed and filter materials	We filter bed and clean filter materials	Filter bed and materials	Physically	Monthly	PSF	Caretaker, community	Maintenance of filter bed and materials by meeting with caretaker, community and neighbors

Control measure	Operational limit	Monitoring					
		What	How	When	Where	Who	Corrective Action
Cleaning of pot with safe water during collection	Clean pot	Water collection pot	Physically	Weekly	Water collection pot	User, Community	Maintenance of collection pot by meeting with user, community and neighbors
Use cover during transportation and storage	Cover with pot	Cover	Physically	Daily	Water pot during transportation and storage	User, Community	Maintenance of cover by meeting with user, community and neighbors
Storage reservoir and place will be neat and clean, dry and elevated place	Neat and clean, dry and elevated place	Storage reservoir	Physically	weekly	Storage reservoir	User, Community	Maintenance of storage reservoir by meeting with user, community and neighbors
Control of saline intrusion during high tide, cyclone by making raised TW	Highest peak of tide, cyclone	Chloride	Field test	Yearly	TW	Caretaker, community	Repair and maintenance of TW considering cyclone by meeting with caretaker, community and neighbors, owner
Platform exists that has no crack or fault and installation of platform during construction of TW	5ft 6in platform with drain	Platform and drain	Physically	Monthly	Platform	Caretaker, community	Trouble shooting by meeting with caretaker, community, owner, neighbors and tube well mechanics

Table 6: Supporting programme or improvement plan for social mobilization and awareness raising among community on climate resilient WSP

Improvement/Supporting programme	Who	When	Remarks
Courtyard meeting	Community, community based organization (CBO), Watsan committee, health department, Project staff	During and post project	
Cable TV network	LGIs, project staff, Watsan committee, student council, SMC, DPHE, UDMC	During and post project	
Day observation	Community, LGIs, Govt. department, CBO, project staff, student council, SMC, DPHE	During and post project	
Bill board	Project staff, supporters	During project	
Folk song	Community, CBO, project staff	During project	
IEC and BCC materials	Project staff, supporters, DPHE	During project	
Demonstration for renovation, installation of water facilities like TW, PSF, RWHS, RO, desalinization plant	Project technical staff, caretakers, DPHE, watsan committee, community, CBO, UDMC	During project and post project	
Training on installation, renovation and operation and maintenance of water facilities like TW, PSF, RWHS, RO	Project technical staff, caretakers, DPHE, watsan committee, community, CBO, UDMC	During project and post project	
School session	Project staff, student council, SMC, UDMC	During and post project	
Session with religious institution like mosque, temple etc.	Project staff, Imam/religious leader	During and post project	

5. Supporting Programmes

Supporting programmes provide a valuable opportunity to build institutional and individual capacity of users, caretakers, water supply venders, and other stakeholders to manage risks associated with water scarcity and reliability (in addition to water quality risks) that influence by the climate change effects including flood, drought and saline intrusion. These programmes are used to bring together stakeholders from different disciplines to support to managing water resources, for more resilient water supplies. Training, community mobilization, orientation, inception, communication materials development, liaison and networking has been done under this programme and gradually mentioned in the below sub sections:

5.1 List and Type of communication and awareness materials

The project was introduced below communication and awareness raising materials mostly in pictorial forms which are easy to understand by the rural community people regarding the type of hazards and its impact on water quality and public health and how to cope and make climate resilient water safety plan (WSP). The materials were customized by fitting with the local context and under process of reprinting for the targeted beneficiaries and stakeholders.

The target beneficiary communities were organized and shared the matrix of both climatic and environmental hazards in pictorial forms including seasons, intensity, impacts.

List and type of materials:

- Bill board for wider dissemination of the WSP related information
- WSP manual on operation and maintenance for the caretakers to improve their skill and guide them as and when need
- WSP manual for the project staff for their training and improve understanding
- Scrolling message on WSP for Local Cable TV network

5.2 Description of community mobilization interventions

Awareness campaign

The project organized awareness campaign for WSP to mobilize community people to take necessary measures against hazardous condition from point water sources to water consumption at HH level during disaster and normal period. A Significant number of people around 9476 (Table 7) attended in these activities including day observance, courtyard meetings, folk songs, bill board, consultation, group discussion and drama which covered gender, age, occupation, institution, location, and economic class. The campaign programmes have been facilitated by trained field mobilizer with coaching and mentoring support of zonal staff of the project. They delivered the sessions addressing water quality issues, steps of water safety plan (source to consumption), effects of climate/disaster and mitigation measures, responsibilities of community people and the different institutions.

Table 7: Beneficiaries were reached by awareness campaign

Sl. No.	Activities	Quantitative Progress			Beneficiaries		
		Target	Achievements	Remaining Target	Total Beneficiaries	Male	Female
1	Observe Sanitation Month (Rally, miking, Discussion, School Hand washing)	8	8	0	3200	1370	1830
2	Courtyard meeting	144	144	0	2880	860	2020
3	School session	NA	64	NA	3396	1527	1869
4	Cable TV network for WSP message dissemination	NA	8	0	Planned for November 2017. Expected to cover 100000 people of 8 unions		
5	Folk song, Jaari Gaan	NA	8	0	Planned for November 2017. Expected to cover 2000 people		
				Total	**9476**	**3757**	**5719**

Sanitation Month

The community people observed sanitation month 2017 in 8 unions through school session, hand washing with school children, stage drama on WSP by local cultural group with participation of Union Parishad Chairman, Member, Female Members, DPHE representative, Health Assistant, Family Planning Assistant, and Family Welfare Worker working at Union level, Students, and community people. The communities organized rally, miking, and discussions on the issue of water safety plan, importance of hand washing. More than 3200 people attended these sessions where 1830 were female.

Courtyard Meeting

Community people with different age group of female attended the courtyard meetings. Union facilitators conducted the sessions and discussed on the issues of water safety plan including safety of water source, collection, transportation, preservation, and use. They also discussed on climate resilient WSP issues, and the responsibilities of household members. During reporting period more than 2880 people enhanced their knowledge on WSP.

Courtyard meeting on WSP message dissemination

School Session

More than 3396 school students attended the sessions on Water Safety Plan including hand washing practices, contamination sources of water from source to consumption, health effects and taking corrective measures.

School session on WSP message dissemination

Folk song, and drama

With the participation of local cultural group folk song on the WSP issues will be organized in the community level. 8 events in most gathering public places will disseminate WSP messages along with importance of hand washing that will increase their responsibility and commitment (Cable TV message as Annex-4).

Folk Song on WSP message dissemination

Households visit

The project has local leaders who have strong acceptability to communities and voluntary mentality and oriented them as change agent to visit neighbours and counselling on the importance of water safety and making their water points safe and resilient. They have done this successfully.

Bill board

The project is under process to build 9 bill boards in one Upazila and 8 unions put key message with photos and place it close to public places (hat bazar and Upazila gate) which is most convenient to attract mass people to see and learn (Content of Bill Board as annex-5).

Displaying Bill Board with WSP message

5.3 Training / Orientation

Field orientation has been given to the project staff, users, union health staff on climate resilient WSP to improve their understanding and skill. Now they are scaling up this learning to their regular practice, operation and maintenance and neighbours.

5.4 Demonstration of renovation of water facilities

There are 26 demonstrations have been done in three working districts of which 20 Tube wells and 6 PSF where mainly platform of TW, filter media and ponds are emphasized. Community, village and unions are considered for demonstration of renovation of water facilities.

Demonstration of renovation of TW platform

5.5 Engagement of stakeholders

Stakeholders including DPHE, department of health, education, LGIs, WatSan committee, private sectors, and local entrepreneurs are engaged with this climate resilient WSP programme to mainstream this within their current ongoing programme for dissemination, leveraging resources, monitoring and follow up and linking with private sectors and local entrepreneurs for future support.

The above social mobilization, capacity building and networking activities on climate resilient WSP from water source to the HH storage have created some visible and tangible changes of behavioural practice, ownership and planning of the community and other stakeholders. Few examples of changes are given below through some pictorial presentation.

6. Emergency response plan

It is difficult to protect natural disasters in most of the cases. But it may reduce the damage and loss by taking some corrective measures. Similarly if the water facilities protect properly during disaster, then after disaster it will possible to safe from the scarcity of water. For example, during cyclone with storm surges and tidal surges, water supply facilities may be vulnerable to saline intrusion and microbiological contamination which depends on the location, frequency and severity of disaster. On the basis of the vulnerability, the below emergency plan may be undertaken:

- Unlock TW head and pipe being covered by wrapping polythene in order to protect from entrance of water.
- Storm surges or saline water do not use for priming of TW water
- Install TW in cyclone free high land, so that there will be less chance to entry saline water during cyclone
- Raise or repair embankment of pond for PSF, so that there will be less chance to entry saline water during cyclone
- Use of Alum to purify water. One tea spoon powder alum mix with 10 litre water, then keep rest for one hour and use up to 24 hours of two third of water.
- Use of bleaching powder to disinfect water. One eighth of tea spoon bleaching powder mix with a glass of water, rest for a while and again mix with 10 litre water by removing the bottom part of the glass, stirring properly and use for drinking after one hour.
- Use of water purification tablet by following the instruction mentioned in the label of the tablet.
- Boiling of water up to 30 minutes, then cool and use up to 24 hours by avoiding the residual of the bottom of water.
- Solar disinfection of water by putting a plastic bottle with water into sun around 6 hours.

OUTCOME: Due to project awareness campaign through courtyard, school session, Union level coordination meeting the perception of people is changing. People are now practicing WSP starting from source to consumption. The practice level is increasing among community people which will be further reflected in the end line survey. For the time being project has captured some best practices.

At water source level:

The user of the SHTW renovate the platform after getting information and motivation on WSP from the project

Before awareness Campaign

After awareness campaign & follow up

At HH storage:

Before awareness Campaign

After awareness campaign & follow up

Annex -1: Option Wise Hazard Matrix

Sl	Water Source	Option wise hazards			
		As+ (ppb)	E. Coli (#/100ml)	NO_3 mg/L	Chloride mg/L
1	SHTW	√	√		√
2	DTW		√		√
3	PSF		√		
4	RWHS		√		
5	Pond		√		
	At storage				
1	Water at HH storage		√		

Annex -2: Correlation between SI and E.coli (Ref. Baseline Report)

On the basis of the sanitary inspection and E.coli test result, a correlation was made in the below table (2a and 2b). It is revealed that low risk score of the water options is 16%, Intermediate risk score is 35%; high risk score is 39% and very high risk score is 10%.

Annex -2a: Sanitary inspection vs E.coli risk score

E.coli Classification	Sanitary inspection risk score (%)				
	0-2	3-5	6-8	9-10	Total
<1	16%	17%	20%	5%	58%
1-10	6%	12%	14%	3%	35%
11-100	1%	1%	3%	0%	6%
>100	0%	0%	1%	0%	1%
	23%	30%	38%	8%	100%

Low risk : no action required	Intermediate risk: Low action priority	High Risk: Higher Action Priority	Very High Risk: Urgent Action required

Annex -2b: Union wise Correlation between SI and E.coli

Gulshakhali Union

		DHTW -Sanitary inspection risk score (%)				
E.coli Classification		0-2	3-5	6-8	9-10	Total
	<1	40	0	40	0	80
	1-10	0	20	0	0	20
	11-100	0	0	0	0	0
	>100	0	0	0	0	0
		40	20	40	0	100

		RWHS- Sanitary inspection risk score (%)				
E.coli Classification		0-2	3-5	6-8	9-10	Total
	<1	67	33	0	0	100
	1-10	0	0	0	0	0
	11-100	0	0	0	0	0
	>100	0	0	0	0	0
		67	33	0	0	100

Shapleza Union

		SHTW- Sanitary inspection risk score (%)				
E.coli Classification		0-2	3-5	6-8	9-10	Total
	<1	0	100	0	0	100
	1-10	0	0	0	0	0
	11-100	0	0	0	0	0
	>100	0	0	0	0	0
		0	100	0	0	100

		Pond -Sanitary inspection risk score (%)				
E.coli Classification		0-2	3-5	6-8	9-10	Total
	<1	0	20	0	0	20
	1-10	40	20	0	0	60
	11-100	0	20	0	0	20
	>100	0	0	0	0	0
		40	60	0	0	100

		PSF -Sanitary inspection risk score (%)				
E.coli Classification		0-2	3-5	6-8	9-10	Total
	<1	0.00	16.67	33.33	16.67	66.67
	1-10	0.00	0.00	0.00	16.67	16.67
	11-100	0.00	0.00	16.67	0.00	16.67
	>100	0.00	0.00	0.00	0.00	0.00
		0.00	16.67	50.00	33.33	100.00

Bharuakhali Union

		DHT -Sanitary inspection risk score (%)				
E.coli Classification		0-2	3-5	6-8	9-10	Total
	<1	0	0	100	0	100
	1-10	0	0	0	0	0
	11-100	0	0	0	0	0
	>100	0	0	0	0	0
		0	0	100	0	100

		SHT Sanitary inspection risk score (%)				
E.coli Classification		0-2	3-5	6-8	9-10	Total
	<1	0.00	38.46	30.77	15.38	84.62
	1-10	0.00	7.69	0.00	0.00	7.69
	11-100	0.00	0.00	7.69	0.00	7.69
	>100	0.00	0.00	0.00	0.00	0.00
		0.00	46.15	38.46	15.38	100.00

Chaufaldandi Union

		DHTW- Sanitary inspection risk score (%)				
E.coli Classification		0-2	3-5	6-8	9-10	Total
	<1	16.67	8.33	16.67	0.00	41.67
	1-10	16.67	8.33	16.67	0.00	41.67
	11-100	8.33	0.00	8.33	0.00	16.67
	>100	0.00	0.00	0.00	0.00	0.00
		41.67	16.67	41.67	0.00	100.00

		SHTW- Sanitary inspection risk score (%)				
E.coli Classification		0-2	3-5	6-8	9-10	Total
	<1	0	0	0	0	0
	1-10	0	0	100	0	100
	11-100	0	0	0	0	0
	>100	0	0	0	0	0
		0	0	100	0	100

Islampur Union

		DHTW- Sanitary inspection risk score (%)				
E.coli Classification		0-2	3-5	6-8	9-10	Total
	<1	50	0	50	0	100
	1-10	0	0	0	0	0
	11-100	0	0	0	0	0
	>100	0	0	0	0	0
		50	0	50	0	100

		SHTW - Sanitary inspection risk score (%)				
E.coli Classification		0-2	3-5	6-8	9-10	Total
	<1	57.14	28.57	0.00	0.00	85.71
	1-10	0.00	14.29	0.00	0.00	14.29
	11-100	0.00	0.00	0.00	0.00	0.00
	>100	0.00	0.00	0.00	0.00	0.00
		57.14	42.86	0.00	0.00	100.00

Khurushkul Union

		SHTW - Sanitary inspection risk score (%)				
E.coli Classification		0-2	3-5	6-8	9-10	Total
	<1	11.11	11.11	11.11	0.00	33.33
	1-10	5.56	11.11	38.89	5.56	61.11
	11-100	0.00	0.00	0.00	0.00	0.00
	>100	0.00	0.00	5.56	0.00	5.56
		16.67	22.22	55.56	5.56	100.00

Dacop Sadar Union

		SHTW -Sanitary inspection risk score (%)				
E.coli Classification		0-2	3-5	6-8	9-10	Total
	<1	0	100	0	0	100
	1-10	0	0	0	0	0
	11-100	0	0	0	0	0
	>100	0	0	0	0	0
		0	100	0	0	100

		RWHS - Sanitary inspection risk score (%)				
E.coli Classification		0-2	3-5	6-8	9-10	Total
	<1	0.00	0.00	33.33	0.00	33.33
	1-10	0.00	33.33	0.00	33.33	66.67
	11-100	0.00	0.00	0.00	0.00	0.00
	>100	0.00	0.00	0.00	0.00	0.00
		0.00	33.33	33.33	33.33	100.00

Kamarkhola Union

		DHTW - Sanitary inspection risk score (%)				
E.coli Classification		0-2	3-5	6-8	9-10	Total
	<1	100	0	0	0	100
	1-10	0	0	0	0	0
	11-100	0	0	0	0	0
	>100	0	0	0	0	0
		100	0	0	0	100

		RWHS- Sanitary inspection risk score (%)				
E.coli Classification		0-2	3-5	6-8	9-10	Total
	<1	0	0	50	50	100
	1-10	0	0	0	0	0
	11-100	0	0	0	0	0
	>100	0	0	0	0	0
		0	0	50	50	100

		Pond -Sanitary inspection risk score (%)				
E.coli Classification		0-2	3-5	6-8	9-10	Total
	<1	0	0	0	0	0
	1-10	0	100	0	0	100
	11-100	0	0	0	0	0
	>100	0	0	0	0	0
		0	100	0	0	100

		PSF - Sanitary inspection risk score (%)				
E.coli Classification		0-2	3-5	6-8	9-10	Total
	<1	0	0	50	0	50
	1-10	0	50	0	0	50
	11-100	0	0	0	0	0
	>100	0	0	0	0	0
		0	50	50	0	100

Annex -3: Climate Resilient WSP process for some relevant hazardous event

Climate Cahnge Effect	Hazardous Event	Water Stress Situation
Temperature Change: Favourable condition for pathogens specially for surface water i.e. pond	• High level of contamination in pond and PSF	• Water quality
Change in rainfall: increase concentration of salinity and lowering ground water table	• Exceed the limit of salinity in TW • Use of unimproved water sources due to unavailability of water	• Water Quality • Functionality • Availability
Sea level rise: Increase intensity of salinity in ground water	• Exceed the limit of salinity in TW	• Water Quality
Cyclone and tidal surges: Increase intensity and frequency	• Damage water sources like TW, PSF • Saline intrusion in pond, PSF and underground water • Microbial contamination in TW, Pond and PSF	• Functionality • Avvailability • Water quality

Annex -4: Cable TV Network

The project will broadcast video documentary/ WSP messages through local cable network at 3 working districts in reaching out to people of 8 unions under three Upazilla's. People will be reached by this event and they will be able to tell about the safe water, hazards and hazardous event and take actions against the hazards. The main messages are as follows.

- Distance between toilet and TW will be minimum 30ft
- Clean pot with safe water during water collection
- Use cover while Transport water
- Put storage water at clean, high and dry place with cover inside your house
- Use clean pot while consumption of water

Annex -5: Content of a Bill Board