Project Completion Report

Implementation of Climate Resilient Water Safety Plan In 4 Pourashava

Birampur Pourashava

Cox's Bazar Pourashava

Naogaon Pourashava

Ullahpara Pourashava

Ground Water Circle

Department of Public Health Engineering

December 2015

UKaid

World Health Organization
Country Office for Bangladesh

Project Completion Report of

Implementation of Climate Resilient Water Safety Plan (WSP) in Water Supply Systems of Four Pourashava

- **Birampur Pourashava**
- **Cox's Bazar Pourashava**
- **Naogaon Pourashava**
- **Ullahpara Pourashava**

Groundwater Circle
Department of Public Health Engineering, Bangladesh

Acronyms and Abbreviations

DPHE - Department of Public Health Engineering, Bangladesh
IRP - Iron Removal Plant
PTW - Production Tube Well
PWSS - Pourashava Water Supply Section
TLCC - Town Level Coordination Committee
WSP - Water Safety Plan
WSS - Water Supply System
WHO - World Health Organization
WASH - Water Supply, Sanitation Hygiene

Executive Summary

The climate change, its variability and increased extreme weather events (e.g. floods, drought, storms, sea level rise, saline water intrusion etc.) have been impacting the water supply system by worsening the water availability, quality, functionality and accessibility. The primary climatic variables temperature, rainfall and humidity and the extreme weather events has also been deteriorating different environmental determinants of health (e.g., solid sludge, fecal sludge, agrochemical, erosion, salinity, industrial effluents etc.). These add an additional potential for the deterioration of the water supply system eventually reducing the drinking water security and safety. The population growth, rapid unplanned urbanization, industrial activities have been further exacerbating the situation by increasing water demand in urban areas. As a result the WASH related health vulnerability of the Pourashava dwellers has been increasing, required an effective intervention.

The Climate Resilient water safety plan is an effective management intervention for building resilience over water supply systems for the reduction of the health vulnerabilities. The DPHE-WHO implemented climate resilient water safety plan in the four Pourashavas located in coastal, drought and flood prone area (Drought prone area: Naogaon Sadar and Birampur; Coastal area: Cox's Bazaar Sadar and flood prone area: Ullahpara Pourashava). This resulted in some noticeable improvements in the water supply systems. The awareness raising events and improvement actions taken by the Pourashavas have improved consciousness among users and PWSS staff. The documented climate resilient WSP was one of the effective outcomes of the assignment. It is further utilized in prioritizing interventions that are needed to improve the water supply system for gaining confidence of users on the water supply system.

The comparison between baseline and end lime condition revealed that the Pourashavas have gained substantial momentum in the field of revenue collection, understanding of the water supply system, hazard/hazardous event and registering complaints record etc. The practice of water quality testing helped them to monitor the water quality hazards of supplied water regularly. The improvement actions being carried out by PWSS and DPHE, selected in the light of climate resilient WSP of each the Pourashava. It influenced and helped them to begin the practice of adopting pro-active approach while working.

One of the major outcomes of this assignment was the improved understanding and relationship among DPHE and PWSS staff, and the collaborative approach. Since the WSP approach was not very familiar to all the staff, the local level trainings, meetings, awareness raising events and follow-up of activities have created an enabling environment for PWSS to seek technical knowledge on management of the water supply system through implementation of climate resilient WSP. Overall, the program was able to motivate the PWSS staff and the Pourashava authority to follow climate resilient WSP onwards, which would contribute to improvement of water quality as well as would make better participation from Pourashava authority and the users possible in these Pourashavas.

Table of Contents

List of Tables

List of Figures

Chapter 1: Introduction

1.1 Project Background

The Pourashavas in Bangladesh are located in different climate-vulnerable location such as coastal, flood-prone, drought-prone and hilly areas. The Pourashava pipeline water supply system is the main source of drinking and household water among its dwellers. This climate variability and extreme weather events along with environmental hazards are linked with physical, chemical and biological quality of water as well as functionality of technologies and availability of water. As result the incidences of water related diseases like diarrhoea, cholera, malaria, dengue, dysentery, arsenicosis etc. are increasing significantly. The impacts of climate variability, weather extreme events are variable considering different steps of a water supply system, e.g., source/catchment, treatment plant, storage, distribution and household connections. Such situations also have negative impact on accessibility to the safe water as result the risk of health outcomes are increasing. The situation is further aggravated by different socio-economic factors like population growth, rapid urbanization and industrial activities. As a result the incidence of water born, washed and related diseases are increasing. Presumably the health vulnerability has been increasing gradually.

WHO-DPHE has been implementing Climate Resilient WSPs to support Pourashavas and its dwellers in Bangladesh for addressing the challenges posed by climate change and environmental hazards in large scale water supply systems by making the water supply systems more resilient. The climate resilient water safety plan systematically identifies the climatic and environmental hazards considering the frequency and severity of the risks in relation to the water supply systems, and suggests the necessary control measures and improvement plans as a preventive measure. It is cost-effective and management oriented preventive approach that ensures safety of drinking water.

Under this assignment, four Pourashavas namely Naogaon Sadar and Birampur Pourashava in drought prone area; Cox's Bazar Sadar in coastal area and Ullahpara in flood prone area were selected with an objective to support for ensuring the supply of safe water through implementation of climate resilient WSPs considering climatic and environmental hazards and risks.

1.2 Objectives of the Assignment

The overall objectives of the assignment are ensuring the supply safe water to its consumers by implementing risk based climate resilient WSP and its integration with the regular management system. The specific objectives are:

a. To develop full-fledged climate resilient WSP for water supply system including improved action plan and incidence response plan
b. To enhance capacity of the water professionals and workers for monitoring and

preventive maintenance of the water supply system from the impact climate variability, climate extreme events and environmental hazards

c. To promote and motivate the consumers to practice safe water handling and improved hygiene in their daily life considering the climate variability, climate extreme events and environmental hazards

1.3 Organization of the Report

This report is prepared to summarize the activities that have been carried out in four Pourashavas of Bangladesh namely Birampur, Cox's Bazar, Naogaon and Ullahpara Pourashava. The report consists four chapters. The first chapter provides short introduction on the project background and project objectives. The second chapter discusses the climate resilient WSP implementation works that have been carried out in each of the Pourashavas by DPHE and Pourashava jointly. The third chapter presented the climate resilient WSP documentation for each of the Pourashavas including the water supply system profiles. Finally, the fourth chapter made some recommendations for climate resilient WSP implementation in water supply systems in future.

Chapter 2: Implementation of Climate Resilient WSP in Different Pourashavas

2.1 Initiatives at Central Level

A preparatory meeting held in Ground Water Circle, Department Public Health Engineering before starting the implementation of climate resilient WSP in four Pourashavas. The Pourashavas were Birampur and Naogaon Pourashava in drought prone area, Cox's Bazar Pourashava in coastal area and Ullahpara Pourashava in flood prone area. The professionals from the ground water circle and district Executive Engineer of DPHE were present in the preparatory meeting. The agenda of this meeting was mainly to inform DPHE (district level) about the project, its objectives, as well as to discuss different activities of this project in brief. Relevant WHO technical professionals elaborately provided the insights of the climate change, WASH and health project and climate resilient WSP and provided technical input. DPHE officials elaborately discussed about the program implementation modalities and prepared action plan.

2.2 Initiatives at Pourashava Level

Implementation of climate resilient WSP in each of the four Pourashavas started through an orientation workshop with the Pourashava authorities and district DPHE professionals. Two orientation workshops conducted. The first workshop held in Bogra with the participation of Pourashava water sections and district level DPHE professionals and workers. The participants included the Executive Engineers, Water Supers, Sub Assistant Engineers and Mechanics of Birampur, Naogaon and Ullahpara Pourashava.

Figure 1: Photograph of climate resilient WSP program orientation workshop
At Bogra At Cox's Bazar

The second orientation workshop organized in Cox's Bazar with the similar types of participants. In the day long program, the participants oriented about the climate resilient water safety plan, objectives of the program, planned activities etc. The participants prepared Pourashava wise actions plan of different activities though group work and presented the action plan. The action plans were finalized after a long discussion among the percipients and put forward for action in the respective Pourashava.

The Pourashava water supply section and DPHE staffs and professionals were provided training later on how to development, implement WSP through training workshops, and practical works (site visit), group works so that they can finalized the climate resilient water safety plant with subsequent implementation. The training events organized in two locations namely at Bogra and Cox's Bazar. The participants were the professionals and workers of the Pourashava water supply section and the Pourashava respective districts and upazila DPHE professionals and workers. The training followed the lecture methods with

Figure 2: Photograph of training on climate resilient WSP development and implementation
At Bogra At Cox's Bazar

interactive presentation. The training covered different issues of the climate resilient water safety plan which included climate resilient water safety plan team, system description, hazard identification and risk analysis, improvement action plan, operation monitoring and corrective actions, verification, management and communication, supporting programme development and WSP review procedure. After completion of each of the session participants conducted group work and presented.

2.3 Formation of Pourashava Climate Resilient WSP Team

The top authority of each the Pourashava was committed to engage relevant staff of the Council to implement climate resilient Water Safety Plan and to provide necessary support continuously. In this respect, a statement of such commitment was duly signed by Mayor of each Pourashava, and was circulated as a declaration among concerned staff and stakeholders. The statement was also included in the citizen charters of the Pourashavas.

The climate resilient WSP team of each the Pourashava consists of 8 to 13 members with the Mayor of the Pourashava as a Chairman or Adviser. Other members of the team were selected through group discussion among the Pourashava and DPHE professionals. Each of the WSP team consists of Councillors of the Pourashava, Local Journalist, Urban Planner, Slum Development Officer, Executive Engineers of Pourashava and DPHE, Assistant Engineer of Pourashava and DPHE, Sanitary Inspectors of Pourashava, representative from civil surgeon/UH&FPO office, representative from nearest weather station, ward councillors,

representative from local disaster management office and eminent personalities of the Pourashava. The team played the important role for implementation climate resilient in each of the Pourashavas.

There are four types of members in each of the WSP team; Chairman, Member Secretary and Members. Each type of member in the team has been assigned different roles and responsibilities. The members of climate resilient WSP team in each Pourashava have set few common objectives for the team, which was approved by the Mayor and as follows:

- Regular checking of climate resilient WSP implementation and its functional integrity in different steps
- Regular checking of the progress of improvement plan
- Regular (e.g. quarterly) checking of operational monitoring activities
- Preparation and regular checking of annual report on WSP and impact of WSP
- Ensuring implementation of the decisions taken by WSP team in meetings
- Monitoring of actions taken by PWSS to implement climate resilient WSP
- Facilitation of awareness raising program for consumers on importance of safe water consumption
- Encouraging all consumers to pay water bill regularly
- Campaigning to increase number of water connections/consumers
- Active participation in development and review of climate resilient WSP each year

2.4 Inception Workshops

The climate resilient WSP implementation activities in each of the the Pourashavas started through an inception workshop in presence of WSP Team Members, DPHE representatives and Pourashava key personnel. The main objective of this Inception Workshop was to aware WSP team, Pourashava authority, TLCC members and all other stakeholders about the implementation of the climate resilient Water Safety Plan in each of the Pourashavas. During the inception workshops, commitment from Mayor, key personnel and stakeholders were sought to cooperate to implement the climate resilient in the respective Pourashavas. The participants of the workshops were Mayor, Ward Councillors, DPHE officials, Pourashava officials, PWSS staff and all members of the WSP team. The total number of participants was around 120. The work plan for climate resilient WSP implementation was shared in the workshops and feedbacks from participants were collected. Few of the suggested changes in the workshops were noticed and taken into consideration by climate resilient WSP team.

2.5 Baseline Survey

The baseline survey composed of there activities namely the knowledge attitude and practice survey among the users, sanitary inspection of the water supply system and the

water quality hazards identification through water quality test. The temperature, rainfall and humidity data was collected form nearest weather station and health data from health department. The baseline survey was conducted in each of the targeted Pourashava. It needs to be noted that the KAP survey and water quality testing was done under a separate APW contract with WHO by another organization.[1] The climate resilient water safety plan was developed by using the baseline information of each of the Pourashava. The summary findings of these activities briefly presented in the following:

2.5.1 KAP Survey

The KAP survey in each of the Pourashava covered different aspects in relation to knowledge attitude and practice of water users. These included understanding about the safe water, climate change and variability, water source, collection, transportation, storage, satisfaction, tariff, roles and responsibilities of the users and incidences of water related diseases and sickness among the Pourashava dwellers. The KAP survey provided the baseline status of the consumer's awareness about the safe water consumption.

The respondents of Birampur, Cox's Bazar, Naogaon and Ullahpara Pourashava are aware about the climate change and its variability to a variable degree. The respondents in coastal area mentioned that they were observing increase of temperature, excessive flood, and increase of salinity, water logging and sea level raise. The respondents from drought-prone areas mentioned that they were observing increased temperature, excessive drought and excessive rainfall. The respondents from flood-prone area mentioned that they were observing increase temperature and water logging problem due to the impact of climate change. All of these changes of climate have significant impact on the water source considering the quality and quantity of the supplied water. The respondents in different Pourashavas assumed that water would be less available due to the impact of climate change, especially during the summer period. It needs to be noted that the water unavailability has significant impact on the accessibility.

The KAP survey results indicated that almost all of the respondents of Naogaon and Birampur Pourashava have good knowledge about safe water compared to the respondents in Ullahpara and Cox's Bazar Pourashavas. It was found from the survey that use of piped water supply for drinking purposes was relatively high in Naogaon and Ullahpara Pourashavas, whereas very low in Cox's Bazar and Birampur Pourashavas which indicated that water supply system needs significant improvement regarding water quality in these two Pourashavas.

The analysis of response regarding the cleaning and maintenance of water reservoirs of household, it appeared that users in Naogaon Pourashava need motivation regarding proper cleaning and maintenance of their reservoirs tanks. The users of Birampur Pourashava found to have better knowledge and practice regarding cleaning of their water reservoirs. It was

[1] *Participatory Management Initiative for Development (PMID).September 27, 2016. Revised baseline survey report on identification of the impact of climate variability and environmental hazards in water supply systems. PO No. 201521312*

found that the proportion of users in Naogaon and Ullahpara Pourashavas who clean their water collection pot before collecting water was high compared to Cox's Bazar Pourashava and Birampur Pourashava. The analysis results showed that proportions of users cover their water collection pots during transportation was very low in Naogaon Pourashava, whereas in Ullahpara almost all the respondents covered their water collection pot during transportation of water to home. The analysis showed that almost all of the respondents of Naogaon, Ullahpara and Birampur Pourashavas covered their water collection pots during storing water but such practice of water preservation was low in Cox's Bazar.

In Naogaon Pourashava, incidents of diarrhea and dysentery were found more than the other diseases. It was found in Naogaon Pourashava that children below 5 years are the most vulnerable to water-borne diseases. In other Pourashavas people of all age group were more or less affected. In Ullahpara Pourashava almost all the respondents mentioned that diseases are water-borne but in other Pourashava such understanding was less. Variable percentage of respondents mentioned that the diseases are occurring because of the water of the water supply system.

A very few percentage of respondents were satisfied with water supply in each of the Pourashava the different Pourashava considering the water quality and quantity. Awareness about complaint system was found relatively higher in Ullahpara and Naogaon Pourashavas, but low in Cox's Bazar Pourashava. In Birampur Pourashava, majority of users were aware about the complaint system and WSP. In other three Pourashavas, awareness about WSP found less.

2.5.2 Sanitary Inspection

A sanitary inspection of water supply system is an on-site inspection of different components of the system to identify actual and potential sources of contamination that is hazards and risk. The sanitary inspection was done by following the WHO sanitary inspection format for each of the water supply systems located in different geographic area. The physical structure and operation of the system, and external environmental factors are evaluated during conducting a sanitary inspection. This information used to select appropriate control measure to improve or protect the water supply system. The sanitary inspection carried out in each of the Pourashava water supply system with an aim to find out the hazards and risk in different components of the water supply systems. A sanitary risk score was assigned for each of the components based on its vulnerability. A "low" sanitary risk score indicates that the component is in good condition, a "very high" risk score indicates that the component is under severe threat and needs immediate remedial actions. In between "low" and "very high" sanitary risk scores, there were "medium" and "high" risk scores. The summary of the sanitary inspection findings of water supply systems of four Pourashavas are shown in Table 1.

Table 1: Results of sanitary inspection survey in the water supply systems

Steps/Components	Risk Category (based on Risk Score)			
	Naogaon	Birampur	Ullahpara	Cox's Bazar
Source	Low	Low	Low	Low
Pump House	Low	Low	Low	Medium
Raw Water Reservoir	N/A	N/A	Medium	N/A
Treatment Plant	N/A	N/A	Low	N/A
Clear Water Reservoir	N/A	N/A	Medium	N/A
Transmission and Distribution Lines	High	Medium	High	High
House Connections	Medium	Medium	Medium	Medium

The risk scores in Table 1 illustrates that the risk at transmission and distribution lines was found high in Naogaon Pourashava water supply system, medium at house connections and low at sources and pump houses. In Birampur Pourashava water supply system, risk was found low at sources and pump houses, but medium at transmission and distribution lines, and at household connections. In Ullahpara water supply system, risk was found low at sources, pump houses and treatment plant; medium risk was found at raw water reservoir, clear water reservoir and house connections. High risk was found at transmission and distribution lines in this system. In Cox's Bazar Pourashava water supply system, risk was high at transmission and distribution lines, medium at pump houses and house connections, and low at sources.

2.5.2 Water Quality Testing

A water quality testing was conducted by Assistant Engineer, Ground Water Circle of DPHE in each of the Pourashava water supply system to identify the water quality hazards. DPHE also facilitated collection of samples from different points of water supply systems in each of the four Pourashavas. Five water quality parameters were tested for each of the collected samples from production tube well and treatment plant and two parameters were tested for samples collected from water collection points for users. For production tube well samples, the tested parameters were Arsenic (As), Iron (Fe), Manganese (Mn), E. Coli and Electrical Conductivity (EC). For samples collected from user points, only E. Coli and Electrical Conductivity were tested. The As, Fe and Mn tests were carried out at the laboratory of Bangladesh University of Engineering and Technology (BUET), and the E. Coli and EC tests were carried out using portable field testing kits. For each ward in a Pourashava, at least three samples from each o wards of each o the Pourashava. While analysing the water quality results, concentration of As and E. Coli was

Figure 3: Photograph of Water Quality Testing At Cox's Bazar

given priority to assess chemical and microbial risk respectively. If concentration of As was found < 0.05 mg/l, then the chemical risk was assumed to be "low" else high. For E. Coli concentration, the risk classification was done as below:

- If concentration is 0 CFU/100 ml, then "low" microbial risk
- If concentration is 1-9 CFU/100 ml, then "intermediate" microbial risk
- If concentration is 10-99 CFU/100 ml, then "high" microbial risk
- If concentration is > 100 CFU/100 ml, then "very high" microbial risk

The water quality test results indicated that arsenic (As) was not posing any threat to water quality in any of the four Pourashavas. Fe concentration was found above acceptable limit in Naogaon, Ullahpara and Birampur Pourashavas which created and aesthetic problem among the users. Only in Ullahpara Pourashava Mn was concentration was found above critical limit. Salinity is a threat in Cox's Bazar Pourashava supply water. The microbial risk was found significant in all the Pourashavas at the water collection points for users, as most of the tested samples showed high concentration of E. Coli in tested water. Therefore, the WSP needs to identify the challenges in water supply systems through hazard analysis and take proper control measure to improve the microbial quality of water at user's end. Technical detail with of the overall assessment of water quality is presented in the Table 2.

Table 2: Overall assessment of the Pourashava water supply systems

Geographic Location			Drought		Coastal	Flood
Items/Pourashava			Birampur	Naogaon	Cox's Bazar	Ullahpara
Production Well	Source		Ground Water	Ground Water	Ground Water	
	Number		2	8	8	1
	Average Depth (ft)		80	130	225	60
	Average Water Quality	Arsenic (mg/l)	0.001	0.003	.010	0.008
		Iron (mg/l)	0.325	0.140	0.240	0.330
		Manganese (mg/l)	4.5	2.36	0.24	7.75
		FC	Low 50% (1) Intermediate 50% (1) High 0% (0) Very High 0% (0)	Low 63% (5), Intermediate 0% (0), High 38% (3) Very High 0% (0)	Low 71% (5) Intermediate 29% (2) High 0% (0) Very High 0% (0)	Low 71% (5), Intermediate 29% (2) High 0% (0), Very High 0% (0)
		EC (µS/cm)	NA	NA	362-1812	NA
Sanitary Inspection of the Water Supply system	Source		Low	Low	Low	Low
	Pump House		Low	Low	Medium	Low
	Raw Water Reservoir		N/A	N/A	N/A	Medium
	Treatment Plant		N/A	N/A	N/A	Low
	Clear Water Reservoir		N/A	N/A	N/A	Medium
	Transmission and Distribution Lines		Medium	High	High	High
	House Connections		Medium	Medium	Medium	Medium
Pipe Network	Length (km)		7.0	90.0	28.37	6
	Number of Wards Supplied		6	9	5	5
	Average Water Quality	FC	Low 11% Intermediate 78% High 0% Very High 11%	Low 04% Intermediate 21% High 57% Very High 18%	Low 44% Intermediate 19% High 13% Very High 25%	Low 39% Intermediate 44% High 17% Very High 0%

Geographic Location			Drought		Coastal	Flood
Items/Pourashava			Birampur	Naogaon	Cox's Bazar	Ullahpara
		Average EC (µS/cm)	NA	NA	750	NA
Number of Sluice Valve	Functional		18	61	3	7
	Non Functional		0	189	22	3
Number of Washout	Functional		13	30	Unknown/lost	1
	Non Functional		0	22		3

2.8 Climate Resilient WSP Document Preparation Workshop

A consultant team, with support from DPHE engineers, developed four climate resilient WSP documents for water supply systems of each of the four Pourashavas. The key processes used to develop the document are physical observation of each step of existing water supply systems, collecting sanitary inspection results, collecting water quality testing results, information collection on climatic parameters from the nearest weather station, disease information collection and KAP survey findings and analysis of the information. A draft climate resilient WSP was prepared presented to the Pourashava and DPHE water professionals and workers by conducting a review workshop in each of the Pourashava. It needs to be noted that the participants of the review workshop received training earlier on climate resilient WSP development and implementation. In the two day-long review workshops, the participants provide feed backs and suggestion and accordingly the climate resilient WSP document of each Pourashava was updated and finalized.

Figure 4: Review Workshop for climate resilient WSP document finalization in different Pourashavas

The climate resilient WSP illustrated the potential hazards and hazardous events for each of the Pourashava, risk assessment for identified hazards, identification of existing control measures, risk reassessment after existing control measure. In addition, corrective actions and improvement plans for identified hazards were documented collectively by PWSS staff, with technical assistance from experts. The climate resilient WSP documents also include an operational monitoring plan as well as verification monitoring plan to facilitate effective implementation of climate resilient WSP at field level for each Pourashava. The supporting programs needed for improvement is also been presented in the WSP documents. The monitoring log sheets for all relevant staff of the PWSS were included in the WSPs that would help keeping records of WSP implementation in each Pourashava.

2.9 Implementation of Awareness Programs

Under the overall guidance of the Programme Manager, water sanitation the awareness activities implemented in all four Pourashavas, where the Executive Engineers of DPHE at district level supervised the activities closely. The DPHE engaged one technical staff exclusively for the implementation of the climate resilient WSP for progress monitoring and carrying out required day to day activities at the central level. Professionals from WHO provided technical support to the programme as when required.

Each of the Pourashava water section and DPHE prioritized awareness raising activities among the consumers for improving the situation by conducting awareness rising and media campaign program, to sensitize safe water consumption by the users. The awareness raising program improved the understanding about the roles and responsibilities of the consumers for safe water consumption and healthy living. In this regard, along with many other events, the town level coordination committee (TLCC) was made instrumental in carrying out advocacy and monitoring of such actions through orientation sessions.

Their awareness can removed various types of wrongdoing for safe water consumption of the consumers as observed during the KAP survey. The major constrains at household level are no/faulty tap in the household connection, broken platform, unclean surroundings, unclean underground and overhead tanks (some are presented in the following) etc. The water users were informed about these problems and motivated for corrections so that the safe water consumption is assured.

No Tap of Household

Broken platform & unclean surroundings

No platform & unclean surroundings

A team was mobilized for awareness campaign activities after the signing of the agreement between DPHE and the Pourashavas. The activities included orientation of caretakers and users, orientation session with ward sanitation task force, showing video documentary through cable TV, news paper article, climate resilient WSP campaign at community level, school sessions with teachers, management committee and students, sign board and billboard etc. (Table 3). These programs were implemented for improving the consumer awareness safe water consumption and improved hygiene practice. Similar types of activities were also conducted for the supplier for keeping the supply water safe.

Table 3: The awareness activities performed in each of the Pourashava

No	Activity Name	Pourashava (No. of events)			
		Birampur	Cox's Bazar	Naogaon	Ullahpara
1	Orientation of caretakers and users (one in each ward of Pourashava)	3	5	9	5
2	Orientation session with TLCC (two sessions in each Pourashava)	2	2	2	2
3	Orientation session with ward sanitation task force (two sessions in each Pourashava)	2	2	2	2
4	Preparation and telecast video documentary (duration 5 minutes, for each Pourashava)	1	1	1	1
5	Publication of CC resilient WSP related messages in three local newspapers	3	3	3	3
6	Climate resilient WSP campaign at community level (one session per ward)	5	5	5	5
7	Session with schools teachers and school management committee (three major educational institutes)	3	3	3	3
8	Design and installation of sign board (15 per Pourashava)	15	15	15	15

2.9.1 Mike announcement

Mike announcement in Pourashavas was carried out in two stages. Messages related to hygienic practice for use of safe water and importance of safe water consumption for healthy living considering the climatic and environmental hazards were announced. In addition the users were informed about their roles and responsibilities for keeping water safe. These included cleaning of surroundings of the water connection point, underground reservoir and overhead tanks with specials emphasis during the flood, drought and storm times. The users were also informed for fixing of the tap, repairing of platform, cleaning of the water collection container before water collection and storing the collected water in the air and light ventilated raised place. The initiatives also taken by the Pourashava water supply section for improving the safe water supply were also shared with the consumers through miking.

2.9.2 Print and Electronic Media

The Pourashavas water supply section published different messages in relation to safe water use and consumption in newspapers, and showed local cable TV show for publicizing the key climate resilient WSP messages.

2.9.3 Display Boards and Banners

Information on standard practice of water collection, transportation, storage and consumption were mounted and displayed in the different key location of the municipality through display boards. Two large size digital banners on climate resilient WSP concept have been mounted at strategic locations of each of the four Pourashavas. The main objective of installing these boards is to spread the key messages of climate resilient water safety plan.

Figure 5: Sign boards for awareness rising on water safety plan in Pourashavas

2.9.4 Meeting Sessions with Consumers

TLCC Meeting: TLCC meetings being regularly organized by Pourashavas where Mayor, Ward Councillors, Executive Engineer from Pourashava and DPHE, relevant Pourashava staff and representatives of other stakeholders participate, were utilized to disseminate the messages and processes of climate resilient WSPs in the Pourashavas. The key discussion points of the session included, safe water and its importance, climate resilient WSP, necessity of climate WSP, roles & responsibilities of TLCC for implementation of climate resilient WSP, how the communities can help implementation of climate resilient WSPs, water quality, personal hygiene practice etc.

Figure 6: Town Level Coordination Committee meeting in Pourashavas

Ward Level Sessions: Ward commissioner played a vital role for motivation of the peoples in each of the ward for their responsibilities to keep water safe from source to consumption. The participants of ward level sessions were ward commissioner, female male and female members, eminent personalities, representatives from NGOs, government departments, students, workers and ward dwellers. In the orientation session the percipients were

informed about different aspects of safe water consumption. They were briefed about the technique for keeping water safe from source to consumption so that they can communicate with ward dwellers. The ward level climate resilient WSP orientation sessions were organized in all the wards of each of the Pourashavas and the Ward Councillor of each ward lead these sessions.


Figure 7: Ward level awareness raising meetings in Pourashavas

School Management Committee Session: Three school management committee sessions were carried out at each of the four Pourashavas, where WSP booklets were distributed among the members of school management committees and teachers so that they can sensitize the students for safe water consumption by following the standard practice.


Figure 8: School management committee awareness raising meetings in Pourashavas

2.9.6 Bill Boards

Three types of bill boards were designed and prepared for flood, coastal and drought prone area. The messages are written in Bengali in the design. English translation is shown in the right side.

As soon as getting the flood warning take action to save the water source as well as the reserve tank of your house

Lets all together implement the climate resilient WSP

During the cyclones and storms let's keep the water source as well as the reserve tank safe. In addition stopping the infiltration of saline water in sources

Lets all together implement the climate resilient WSP

Reduce the excess use of ground water in drought prone area. Lets not waste water for household activities

Lets all together implement the climate resilient WSP

Figure 9: Billboards designed for coastal, drought and flood prone area

2.10 Implementation of Corrective Actions

The DPHE and Pourashava water supply section jointly undertook some small scale improvement actions considering the project resources and prepared climate resilient WSP document in each of the Pourashava. Some of the worst scenario of the supply system is presented below:

Exposed pipeline

Connection Over the drain

Water point over the drain

Illegal Connection

Illegal Connection

Sluice valve Chamber

Considering these the activities performed were mainly related with sluice valve chamber, pipe line leakage, wash out system, treatment plant maintenance, cleaning of system etc. The lists of works performed mainly are:

- Installation of new sluice valves and gate valves where needed
- Construction of chambers for new sluice and gate valves, and providing cover slab
- Filling of the sluice valve chambers with sand
- Increasing height of sluice valve chambers above the road/drain level where required
- Improvement of sanitary seal's condition at PTW
- Installation of chlorine dosing system in the water supply system
- Using pipe drilling device and rubber gasket during providing house connection
- Cleaning of sluice valve chambers, treatment plant, overhead tank, clear water reservoir etc.
- Improvement of wash out systems and installation of required new wash out systems where required
- Repairing of leakages in pipe network and providing casing pipes to protect house connections from wastewater when crossing drains

Chapter 3: Climate Resilient WSP Documentation

The documentation of Water Safety Plan for each of the Pourashavas completed according to the guideline. The climate resilient WSP team formed for each of the Pourashava. Each of the climate resilient WSP document consisted of the findings from several field visits, hazard analysis, operational monitoring plan, required corrective action plans, improvement plans, verification plans, and required supporting programs. The different steps of consideration of documentation of the climate resilient WSP is presented below:

1) Physical observation of each of the step of the water supply system
2) Sanitary inspection results
3) Water quality testing results of the supplied water
4) KAP survey results conducted at household level
5) Analysing all of the of information above a draft climate resilient WSP prepared
6) The draft climate resilient water safety plan finalized through a review workshop with the WSP team and the relevant stakeholders

3.1 Description of Pourashava Water Supply Systems

After several field visits and collection of required information from Pourashava and the DPHE local authority, the water supply system profile and flow diagram of the system prepared for each Pourashava. Based on the flow diagram and water supply system profile, the hazard analysis was done for the Pourashavas. A brief description of the water supply system of each of the Pourashava is presented in the following sub sections.

3.1.1 Naogaon Pourashava Water Supply System

Naogaon district is located in the northern part of Bangladesh situated in the bank of Mini *Jamuna* river. It is bounded by West Bengal on the north, Natore and Rajshahi districts on the south, Joypurhat and Bogra districts on the east, Nawabganj district and West Bengal on the west. The area of the town is about 38.36 km^2 and the population is about 150,025. Agriculture is the major occupation. This district is a home to a considerable rice processing industries. The Pourashava is in the drought prone area with having hot and humid weather and less rainfall.

The water supply system uses groundwater as the source water. There were eight functional production tube wells (Total production tuber well=13; inactive: 5) in the system. The productions wells directly pumping the ground water to the piped network and the water is supplied to the consumers. The depth of the production wells varied from 120' to 140'. The total daily production was approximately 1,200 m^3 during wet season which was reduced to 600-700 m^3 per day in dry season. Water was supplied for 11-13 hours every day to the consumers. There were two inactive treatment plants and an overhead tank exists in the supply system. It was reported by water supply section that there were approximately 250 sluice valve chambers and 52 wash out valves in the water supply network. Total number of

connections in the Pourashava was 7,316 and street water hydrant was 75. The total length of pipe line was approximately 90 km.

3.1.2 Cox's Bazar Pourashava Water Supply System

Cox's Bazar district is located 150 km south of Chittagong district with an area of 2491.86 km². The area of Cox's Bazar Pourashava is 6.85 km². The city is bounded by Bakkhali River on the north and East, Bay of Bengal in the West, and Jhilwanj Union in the south. The climate of Cox's Bazar is mostly high temperature, heavy rainfall, generally excessive humidity, and distinct seasonal variations. The annual average temperature in Cox's Bazar remains at about a maximum of 34.8 °C and a minimum of 16.1 °C. The average amount of rainfall remains at 4,285 mm.

The water supply system uses groundwater as the source water. There were eight active production tube wells (Total production tube well = 11; Inactive = 3) in the system from which water was supplied to the consumers. The total number of connections was 996. Groundwater was abstracted from 210' to 455' depth through production wells. Total daily production was approximately 2,400 m^3. Water was supplied for 10-11 hours every day to the consumers. There was no treatment plant and overhead tank existed with water supply system. Ground water was directly pumped to the pipe network. It was reported by water supply section staff that there were approximately 23 sluice valve chambers among which 3 are active. There was no active wash out valves found in the pipe water supply network. The total length of pipe line was approximately 60 km.

3.1.3 Ullahpara Pourashava Water Supply System

Ullahpara Pourashava of Sirajganj district is situated in Rajshahi division of Bangladesh. It is known as the gateway to North Bengal as the intersection of Dhaka-Rangpur and Dhaka-Rajshahi highways at Hatikumrul falls within it. The upazila has an area 414.43 sq km. The annual average temperature reaches a maximum of 34.6 °C, and a minimum of 11.9 °C. The annual rainfall is 1610 mm.

The water supply system of Ullahpara Pourashava used groundwater as the source water. The supply system has only one production tube well. The water abstracted from the production well, subjected to an iron removal plant and the processed water was stored to an over ground reservoir from where water supplied to its consumers through pumping. No disinfection method was used before the supply of water to the consumers. Total number of connections in the Pourashava water supply system was 650.

3.1.4 Birampur Pourashava Water Supply System

Birampur Pourashava of Dinajpur district is located in the Rangpur division of Bangladesh. It has 25,770 households and total area 211.81 km². The average temperature in Birampur is 25.2 °C and highest on average in August, at around 28.9 °C and in January, the average temperature is 17.8 °C. The average rainfall is 1860 mm in a year.

The water supply system uses groundwater as their source of water. There were two active production tube wells in the system from which water was supplied to the consumers. There was no treatment plant, underground reservoir and overhead tank attached to the water supply system. Ground water was abstracted and directly supplied to the pipeline network without any any treatment/disinfection. Total number of connections in the Pourashava was only 191.

3.2 Hazard Identification and Risk Analysis

All potential biological, physical and chemical hazards and hazardous event associated with each step of the water supply system (as presented below) can affect the water safety and security were identified.

- Source (Groundwater)
- Production Tube Well and Pump House
- Treatment Plant
- Reservoirs (Clear Water Reservoir and Overhead Tank)
- Transmission and Distribution Lines
- House Connection and Households

Each identified hazard was assigned a risk score based on the "Likelihood" and "Severity". Semi-quantitative approach was followed. Hazards table for each of the Pourashava were prepared and risks prioritized and presented in the climate resilient water safety plan.

3.3 Operational Monitoring Plan

An operational monitoring log-sheet has been developed for each type of staff of PWSS who are assigned with different tasks. Separate log-sheets are developed for Pump Operator, Treatment Plant Operator, Pipe Line Mechanic, Bill Distributor and Laboratory Assistant. The operational monitoring plan was discussed with relevant WSS staff of each Pourashava and they were informed how to fill up the log-sheets as per the planned period.

3.4 Corrective Action for PWSS

When the existing control measures were reported to be ineffective or not sufficient for long time in the water supply systems of the Pourashavas, the risks were reassessed in terms of likelihood and consequences taking into account the effectiveness of each control. For each identified risk considering the existing control measure, if exists, corrective actions were recommended to minimize the risk. Some examples of corrective actions are - regular cleaning of the supply system, avoid selection of aquifers with high chemical contamination; repair sanitary seals at PTW; repair/replace non-return valves, flow meters, pressure valves if damaged; install protection system around the treatment plant; manual chlorination as long as mechanized system is not installed, use of rubber gasket and pipe drilling device during providing house connection etc.

3.5 Improvement Plans and Supporting Programs

Improvement action plan is the plan for new (future) operational controls or any other improvements required in the water supply system. In the climate resilient WSP for each Pourashava, long-term action plans that requires time and substantial amount of resources considered in improvement action plan. Some examples of improvement action plans are:

- Construction of large scale Iron Removal Plant (IRP) for PTW
- Installation of chlorine dosing machine in the water supply systems.
- Replacement of old pipe lines in transmission and distribution lines that have either too many leakages or substantially reduced in diameter, with new pipe line networks.
- Construction of pump houses for PTW that do not have any pump house to protect the PTW from contamination.
- Replacement of all old turbine pumps with new submersible pumps.

Few supporting programs were considered in the WSP to complement the regular operation monitoring activities as well as to raise awareness among the consumers on water safety. There were also some training events proposed in the WSP for capacity building of PWSS staff e.g. training on chlorination of the system, alum dosing, using rubber gasket and pipe cutter during providing house connection etc. Pourashavas have also provided uniform and safety equipment for convenience of workers.

3.6 Verification Plans

Verification of all the activities planned in the climate resilient WSP is very important for the success of the whole process. In the WSP for each Pourashava, a verification plan for each type of activity to be carried out by PWSS staff was documented. The Executive Engineer-Pourashava and Executive Engineer-DPHE are given the tasks of verification of climate resilient WSP operational monitoring activities.

3.7 End Line Survey

Methodology: The end line survey was conducted during December 2016 in the project area. Quantitative information was collected using pre-tested questioner and through face to face interview (sample questionnaire is attached). The number of surveyed households in four Pourashava was 226. A total of 5% households were selected randomly from the list of household provided by the respective Pourashava with ward wise proportionate distribution. The respondents of the household were mainly the housewives who were the real water managers at the household level. The data analysis was done with regard to knowledge, attitude and practice on water by the households by Microsoft excel.

Result: From the end line survey results regarding safe water, it was found that in Birampur and Naogaon Pourashavas, 100% of the respondents have good knowledge about "safe water," whereas 98% and 87% of respondents in Ullahpara and Cox's Bazar Pourashavas

respectively have that knowledge. While answering if the users have any responsibility regarding keeping their water safe, 100% respondents of all Pourashavas said that they do have responsibility in this regard, which indicates their good attitude towards water management.

The survey results from climate change related understanding indicated that more than 95% of the respondents in each Pourashava were aware about the climate change threats to water supply systems. After the awareness programs, more than 90% respondents in each Pourashava told that they have been following the hygienic process of water collection, transportation and storage in their households.

The awareness programs also had a positive impact on understanding of users regarding effect of water quality on water-borne diseases. In three Pourashavas, 100% respondents agreed their water supply system could be a source of water borne diseases when water quality is unsafe. Only in Cox's Bazar Pourashava, 96% respondents agreed with that.

Table 4: Sanitary inspection score after the completion of the activity

Steps/Components	Risk Category (based on Risk Score)			
	Naogaon	Birampur	Ullahpara	Cox's Bazar
Source	Low	Low	Low	Low
Pump House	Low	Low	Low	Low
Raw Water Reservoir	N/A	N/A	Low	N/A
Treatment Plant	N/A	N/A	Low	N/A
Clear Water Reservoir	N/A	N/A	Low	N/A
Transmission and Distribution Lines	High	Medium	Medium	Medium
House Connections	Medium	Medium	Medium	Medium

Chapter 4: Conclusion and Recommendation

5.1 Conclusion

The climate variability and weather extreme events have significant impact on the water availability and quality by the side of the environmental hazards. The implementation of climate Resilient WSP in four Pourashavas have resulted in reduction of such impact and made some noticeable improvements in the water supply systems. The assignment, which was intended to see that the Pourashava water supply system authorities are adequately motivated and strengthened to implement water safety plan in their respective water supply systems by them by focusing on preventive maintenance, has achieved its goal substantially in its first year. The awareness raising events and improvement actions taken by the Pourashavas are gradually improving the consciousness among both users and PWSS staffs. The documented climate resilient WSP was one of the effective outcomes from this assignment. It is expected that the WSP document for these four Pourashavas will be utilized in prioritizing interventions that are needed to improve the water supply systems and to gain confidence of users. The documented climate resilient WSP will also attract other development partners and investors for further improvement. The systematic approach suggested would help PWSS staff to gradually overcome the limitations too, that often drive them to compromise with water quality.

One of the major outcomes of this assignment was the improved understanding and relationships among DPHE and PWSS staff, and the collaborative approach throughout the project period. The WSP approach was not very familiar to all the staff at the beginning of the programme. But the local level trainings, meetings, awareness raising events and progress monitoring activities have created an enabling environment for PWSS staffs to seek technical knowledge on management of the water supply systems through the implementation of the climate resilient WSP. Overall, the program was able to motivate the PWSS staff and the Pourashava authority to continue the climate resilient WSP onwards, which would contribute for the improvement of water quality and availability as well as would help to gain better participation from authority and users in these Pourashavas as far as water supply, is concerned.

5.2 Recommendation

As all the four Pourashavas have experienced the benefit of climate resilient WSP in this short period, it is expected that they would continue the progress, since all these Pourashavas have their own climate resilient WSP, including all the action plans. However, based on the learning of this assignment, and received feedback from PWSS and DPHE staff who were involved in climate resilient WSP implementation in four Pourashavas, few recommendations are made here for future consideration:

- The Pourashava need keeping the records of climate variability considering rainfall, temperature, humidity and climate extreme events by side of environmental hazards and health outcomes for better planning and improvement of supply systems
- All kinds of trainings need to be arranged at local level where the trainees would get i) chance to work directly with their own system at field, ii) higher number of participants could attend.
- Computerized system could be adopted for record keeping of the climate resilient WSP's operational monitoring activities carried out by PWSS staff. This will help them to check the results instantly. One staff could be appointed to update the records in a developed format in each Pourashava. The computerized system could be developed by DPHE involving PWSS staff.
- Pourashavas should arrange at least one "exposure visit" per year where they will invite PWSS staff from other Pourashavas. It will provide the opportunity to exchange ideas as well as incentives for PWSS staff to follow the WSP efficiently.
- Education institutes (schools, colleges etc.) need to be given priority for awareness campaigning to reach more people with the WSP messages effectively.
- A yearly follow-up monitoring program in all four Pourashavas could be planned to assess the progress of climate resilient WSP by DPHE.