

Vulnerability and Adaptation to Climate Change in Coastal and Drought Prone Areas of Bangladesh: Health and WASH



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Study Management and Technical Inputs

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EXECUTIVE SUMMARY

Water scarcity and poor water quality contributed significantly to direct and indirect health impacts related to water born, vector-borne diseases water related diseases such as diarrhoea, dysentery, arsenicosis etc. which reduces the health security of livelihood. Despite substantial gains in provision of safe water supply in many areas of Bangladesh through improved water supply sources comprising different types of water technologies, some regions of Bangladesh still continued to suffer from water scarcity and quality. Information on the extent to which long term climate changes, weather variability have already been impacted or will impact on water availability and water quality with subsequent impacts on health across country is limited, though future projections of climate change for the South Asian region illustrated that drought conditions will be worsen and water quality issues related to extreme events, flooding, sea-level rise and saline intrusion will continue.

This study was undertaken by the Environmental Health Unit of WHO to gather some preliminary evidence of the community perceptions about climate changes, weather variability and climate extremes in coastal and drought prone areas on livelihood mainly in relation to the water and health and the capacities of the communities for adaptation. The study primarily focused on qualitative data collected through observations, workshops and key informant interview to gather perceptions of the community people, health and water professionals and workers and secondarily a limited scale purposive sample survey. Three field sites were chosen comprising of two sites in the coastal areas (Pattashi Union of Zianagar upazila of Pirojpur district and Patharghata union, Patharghata upazila of Barguna district) and one in the drought-prone area (Sapahar union, Sapahar upazila, Naogaon district). The meteorological data, disease data and WASH related data were collected form the respective upazila offices and from internet resources. The qualitative and quantitative data were used for painting the picture of climate change impact and short term weather variability on communities. The existing system capacities (health and water) of to cope with the current issues and what the needs would be into the future as climate changes continues were also collected from the sub district level.

The communities of drought prone site was identified as most vulnerable to climate changes associated with reduced rainfall and reliability of seasons which impacted the drinking water supplies, agricultural production, livelihood and has been exacerbating poverty. In this area, insufficient water round the year has been leading to sanitation and hygiene problems. The use of contaminated untreated water increased the risk of water-borne diseases. It was found that the increased prevalence of diarrheal incidences in the dry season was related to the consumption and use of unsafe water. The tube wells were the dominant water source for drinking and pond water was the most common source for cooking and washing. However, despite the diversity, some of those have very limited coverage (e.g., central water supply) many of them were not active (e.g., Tube wells) and many were not active during certain periods of the year (e.g., ponds, ring wells and rivers/canals). The problem of insufficient water for drinking in this area was compounded by the domination of agriculture for livelihoods and the reliance on natural rainfall for agriculture. This had impacts on food, nutrition and impacted on mental health of the people as well. The study identified that the existing health system was inadequate and less ability to cope with the health impact of climate change and weather variability. This study also identified that there will be significant challenges in this drought-prone community for adapting to climate change and short term weather variability as there was an existing adaptation deficit, particularly in relation to sustainable water supply.

The coastal communities were identified as being vulnerable to climate changes associated with increased rainfall, more frequent and extensive flooding, extreme temperatures (hot and cold) and sea-level rise. Changes in seasonal patterns were also frequently mentioned. The most reported impact of climate change was basically on the agriculture, livelihood, water quality and health. Water quality was the primary concern among the coastal community and the self reported water use data suggested that many households in this region has been using pond or river water, not only for cooking and washing but also for drinking. The key problem associated with water quality was related to salinity of tube well water. It not only made water quality poor, but also reduced the functionality of the tube wells as well. The poor quality of tube well water turned many people to collect water form canal/river/pond for drinking and other household uses (e.g., cleaning) and even if they used safer alternatives for drinking (disinfection or rainwater), many still used pond water for cooking and cleaning and washing. Diarrhoea and dysentery were the most common reasons for hospital visits though different seasonal patterns were identified by different data collection methods. The identification of the seasonal patterns of diarrhoea may provide clues to their cause and need to be studied further in future studies.

In drought prone area investment is required for providing sufficient water that fits the purpose, with a priority given to the drinking water. The restricted water supply for agriculture was also associated with indirect health impacts relating to nutrition and mental health and as such significant work is required to assess how the community can adapt to these more broad impact changes. In coastal area investigation of utility of existing water supplies (e.g. PSF and deep tube wells) to either fix or replace and comprehensive assessment of alternative supplies that can provide sustainable supply of water that is fit for purpose and resilient to extreme events. The impacts of salinity on the broader issue of livelihoods also require assessment of adaptation strategy. Recommendations for all communities in two geographic sites are:

- Improved consideration of health prevention activities within the health services to include behavior change around sourcing of safe water, fit-for-purpose use of water, sanitation and hygiene and waste management to help build resilience in the community and assist with adaptation to climate changes.
- Improved community engagement to identify current coping strategies and to collectively work out ways to better adapt to the future impacts of climate change.
- Improved multi-sectoral engagement (environment, health, water, agriculture) to respond to the many challenges that climate change is already bringing to these vulnerable communities.
- Capacity building in the local government about climate change, potential impacts and adaptation options.

The broader recommendations to enhance vulnerability assessments and evidence base for adaptation to health in Bangladesh include: A system for climate sensitive disease surveillance system needs to be established to enable local vulnerability assessments. This system should include, a set of climate sensitive disease/health indicators, including potential vulnerable populations (e.g. age, gender sensitivities); an awareness in upazila health staff of the importance of routine diagnosis, recording and collection of data; reporting of such data to higher tiers of the health system to allow for improved decision making at higher levels; quality assurance measures to ensure high standards of collection of data and reporting; daily data to allow for seasonal and cyclical patterns of CSD monitoring. Larger studies consisting of more and diversified information is required for better understanding of vulnerabilities and adaptation capacity of the communities as well as the health and WASH system for addressing larger population of the area.

Table of Contents

Page

1.0 Overview of Health, WASH and Climate Change in Bangladesh.....	1
1.1 Geography, Climate and Climate Variability	1
1.2 WASH Coverage and Interventions.....	3
1.3 Health System, Current Health Status and Climate Sensitive Health Outcomes.....	5
1.4 Population Vulnerability	6
2.0 V&A Assessment Background.....	6
3.0 Assessment Objective.....	7
4.0 Assessment Methodology.....	7
4.1 Tools and Techniques.....	7
4.2 Field Sites	7
4.3 Data Collection Method and Analysis	8
5.0 Findings by Geographic Area	11
5.1 Drought Prone Area	11
5.1.1 General Community Profile.....	11
5.1.2 Meteorology and Extreme Events	12
5.1.3 Health Profile and Trends	13
5.1.4 General WASH Technology Profile.....	16
5.1.5 Health Vulnerabilities.....	17
5.1.6 WASH Vulnerabilities	18
5.1.7 Adaptive Capacity of Sapahar Population.....	19
5.2 Coastal Area	20
5.2.1 General community Profile	20
5.2.2 Meteorology and Extreme Events	23
5.2.3 Health Profile and Trends	24
5.2.4 General WASH Technology Profile.....	29
5.2.5 Health Vulnerabilities.....	30
5.2.6 WASH Vulnerabilities	31
5.2.7 Adaptive capacity of the communities	32
6.0 Overall Discussion.....	34
7.0 Study Limitations.....	37
8.0 Recommendations	38

List of Figures

<i>Title</i>	<i>Page No</i>
<i>Figure 1 Photograph of Community Workshop</i>	8
<i>Figure 1 Photograph of interview conducted professional of UH&FPO office</i>	8
<i>Figure 3 Photograph of household survey</i>	9
<i>Figure 4 Respondent's education level (%) in Sapahar union</i>	11
<i>Figure 5 Most commonly mentioned impacts of climate change in Sapahar</i>	12
<i>Figure 6 Sector wise impacts of climate change in Sapahar</i>	12
<i>Figure 7 Decadal mean temperature and rainfall pattern in the drought region</i>	13
<i>Figure 8 Health cases for the years 2012 to 2014 recorded for various climate sensitive health issues for the Upazila health complex (includes Sapahar field site</i>	14
<i>Figure 9 Health facility visited to receive treatment for reported health conditions</i>	14
<i>Figure 10 Community reported visits to a health service for a range of CSD conditions in Sapahar</i>	14
<i>Figure 11 Seasonal distribution of commonly reported health conditions for which respondents seek health services in Sapahar</i>	15
<i>Figure 12 Community responses for related links between climate change and health impacts in Sapahar</i>	15
<i>Figure 13 The matrix of impact of climate change and short term weather variation on water supply technologies as mentioned by the workshop participants qualitatively</i>	17
<i>Figure 14 Respondent's education level (%) in Pattashi union</i>	20
<i>Figure 15 Respondent's education level (%) in Patharghata union</i>	20
<i>Figure 16 The climate changes observed by the community in Zianagar</i>	21
<i>Figure 17 The climate changes observed by the community in Patharghata</i>	21
<i>Figure 18 Sector mostly impacted due to climate change in Zianagar</i>	22
<i>Figure 19 Sector mostly impacted due to climate change in Patharghata</i>	22
<i>Figure 20 Decadal mean temperature and rainfall pattern in the coastal region</i>	23
<i>Figure 21 Health cases for the years 2012 to 2014 recorded for various climate sensitive health issues for the Zianagar Upazila</i>	24
<i>Figure 22 Health cases for the year 2014 recorded for various climate sensitive health issues for the Patharghata Upazila</i>	24
<i>Figure 23 Community reported visits to a health service for a range of CSD conditions in Zianagar Upazila</i>	24
<i>Figure 24 Seasonal distribution of commonly reported health conditions for which respondents seek health services in Zianagar Upazila</i>	24
<i>Figure 25 Community reported visits to a health service for a range of CSD conditions in Patharghata Upazila</i>	25
<i>Figure 26 Seasonal distribution of commonly reported health conditions for which respondents seek health services in Patharghata Upazila</i>	25
<i>Figure 27 Health facility visited to receive treatment for reported health condition in Zianagar</i>	26
<i>Fig 28 Health facility visited to receive treatment for reported health condition in Patharghata</i>	26
<i>Figure 29 Community responses for related links between climate change and health impacts in Zianagar</i>	26
<i>Figure 30 Community responses for related links between climate change and health impacts in Patharghata</i>	26
<i>Figure 31 The matrix of impact of climate change and short term weather variation on water supply technologies as mentioned by the workshop participants qualitatively</i>	28

List of Tables

<i>Title</i>	<i>Page No.</i>
<i>Table 1 Description of different data collection methods used at each field site</i>	<i>9</i>
<i>Table 2: Access to, and cost of health treatment for survey respondents in Sapahar</i>	<i>15</i>
<i>Table 3: The functionality of the public water points in Sapahar upazila with respect to seasons</i>	<i>17</i>
<i>Table 4: Respondents access to the health service and cost involvement for treatment in the study Upazila</i>	<i>27</i>
<i>Table 5: Drinking water sources and their status for 3 unions of Zianagar Sub-district</i>	<i>30</i>
<i>Table 6: Water sources and their status for all unions within Patharghata sub-district</i>	<i>30</i>
<i>Table 9: Qualitative assessment of vulnerability related to drinking water sources</i>	<i>34</i>

Abbreviation

SLR	Sea Level Rise
MSL	Mean Sea Level
IPCC	International Panel of Climate Change
WASH	Water Supply Sanitation and Hygiene
ADB	Asian Development Bank
MICS	Multiple Indicator Cluster Survey
cfu	Coliform Unit
CC	Climate Change
MOHFW	Ministry of Health and Family Welfare
UHC	Upazila Health Complex
UHFWC	Union Health and Family Welfare Centre
MCH	Maternal and Child Health
HNP	Health National Plan
CSD	Climate Sensitive Disease

1.0 Overview of Health, WASH and Climate Change in Bangladesh

1.1 Geography, Climate and Climate Variability

Bangladesh is a South Asian republic bordering India, Myanmar and the Bay of Bengal, one of the largest deltas in the world, formed by the dense network of large rivers namely the Ganges, the Brahmaputra and the Meghna. It has nearly 600 kilometres of coastline and a total land area of 147,570 sq. km. Bangladesh is the seventh most densely populated country in the world.

The country has a humid, warm, tropical climate. Its climate is influenced primarily by monsoon and partly by pre-monsoon and post-monsoon circulations. The south-west monsoon originates over the Indian Ocean and carries warm, moist and unstable air. In Bangladesh there are four prominent seasons, namely, winter (December to February), Pre-monsoon (March to May), Monsoon (June to early-October) and Post-monsoon (late-October to November)¹. The monsoon has its onset during the first week of June and ends in the first week of October, with some inter-annual variability. January is the coldest month, with having temperatures averaging 26°C (78°F), and April is the warmest month, with having temperatures ranging from 33°C to 36°C (91°F to 96°F). Most places of the country in general receives more than 1,525mm of rain a year, and the areas near the hills receives 5,080mm mostly during the monsoon (June-September) and little in the winter (November-February). The humidity varies from 73% to 86%, the highest in the monsoon and the lowest in the winter.² Since 1960 there has been widespread warming over Bangladesh during both the hot season (March to May) and cool season (December to February). There also has been a reduction of the number of cool nights and an increase in the number of warm nights over the period 1970-2000 and there has been a small increase in total precipitation over Bangladesh since 1960.

Bangladesh is extremely vulnerable to extreme weather events particularly flooding, drought, sea level rise, cyclones and storms and storm surges due to its geography (proximity to Bay of Bengal and Himalayas) and its topography, all land types except highlands are exposed to monsoon flooding for a part or all of the year. Floodplains located in the north-western, central, south-central and north-eastern regions are subject to regular flooding at different frequency and intensity. About 10% of the country is barely one metre above the mean sea level (MSL), and one-third is under tidal excursions. The country has three distinct coastal regions—namely, western, central, and eastern coastal zones. Several studies showed that Bangladesh is one of the countries on the globe that is most vulnerable to the impact of sea level rise (SLR). Ironically, considering its tropical status, drought is also a recurring problem in Bangladesh and between 1960 and 1991 a total of 19 droughts occurred. The southwest and northwest regions of the country are most vulnerable to drought.

There is limited data available within the country for climate projections. A Climate Change Resilience Fund³ project has been commissioned (Making Climate Data Relevant to Decision Making in

¹ Agrawala, S., Ota, T., Ahmed, A., Smith, J. a., & Aalst, M. (2003). *Development and climate change in bangladesh: focus on coastal flooding and the sundarbans*, Organisation for Economic Co-operation and Development

² Source: DGHS, 2010

³ Bangladesh Climate Change Resilience Fund (BCCRF) – 2012 Annual Report, prepared by World Bank, BCCRF and MoEF

Bangladesh: Spatial and Temporal Downscaling) to provide more regional level data for Bangladesh to assist in prioritizing vulnerable regions/areas and for better identification of the environmental changes in the future. In the absence of such data, three most recent documents namely AR5 models, scientific authority (IPCC reports) and regional coverage (e.g. South Asia) are used to reflect the most up-to-date projection.

The A1B emissions scenario projected that the temperature of Bangladesh will be increased to 3 to 3.5°C by 2100. If the temperature of the world increased to 4°C the northern part of Bangladesh will shift to new climatic regimes, with the monthly temperature distribution moving 5–6 standard deviations toward warmer values.⁴ The updated AR5 South Asia projections indicated for future increase in extreme temperatures in this region.

Precipitation is projected to be increased in Bangladesh under the A1B emission scenario and 20% rainfall could be increased in the north part of the country and 5-10% more typical through the rest of the country. Agreement across the CMIP3 ensemble is moderate to high.⁵ As projected in most modelling studies, increases in inter-annual and intra-seasonal variability of rainfall will lead to future increase of frequent years with above-normal monsoon rainfall and years with extremely deficient rainfall; more rainfall during the wet season, an increase in the number of dry days and droughts; and an increase in the number of extreme precipitation events.⁶ The AR5 South Asia projections also indicate a future increase in extreme precipitation within this region.

The climate change projections obtained from the few available global and regional assessments indicated that Bangladesh could be exposed to moderate to high water stress with climate change. This will further exacerbate water quality problems related to other drivers (industry, irrigation etc.).⁷ Recent simulations obtained from AVOID program broadly agree with global and regional scale studies which projected an increase in water stress for Bangladesh as a whole with having a high uncertainty at large about the projected changes. Recent studies indicated that there was an increase of mean and extreme precipitation over Bangladesh. Large uncertainties remained, particularly with respect to how the large-scale Asian monsoon system might respond to climate change and changes in precipitation associated with tropical cyclones. A number of studies suggested that fluvial flooding could increase in Bangladesh with climate change.

Estimates of future tropical cyclone related damages in Bangladesh due to climate change are highly uncertain. AR5 report for South Asia indicated a low confidence in projections for cyclones in the region. Most projections were for reductions in frequency but the impact on intensity is highly uncertain. It was predicted that the cyclones may penetrate further inland and the cyclone high risk areas were likely to be

⁴ World Bank, (2013). *Turn down the heat: Climate extremes, regional impacts, and the case for resilience. A report for the World Bank by the Potsdam Institute for Climate Impact Research and Climate Analytics.* Washington, DC: World Bank.

⁵ DECC (2011) *Climate: Observations, projections and impacts – Bangladesh* (<http://www.metoffice.gov.uk/media/pdf/1/q/Bangladesh.pdf>)- Commissioned by DECC, UK for 20 Countries – based on IPCC AR4 projections (CMIP3 Models)

⁶ World Bank, (2013). *Turn down the heat: Climate extremes, regional impacts, and the case for resilience. A report for the World Bank by the Potsdam Institute for Climate Impact Research and Climate Analytics.* Washington, DC: World Bank.

⁷ *Final Draft IPCC WGII AR5 (2014): Chapter 24 Asia*, (<http://www.ipcc.ch/report/ar5/wg2/>) Includes South Asia (which includes Bangladesh)

increased in size resulting from the associated increase in wind velocity and storm surge height⁸. A 10% intensification of the current 1-in-100-year storm surge combined with a 1m SLR could affect around 23% of Bangladesh’s total coastal land area. Increases in salinity intrusion as a result of SLR pose a serious issue for Bangladesh.

1.2 WASH Coverage and Interventions

Water, sanitation and hygiene (WASH) are essential for human health, welfare and livelihoods and yet to date 2.5 billion people are still without having access to improved sanitation and 780 million people are without having access to an improved water supply of the world.⁹ The World Health Organization (WHO) estimated that approximately 2.4 million deaths and 7% of the total disease burden could be prevented annually with safe WASH. Evidence suggested that the health impacts of WASH extended far beyond diarrhoea to include many other important diseases including acute respiratory infections, under nutrition, soil-transmitted intestinal helminth infection (ascaris, trichuris and hookworm), Schistosomiasis, Guinea worm, trachoma and certain non-infectious diseases associated with chemical water quality (arsenicosis and fluorosis). Improved hygiene can reduce the risk of acute respiratory infections (pooled estimate of 23% risk reduction).

WASH issues are led by the Department of Health and Engineering within the Ministry of Local Government, Rural Development and Cooperatives in Bangladesh. The groundwater is the major source of drinking water in Bangladesh. It offers great opportunities for sinking shallow and deep wells in most areas, and these have gradually been availed of by most of the population. There are now around 7.0 million tube wells (hand pump tube wells, deep set tube wells, and deep tube wells) in the country. The average number of people served by a tube well is 20.¹⁰ The tube wells have ensured basic levels of drinking water supply to most of the population, and this could be called a success of sorts, although the poor peoples are often still have no access close to their homes. Although more than 80% of the populations have access to some form of improved water supply, unfortunately the arsenic contamination of wells has complicated the situation by causing considerable health problems since it was discovered in 1993. Between 16% and 25% of all existing wells in Bangladesh are contaminated by arsenic. About 29% of the shallow tube wells were contaminated with bacteria, mainly due to poor

BOX 1: Existing Water Supply and Sanitary Technologies in Coastal and Drought Area

Technology	Coastal Area	Drought Area
Dug Well		✓
Pond Water	✓	
Shallow Tube Well	✓	✓
Deep Tube Well	✓	
Pond Sand Filter	✓	
Rain Water Harvester	✓	
Sanitary Latrine	✓	✓

⁸ Tanner TM, Hassan A, Islam KMN, Conway, D, Mechler R, Ahmed AU, and Alam, M (2007) ORCHID: Piloting Climate Risk Screening in DFID Bangladesh. Detailed Research Report. Institute of Development Studies, University of Sussex, UK

⁹ WHO/UNICEF JMP (2010): Progress on drinking water and sanitation

¹⁰ ADB (2009) Sector assistance program evaluation for the urban sector and water supply and sanitation in Bangladesh: an exploratory evaluation of the programs of ADB and other aid agencies

maintenance of the tube well surroundings.¹¹ The most recent MICS survey (2012-13) found that that 97.9% of the people of the country has been using the improved water supply sources and 12.5% and 25.5% of people are exposed to arsenic contamination over the Bangladesh standard of 0.05 mg/l and 0WHO guideline value of .01 mg/l respectively. The survey also showed that 41.7% of the source water contained *E. Coli* concentration > 1 cfu which was increased to 61.7% at household level.

Sanitation coverage was very low in Bangladesh until recently. In 1991, less than 15% of the rural population had access to sanitary latrines. But gradually, the coverage has increased, notably due to the sinking of tube wells, which made more water available for cleaning; greater government effort; and improved primary health care. This has led to a drop in the number of fatalities from diarrheal diseases from 300,000 deaths per year in 1980 to about 150,000 in 1997.¹² However, although conditions have improved, the overall situation was still far from satisfactory since 2000s. The MICS survey (2013-14) revealed that 59.9% of the peoples have been using improved sanitation facilities.¹³

Child mortality stood at 76 per 1,000 live births in 2003, of which 20%–25% is assumed to have been caused by a lack of adequate sanitation and hygiene behavior. The recent MICS survey (2013-14) showed that 59.1% people have hand washing facilities of which 94% have soaps and other cleaning agents. Hygiene practices were poor, with only 43% of the population washing their hands with soap after defecation as found from the national hygiene survey.¹⁴

Scarcity of water can increase the possibility of drought which eventually increases the non-functionality of the rate of water technologies. This can also impact different hygiene issues like hand washing practice, sanitary latrine use etc. Excess water could impact in the same way including microbiological water quality deterioration. Storms, tidal surges, cyclone may also impact in the same way either by destroying water sources or by mixing up human excreta and other waste with water bodies. In the western part of the country, a silent disaster has been affecting about 20% of the geographical area. In this region, frequent drought coupled with excessive groundwater withdrawal for irrigation is continually responsible for the drawdown of the aquifers. As a consequence of this drawdown, the shallow tube wells remain seasonally defunct challenging communities to find alternative water resources. This also posed challenge to households in securing water for the use of latrines and other hygiene practices.

Water issues are consistently identified as a significant climate change impact for Bangladesh. Water supply is challenged in some parts of the country where droughts are more common and in dry seasons due to limited storage and water contamination of natural water sources. Flooding is associated with elevated drowning risks, increased skin contact with contaminated water and seasonal water quality issues due to disruption to normal supplies and contamination of surface water supplies. Water-logging can

¹¹ ADB (2009) *Sector assistance program evaluation for the urban sector and water supply and sanitation in Bangladesh: an exploratory evaluation of the programs of ADB and other aid agencies*

¹² ADB (2009) *Sector assistance program evaluation for the urban sector and water supply and sanitation in Bangladesh: an exploratory evaluation of the programs of ADB and other aid agencies*

¹³ URL: http://www.unicef.org/bangladesh/MICS_2012-2013_Key_Findings.%282%29.pdf

¹⁴ Bangladesh May be national hygiene survey?? Bangladesh National Hygiene Baseline survey (June 2014): International Centre for Diarrheal Diseases Research, Bangladesh (icddr,b) WaterAid Bangladesh, Policy Support Unit (PSU), Local Government Division, Ministry of Local Government, Rural Development and Cooperatives, Dhaka, Bangladesh

impact on skin diseases. Cyclones and associated storm surges disrupt access to supplies and damage infrastructure and also affect water quality. Sea level rise and subsequent salinity presents significant challenges for water quality and water availability for food production and in the long term may be responsible for food shortages and population displacement.

1.3 Health System, Current Health Status and Climate Sensitive Health Outcomes

The health system of Bangladesh is dominated by the public sector. The private sector is operated by local entrepreneurs, different NGOs and international organizations. In the public sector, the Ministry of Health and Family Welfare (MOHFW) is the lead organization for policy formulation, planning and decision making at a macro and micro level. Under the ministry, four Directorates are operational namely Directorate General of Health Services, Directorate General of Family Planning, Directorate of Nursing Services and Directorate General of Drug Administration provide and has been providing health services to the citizens (WHO, 2012). Primary health care in the public sector is systematized around the Upazila Health Complex (UHC) at sub-district level, which works as a health-care hub. These health care complexes have both in- and out-patient services and care facilities. At lowest administrative level, the Union Health and Family Welfare Centre (UHFWC) and Community Clinic (CC) have been providing health services. Two or three sub-centres existed at the lowest administrative level with having a network of field-based functionaries. (WHO, 2010)

Non-Government Organizations (NGOs) contribution for growing sources of HNP services in both rural and urban Bangladesh is significant. Their services have mainly been in the areas of family planning and maternal and child health (MCH). More recently, NGOs have extended their range of services and now became the major providers of urban primary care where the government's system is not capable to serve sufficiently to the large population. Additionally, NGOs are committed to teaching health awareness by providing health counselling. They have successfully shown that they can improve people's health by suggesting lifestyle changes. The government does not provide and promote such health awareness-related services as readily as the NGOs do. Thus, the NGOs have effectively filled in many gaps of the government's health system, supplementing and supporting it so as to provide more people with necessary health care.¹⁵

The recent AR5 model predictions suggest that the top 5 health impacts in the South Asia region will be related to floods, heat, drought, water-borne disease and vector-borne disease. Such figures indicated that the importance of water-borne and vector-borne health impacts and the potential disease burden associated with extreme events. Some studies in Bangladesh have explored health issues and climate change adaptation for particular vulnerable populations such as urban slum dwellers and others have analysed the direct and indirect reproductive health impacts of climate change. Studies are limited due to absence of high quality temporal and spatial health data which allow for assessment of changes in climate

¹⁵ Chowdhury, A.M.R, Bhuiya, A., Chowdhury, M.E., Rasheed, S., Hussain, Z, Chen, L.C. (2013) *The Bangladesh Paradox: exceptional health achievement despite economic poverty*, *The Lancet*, v382, pp1734-1745

sensitive disease in time and space and the ability to control for other key non-climate variables that influence prevalence and distribution of climate sensitive diseases.

1.4 Population Vulnerability

The population of Bangladesh is 158,570,535 according to 2011 census conducted by Bangladesh Bureau of Statistics. In 2011 an average of 964 inhabitants' lived per square kilometre area making the country one of the highest densely populated country in the world.

The risk of mortality, morbidity and depletion of livelihood in a densely populated area is normally high. But when the climate extreme events like flood, drought, cyclone, sea level rise are considered such risks became extremely high as well. This high density of population means that the extreme events regularly impact the livelihood of thousands of people, and these events have been increasing as observed from different statistics hence increasing potential mortality and morbidity. Furthermore, this high density also

means that there are limited opportunities for large scale population for migrating within the country without putting significant strain on existing infrastructure in destination communities. According to the Sample Vital Registration Survey 2009, two-thirds of the population (63%) live in rural areas. Currently about 8.3 million people live in cyclone high risk areas and, based on projections of future population density, this will increase to 14.6 million in the 2020s and 20.3 million in the 2050s.¹⁶

BOX 2: Population Distribution

Geophysical Area	Population
Coastal Area	3,8517,698
Drought Area	3,42,72,616
Hilly Area	15,87,000
Flood Prone Area	1,06,55,145
Other Area	73,538,076
Total	158,570,535

2.0 V&A Assessment Background

The assessment was undertaken for better understanding about the vulnerabilities of the community people due to the impact of climate change and its links to WASH and health in Bangladesh. This particular project/study used a case study approach to examine vulnerabilities and adaptation needs to climate change considering the WASH and health issues in a drought prone and coastal areas of Bangladesh. As climate change will impact on health through many pathways, the water pathway was the focus of this project as it was a significant one for Bangladesh due to its topography, population and existing water supply and quality challenges. The focus was water and its direct and indirect impacts on health.

The WHO and DPHE has been jointly implementing a pilot project named as "Building adaptation to climate change in health in least developed countries through resilient WASH" with the financial assistance from DFID. The project is designed to reduce the health and health system's vulnerabilities in rural and urban area especially related with WASH. Therefore, a detailed assessment followed by an adaptation strategy is required for the determination of the possible intervention for the reduction of the health and health systems vulnerability in some coastal and drought prone areas of the country. Further

¹⁶ Tanner TM, Hassan A, Islam KMN, Conway, D, Mechler R, Ahmed AU, and Alam, M (2007) ORCHID: Piloting Climate Risk Screening in DFID Bangladesh. Detailed Research Report. Institute of Development Studies, University of Sussex, UK.

this assessment will develop a scientific base to inform ongoing NAP process for inclusion of its key component as H-NAP.

3.0 Assessment Objective

The overall objective of the study is to assess the vulnerabilities and adaptation capacity of specific communities and the health system considering the climate variability and change with special emphasis on WASH activities in coastal and drought prone areas of Bangladesh and make recommendations for adaptation practices. The specific objectives are:

- a. To assess the potential health risks associated with the current climate variability and change in coastal and drought prone areas,
- b. To assess the potential health risks specifically associated with water availability and quality considering climate variability in coastal and drought prone area,
- c. To determine the relationship between the climatic determinants (temperature, rainfall, humidity and extreme events) with different diseases (water born, water washed, water related, vector born and temperature related diseases) in coastal and drought prone area
- d. To make recommendations to reduce health vulnerability especially in relation to WASH and other key determinants in coastal and drought prone areas
- e. To make recommendations for the national scenario on the basis of the assessment of the vulnerabilities and adaptation needs of the case study areas.

4.0 Assessment Methodology

4.1 Tools and Techniques

This study was conducted by using both qualitative and quantitative methods. The tools used for the study included a survey questionnaire, community workshops and in-depth interviews. The survey questionnaire were pretested and modified according to the findings from pre-testing before data collection. Group interviews and workshops were facilitated by two project consultants from CEPH of Griffith University. A WHO professional attended most sessions and explained the purpose of the study. Data collectors from local NGOs were engaged to conduct the household survey and collect available health data from upazila health complex and WASH data from the upazila DPHE office.

4.2 Field Sites

The field sites in coastal and drought prone area were pre-selected by the professionals of DPHE and EHU-WHO Bangladesh after a rigorous exercise by considering the climate change perspective. A total of three communities (one in drought prone area and two in coastal area) were selected within 3 distinct geographical areas to understand the impacts of climate change on water supply, water quality, health and livelihood of the people. Multiple communities from the coastal region provide an idea of consistency of issues and relationships and differences/similarities in adaptation within communities facing similar exposures to climate change impacts. The field sites chosen for this study are:

1. Drought prone area: Sapahar Union, Sapahar Upazila, Naogaon District

2. Coastal area: Pattashi Union, Zianagar Upazila, Pirojpur District
3. Patharghata Union, Patharghata Upazila, Barguna District

4.3 Data Collection Method and Analysis

The methods used for primary data collection included a community workshop, key stakeholder interviews (group and individual) and a community survey. Secondary data from hospitals were also sought in order to identify community health status and any patterns in climate sensitive diseases across years and within years (seasonal variability). Drinking water source information was collected from each field site at Upazila level to identify the diversity of sources and their status. A summary of methods used is provided in Table 1.

Two different groups were interviewed one representing more senior officials, the others representing those health and water workers at the community level to capture the diversity of experience and understanding of water and health professionals at a community level. Workshop participants and interviewees were identified in each community through the support of the local NGO who worked within each community to ensure representation met with the objectives of the project. Workshops and interviews were conducted by



Figure 1: Photograph of Community Workshop

trained facilitators and material from each was audio recorded (with participant's permission) and notes were also taken for each session. Recorded material and notes were summarized against the key items of the workshop and interviews.



Figure 3: Photograph of interview conducted professional of UH&FPO office

A random village was chosen from within the field site and every 10th household was surveyed. If there were no more households within a union then the surveyor sampled from a neighboring union. This was considered suitable to meet the objectives of this case study methodology and to assist with triangulation of data collected through other methods. Household surveys were conducted face

to face with an adult household member by interviewers who had knowledge of the local communities and also who had had experience conducting community surveys. The housewives were mainly targeted for interviewing in Sapahar. The surveyors were trained initially and their work was overseen by an experienced local community development officer. All surveys were conducted between December 2014 and January 2015.

One community workshop and two group interviews for each site were conducted. A total of three community workshops and six group interviews were conducted to provide the necessary information. In addition a total 300 household surveys were selected purposively (100 from each union) considering time, budget and need.



Figure 3: Photograph of household survey

An identified list of climate sensitive diseases (**Appendix 3**) was provided to seek health record data from the relevant sub-district hospital and monthly data were collected by considering the age, for the previous 5 years. The information was sought to identify changes of disease pattern within years and over time. Despite specific requests for data, time periods provided and the full range of disease/health issue attendances requested were limited by record availability. Data on water sources was collected with the permission of the local DPHE engineer. The most up to date information was gathered from written records.

Quantitative Data Assessment

Health record data was entered into Excel worksheet, checked, corrected as and when necessary and analyzed by using SPSS. Descriptive statistics and trends over time were assessed for each field site. Descriptive statistics were calculated and displayed for key variables using SPSS and Excel.

Qualitative Overall Assessment

Workshop and interview information was summarized and key issues identified against each key component. Climate change, water and health risk was identified on the basis of environmental changes (e.g. exposure), sensitivity to impacts of these changes (e.g. population's vulnerability, existing health issues). Adaptation included elements of adaptive capacity (e.g., poverty) of existing projects, existing water sources and existing health system capacity.

Table 1: Description of different data collection methods used at each field site

No	Method	Description
1	Community Workshop	Community workshops were conducted to engage with diverse representatives from the community. These included local government elected representatives, teachers, imam, farmers, business men, NGO workers, and general community including mothers and women's group representatives. The workshop was divided into 5 parts namely climate change experience, climate change impacts, capacity of existing systems (with focus on health) to cope with or adapt to climate changes, existing management/policy/projects for climate change, future needs for adaptation

No	Method	Description
		<i>(Appendix 1 for questions used to guide workshop)</i>
2	Interview with Health/Water Workers at Sub District and Union Level	A range of health professionals and health workers from the Upazila health complex, community clinic, pharmacy's; WASH professionals, workers (mechanics) from upazila DPHE office were interviewed to seek their views based on their engagement and experiences with the community about general health issues, changes in health conditions, water supply and quality and relation of climate change including their capacities, vulnerabilities and adaptation. <i>(Appendix 2 for questions used to guide interview)</i>
3	Community Health Survey	A community health survey was conducted to obtain input from a larger number of families in the community in relation to climate changes, impacts, water and health issues <i>(Appendix 4 for survey tool used)</i>
4	Health data form Upazila	Community health profile data and monthly/daily data of climate-sensitive diseases were obtained from Upazila hospitals.
5	Water source data	Information on drinking water sources was collected manually from staff of Upazila DPHE office in the field site which included functionality and water availability and quality for each source.

5.0 Findings by Geographic Area

5.1 Drought Prone Area

5.1.1 General Community Profile

Sapahar union of Sapahar Upazila of Naogaon district of Bangladesh was selected as a drought prone area for this study. People's livelihood in this district is primarily dependent on agriculture and labor. A total of 100 respondents were interviewed in the Sapahar union. Respondents from Sapahar were predominantly housewives (95%). The average household size was four and 19% of households had a monthly income below BDT 5000 (≈USD 65) and another 80% had a monthly income between BDT 5000 and 8000. A large percentage of the surveyed group was illiterate or had less than a primary school education (combined 81%), followed by primary education (Fig. 4).

The second part of the survey referred to access to health services. This assists with understanding vulnerability, specifically adaptive capacity to water and other climate related health impacts.

The community people's knowledge regarding the observed climate change and its impacts was explored through this survey. The results indicated that in Sapahar, only 11% of the respondents had ever heard of climate change. The respondent's identified different types of impact of climate change including droughts (11%) and longer droughts (17%), less rainfall (24%) and increased

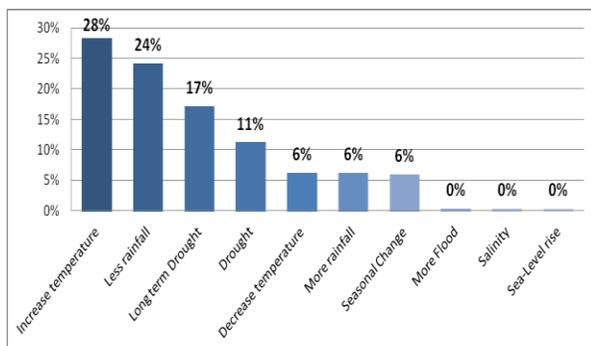


Figure 5: Most commonly mentioned impacts of climate change in Sapahar union

- Changing rainfall patterns (more intense rainfall but less of it and later than it used to be)

BOX 3: Sapahar upazila at a glance



Area:	22.5 km ²
Population:	28,737
Male:	14,632
Female:	14,105
Religion:	
Muslim:	25,283
Hindu:	2,835
Christian:	332
Buddhism:	01
Others:	286
Literacy:	52.41%
Poverty:	
Extreme poor:	9.0%
Poor:	21.4%

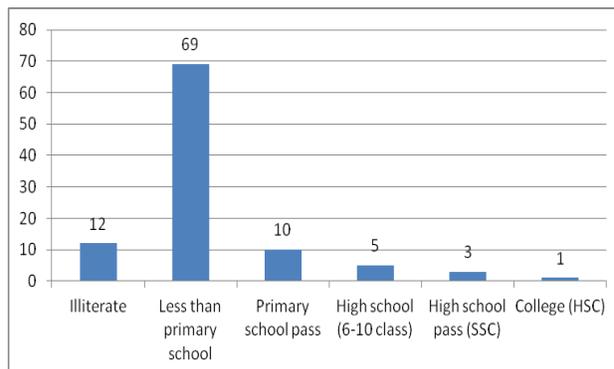


Figure 4: Respondent's education level (%) in Sapahar union

temperature (28%). Seasonal changes were also mentioned (6%) (Figure5).

Household survey findings were generally consistent with the findings of the community workshop and interview of health and water professionals. The key findings from the workshops and interviews were:

- Increased temperatures were reducing time for working and thus reducing income
- Reduced rainfall for grass for domestic animals like cows, that led to less milk

- Temperature increased in the dry season
- Colder temperatures in winter and winter starting earlier (in Sept not Oct)
- Intensity of storms had increased
- Natural equilibrium of seasons had changed

The community workshop and key informants identified the impact of climate change in the key sectors of agriculture, health, social and WASH. The participants mentioned that the impact of climate change on agriculture was prime and significant because of changing patterns of temperature and rainfall. The reduced ground water availability for irrigation impacted negatively on agricultural productivity. Due to the increase of hot weather and draw down of the water table, the area was under the threat of deforestation. Less agricultural productivity was impacting the status of poverty among the community people (farmers are producing only one crop per year now).

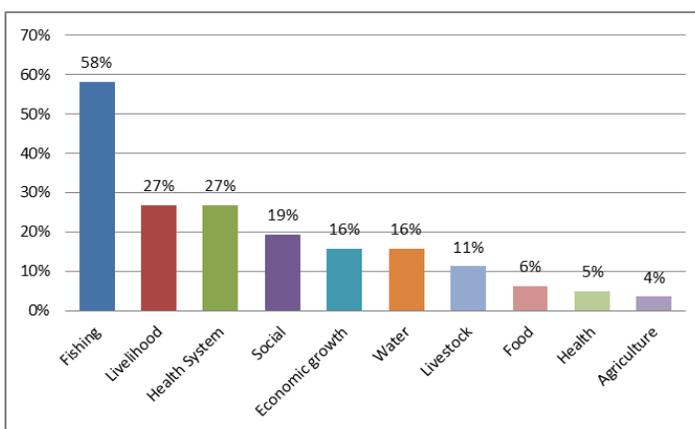


Figure 6: Sector wise impacts of climate change in Sapahar union

The finding of the household survey regarding the impact of climate change and in different sectors is presented in Fig. 6. As multiple responses were allowed a percentage of total number of responses was calculated to identify the reported distribution of types of impacts. Fig. 6 indicates that the community reported the greatest effects of climate changes in the agricultural sector followed by health and food.

5.1.2 Meteorology and Extreme Events

Climate change will exacerbate drought both in terms of intensity and frequency linked to higher mean temperatures and potentially reduced dry season precipitation. Monsoon rains produce 80% of Bangladesh's annual precipitation, and when it reduced, drought become a significant problem. The Southwest and Northwest regions are particularly susceptible to drought. Greater precipitation extremes associated with climate change also mean less rainfall in the dry season, which will increase water stress on those areas that already experience water shortages, particularly in the winter months. It is projected that, by 2020, from 500 to 750 million people will be affected by water stress caused by climate change around the world. In most countries like Bangladesh, yields from rain fed agriculture could be reduced to 50% by 2020. For a country like Bangladesh with increasing population it will have an extremely adverse effect on food security.

Site specific temperature, rainfall and humidity data were unavailable. The nearest weather station was located in Rajshahi district, 85 km from Sapahar. The long term temperature, rainfall and humidity were collected and decadal mean was calculated.¹⁷ The trends of temperature and rainfall is presented in Fig. 7

¹⁷ Data Source Climate <http://www.barcapps.gov.bd/dbs/index.php>

and indicated that the decadal mean maximum temperature has been increasing and the mean rainfall has been decreasing and indication of more droughts in coming time. The decadal mean humidity has also been increasing. The decade mean humidity in 1964-1973 was 74.31% which was increased to 78.41 in 2004-2014 indicated that more evaporation has been occurring as a result the surface water availability will be decreased gradually. The overall analysis results of the primary climatic parameters in regions indicated that there will be more probability of drought and desertification in the area.

The Sapahar sub-district community mentioned that the region had been experiencing hotter temperatures in the dry season, less rainfall overall, though more intense at some times

of the year, and an overall change in seasons, relating to time of onset and duration. The community survey also confirms these findings with 28% of the community surveyed indicating they had noticed increased temperature, 24% less rainfall, 17% longer droughts and 11% more droughts. Interestingly 6% indicated they had noticed seasonal changes and 6% noted both a decrease in temperature and more rainfall which suggests that seasons are more unpredictable and patterns have changed (Fig 5).

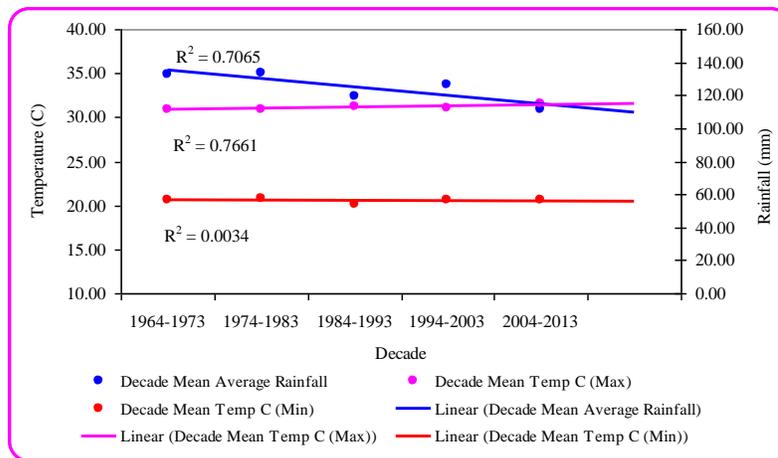


Figure 7: Decadal mean temperature and rainfall pattern in the drought region

5.1.3 Health Profile and Trends

Participants in the community workshops and interviewees mentioned that there were three prevalent health issues existed in the site namely diarrhoea, asthma and fever. The participants of the workshop also mentioned that the people who worked in the field in hot weather faced problem of 'foska' - local name 'pater pira' - a local name actually diarrhoea which was related with bad quality drinking water. They suggested that the water quality and scarcity influenced the water-borne diseases in that area. Respiratory illness and skin diseases were also notable in the site.

A summary of the number of cases recorded at the nearest health complex (Sapahar Upazila Health Complex) from the site for 3 years from 2012 to 2014 is presented in Fig. 8. The figure showed that the visits for diarrheal cases were highest **followed by mental illness and heart disease**. However, pneumonia, fever, cold and skin disease remained static for all of these years. The upazila health complex was the most common place to access health treatment (51% visit) followed by the community health center (28%) as the respondents of the Sapahar workshop mentioned (Fig. 9).

Fig. 10 showed the reasons for visits to a health facility reported by household respondents and their family members in the past 12 months. The figure showed that in Sapahar, fever dominates health service visits (24%), followed by dysentery (14%), respiratory/asthma (12%) followed by diarrhea and stomach conditions. Interestingly mental illness was indicated on 24 occasions (4%). It is clear from the Fig. 11

that, as a whole, there were a higher number of total cases of climate sensitive health issues requiring health services in winter in Sapahar (63% of total visits), compared with summer (16% of total visits) and the rainy season (20% of total visits) with elevated cases of diarrhea, dysentery, fever, colds, skin diseases and respiratory/asthma in particular.

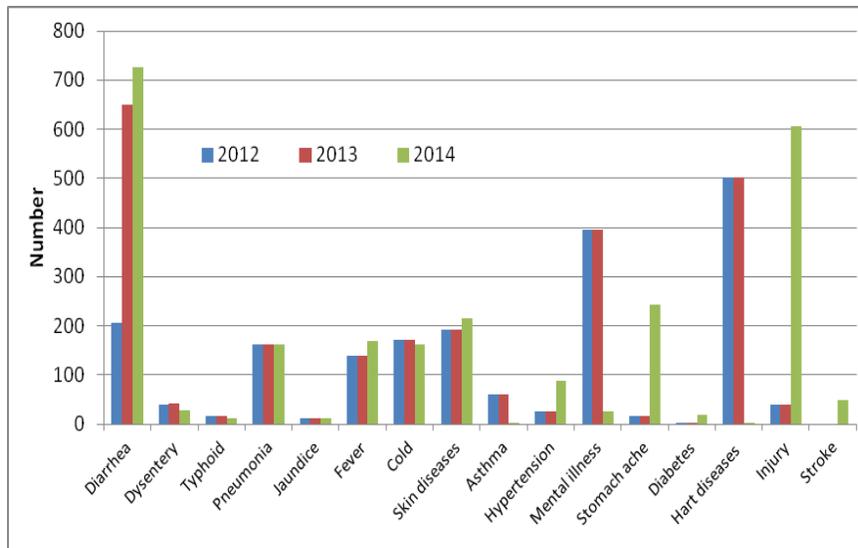


Figure 8: Health cases for the years 2012 to 2014 recorded for various climate sensitive health issues for the Upazila health complex (includes Sapahar field site)

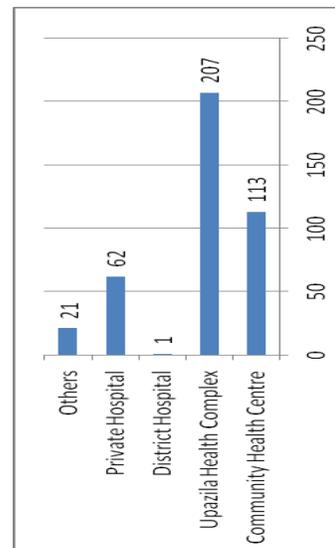


Figure 9: Health facility visited to receive treatment for reported health conditions

When respondents of the survey were asked about how climate changes might impact on health, responses were highest for diarrhea (24%) followed by dysentery (19%) and respiratory (20%) diseases. The full range of health outcomes identified by respondents of the survey is provided in Fig. 12.

The workshop and the interview participants reported similar issues with elaboration of some of the links between health, WASH and climate as summarized below:

- The respondents of the survey mentioned that water quality deterioration related to water scarcity has been impacting human health by creating water-borne diseases increasingly namely diarrhoea, cholera, hepatitis, typhoid. In addition the health professionals mentioned about increase of skin disease and respiratory illness.
- The people who work in the field in hot weather have problem of "foska"- a local name, diarrhoea, amassa, "pyater pira"

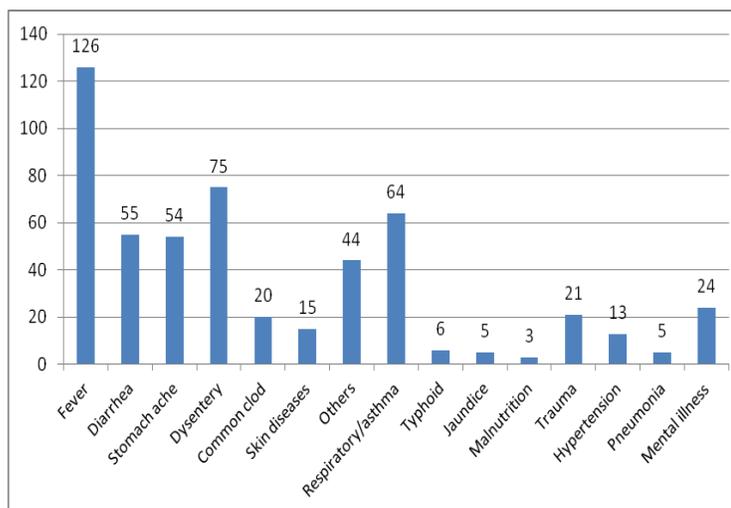


Figure 10: Community reported visits to a health service for a range of CSD conditions in Sapahar

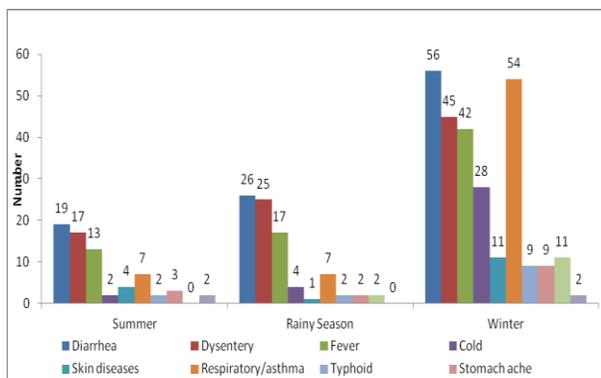


Figure 11: Seasonal distribution of commonly reported health conditions for which respondents seek health services in Sapahar

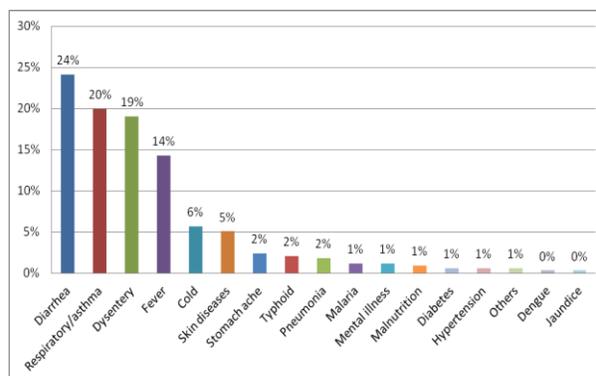


Figure 12: Community responses for related links between climate change and health impacts in Sapahar

- Asthma and other respiratory diseases have increased due to increase of dust particle from dry conditions
- Mental health issues also identified in relation to reduced crop yield due to unavailability of water which impacted livelihood and poverty

Other general health issues indicated by the health interviewees were:

- A general improvement in overall health in the community in the past 5-10 years
- Key health issues for this community included diarrhoea/cholera, hepatitis, food poisoning, typhoid, chronic skin disease and stroke
- Respiratory issues: nasal bleeding and pneumonia in winter; fainting (extreme heat) was more prominent in summer.
- Most vulnerable: one ethnic group (e.g. Kalazar), low socio economic group, children and young people (specially for anxiety) and elderly too
- Seasonal patterns of some diseases changing

The community survey revealed that there was a mean distance of 1.86 km (range of 0.2-8km) reported to the nearest hospital with an average time to reach the hospital of 0.34 hours (range of 0.05-1hr). Only 27% of the respondents were satisfied with the service they received. Responses for mode of travel to hospital, cost of treatment and time taken to be treated are provided in Table 2.

Table 2: Access to, and cost of health treatment for survey respondents in Sapahar union

Indicators	n=100 (%)
Distance to nearest hospital (km): mean ± SD; median (range)	1.86 ± 2.21; 1 (0.20-8)
Time to reach there (hours), mean ± SD; median (range)	0.34 ± 0.32; 0.20 (0.05-1)
Mode of transportation	
Bus	10 (10)
Rickshaw	0
Van	37 (37)

Indicators	n=100 (%)
Private car	0
On foot	53 (53)
Others	0
Cost of treatment	
100-500 Taka	1 (1)
501-1000 Taka	2 (2)
1001-1500 Taka	0
1501-2000 Taka	3 (3)
>2000 Taka	94 (94)
Time to receive treatment	
Immediately	25 (25)
30-60 minutes	72 (72)
60-90 minutes	3 (3)
90-120 minutes	0
>120 minutes	0

5.1.4 General WASH Technology Profile

The workshop participants mentioned some important issues due to the short term weather variation and climate change in relation to the water supply, sanitation and hygiene. The issues were categorized by considering the commonly used technologies in the area into different factors namely functionality, availability, access, hygiene practice, and quality and presented in Fig.13. The matrix indicated that the climate change, short term weather variation and drought have been significantly impacting the WASH interventions in terms of the above mentioned factors. The WASH professionals and the water workers at upazila level also mentioned about the reduced water availability especially in the dry season and the ground water table fluctuation has been significantly increasing in the area.

When questioned more specifically about water, all community survey respondents indicated that climate change had impacted on water. 15% of respondents indicated that the water quality was deteriorated, 16% indicated unavailability of water as an impact and 44% indicated both. Almost 99% of the respondents in general mentioned that they collect water from 150m distance from their home which increased to 500 m during the dry season. Interestingly, participants of the community workshop mentioned that many women don't want to come to the community and marry because of the extra work for water which is becoming a social problem at this site.

The functionality of the government installed water technologies is presented in Table 3. (The information was collected from DPHE for the 9 wards of Sapahar Upazila). The table illustrated that ponds and ring wells were the most common source of water in Sapahar upazila accounting for 88% of active water sources in the rainy season, 82% in the summer season and 86% in the winter season. In the summer season only 45% of ponds and 73% of ring wells were active.

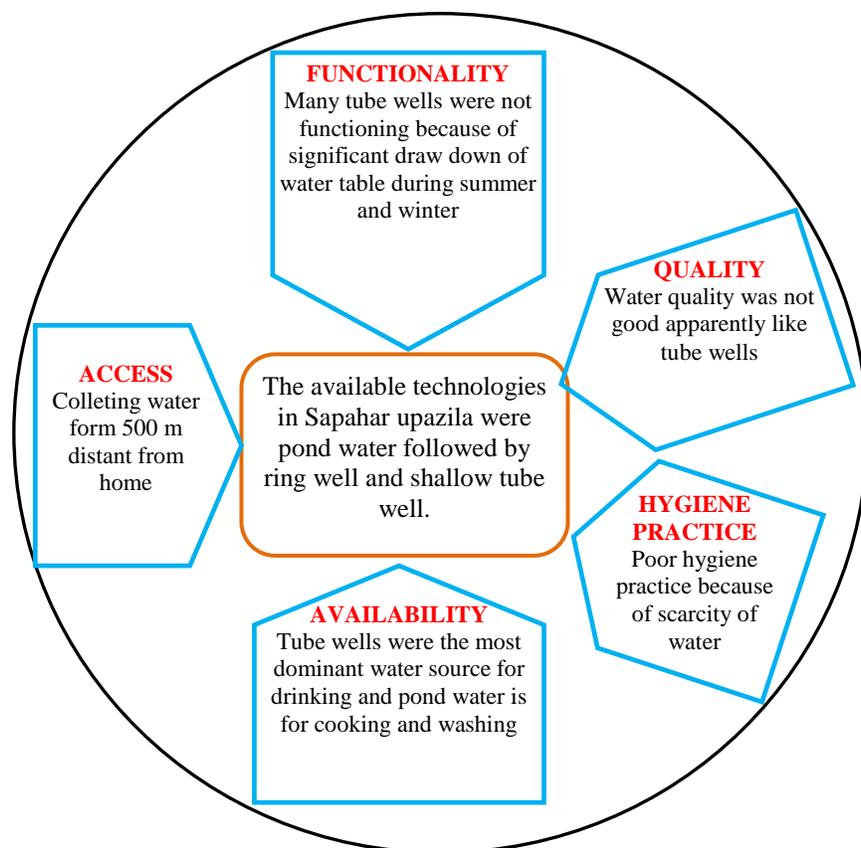


Figure 13: The matrix of impact of climate change and short term weather variation on water supply technologies as mentioned by the workshop participants qualitatively

Table 3: The functionality of the public water points in Sapahar upazila with respect to seasons

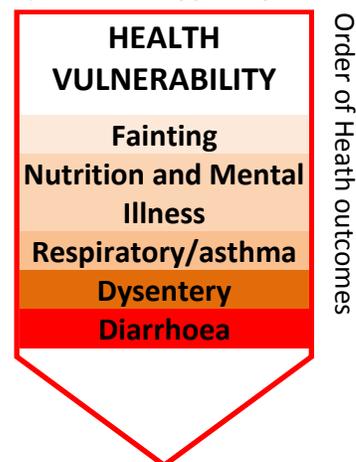
Source water type	Rainy season (%)		Summer season (%)		Winter season (%)		Total (%)
	Active	Inactive	Active	Inactive	Active	Inactive	
Shallow Tube well	63	37	62	38	63	37	100
Deep tube well	100	0	100	0	100	0	100
Ring well	85	15	73	27	79	21	100
Pond	99	1	45	55	83	17	100
Rain water harvesting	0	0	0	0	0	0	0
Pond Sand Filter	100	0	100	0	100	0	100
River/canal	79	21	42	58	68	32	100
TOTAL	90	3	56	44	79	21	100

5.1.5 Health Vulnerabilities

Diarrhoea and dysentery were the most commonly cited and prevalent health outcomes found from the workshops, interviews, hospital data and community survey data which was further confirmed by

observing the number of visits to a health service. The community survey data revealed that the visits to a health service for diarrhea and dysentery were much higher in the winter (dry) season suggesting a link between water scarcity and use of unsafe supplies of water. Data on seasonal trends confirmed the statement mentioned above. It was difficult to determine the long term trends for water borne illnesses due to unavailability of information in the area and hence changes in water-borne illness cannot be significantly attributed to changes in water availability and quality with high level confidence.

Respiratory/asthma conditions were consistently found from community workshops, health worker's interview and community survey. Such illnesses represented a very high percent of attendances to health services in the winter season (based on self-reported community survey data) and community workshops. It might be because of the increased airborne dust in the winter/dry season. Long term standardized data was unavailable to confirm this.

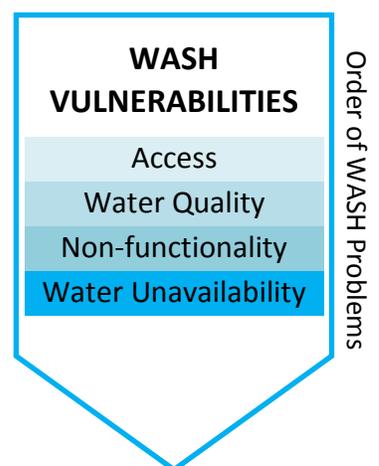


Other health issues mentioned in relation to climate change in this community related to water scarcity and subsequent impacts on food production. This had impacts on livelihoods and led to **increased poverty** which was a significant determinant of sound health. **Nutritional issues** were mentioned and **mental health** around loss of livelihood was identified in the community workshops and by health worker interviews. Interestingly, 6% of self-reported visits to a health facility were for mental illness. Other issues such as increased fainting and farmer health were identified as relating to higher temperatures.

5.1.6 WASH Vulnerabilities

The water scarcity/unavailability was the primary concern for this community for getting adequate safe water supplies throughout the year for drinking cooking and household activities and was a critical concern. There was very limited use of rainwater harvesting in this region because of limited storage capacity to provide water throughout the dry season. Most of the dug well became dry during the dry season due to high draw down of the water table.

Limited numbers of people were getting services from the pipeline water supply system located in the union proper (coverage was very very low). Significant number of tube wells, dug wells became inactive in a certain period of time in a year. The rivers and cannels became dried. One of the most common problems of the dug/ring well that those failed to retrieve water again in the well after collecting small amount of water in rainy and dry season. Despite the diversity of water sources the coverage of water supply in the area dropped down and fluctuated round the year that inhibits the people to get safe water.



It was found that the quality of some of the tube well water was affected by iron and in the dry season, people forced fetch water from over 500 m distant from their households. Community survey data revealed that tube wells were the dominant water source for drinking and pond water was the most common source for cooking and washing. Using untreated pond water for cooking potentially increased health vulnerability.

5.1.7 Adaptive Capacity of Sapahar Population

The profile of the Sapahar sub-district indicated that agriculture was the most important livelihood's concern in the community and as there was little irrigation in the region; farmers were reliant on rainfall for crop cultivation. Hence the reliance on food production for economic viability, this region is particularly vulnerable to the climate changes projected and observed meteorological data for the north-west part of Bangladesh –i.e., less rainfall and higher temperatures. The ability of communities in this region for successful adaptation is depended on the change in reliance on agriculture, a change in the types of crops produced, and/or provision of a more reliable source of water for agriculture. Some health impacts were already being reported qualitatively and to some extent quantitatively in the community from this failure in agricultural production that impacted on poverty – malnutrition and mental health for example.

More acutely and urgently, from a health perspective, safe drinking and household water supplies are required all year round. This was an overwhelming and consistently identified by all stakeholders. The winter season peaks of diarrhea suggested that communities in this region has been already suffering from the insufficient safe water available during the dry, winter season which was reported by the community to be getting drier and hotter. Though it is difficult to definitively attribute these seasonal peaks to climate change, it is reasonable to suggest that more droughts and longer droughts will have adverse impacts on water availability, hence increasing risk of water borne diseases. Furthermore, the data collected suggests that respiratory conditions also are increasing possibly due to the drier landscape and this is another health issue worthy of noting. The mental health visits identified by the community were also noteworthy, suggesting that new health services might also be needed in the future in the area.

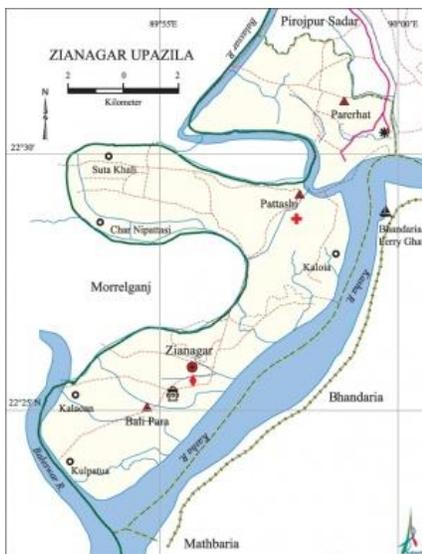
According to the interviews with health workers and the community, health services in the region are not sufficient, for example the community health center requires more resources. The community survey revealed that only 27% of respondents were satisfied with the quality of the health service and the cost of attending a health service for 94% of respondents was over 2000 Taka. Health staff mentioned that there are currently insufficient staff resources (more doctors and paramedics needed) and also from a climate change perspective behavior change remained a big challenge among the staffs. Other existing deficits in the health system identified included insufficient equipment or rooms, insufficient medicines, unhygienic practices, lack of energy efficiency, un-improved sanitation and un-planned medical waste management. More broadly, improved sanitation and medical solid waste was identified, starting with in the health services themselves. Besides correcting these deficits, in the future more efforts are needed to focus on climate change and health links and preventive activities and improved budgeting and planning are required. Better data was also identified as a future need.

5.2 Coastal Area

5.2.1 General community Profile

Pattashi and Patharghata union of Zianagar and Patharghata upazila of Pirojpur and Barguna district were selected for the study as case examples in coastal areas. A total of 52% of the respondents of Pattashi union of Zianagar Upazila were farmers or fishermen, 15% were small businessmen and the remaining were consisted of NGO workers, medium and big business owners, day laborer, housewife, CNG, rickshaw driver or others. The average household size was five and 11% of households had a monthly income below BDT 5000 (equiv to \$US 65) and another 51% had a monthly income between BDT 5000 and BDT 8000. The distribution of education level of population in the study area is presented in Fig.14 and 15. The figure 14 indicated that a very large percentage of the surveyed group were illiterate (35%) followed by less than a primary school education (36%). The Fig. 15 indicated that 18% of the surveyed group was illiterate and 51% had less than a primary school education whereas, 77% of respondents of Patharghata union were farmers or fishermen with 10% small businessmen. The average household size

BOX 4: Zianagar and Patharghata Upazila at a glance



Area: 37.39SqKm
Population: 40,056
Male: 20,943
Female: 19,113
Religion:

Literacy rate: 65%
Poverty
Extreme poor: 35.8%
Poor: 49.1%



Area:
Population: 37,512
Male:
Female:
Religion

Literacy rate: 68%
Poverty:
Extreme poor: 6.1%
Poor: 12.9%

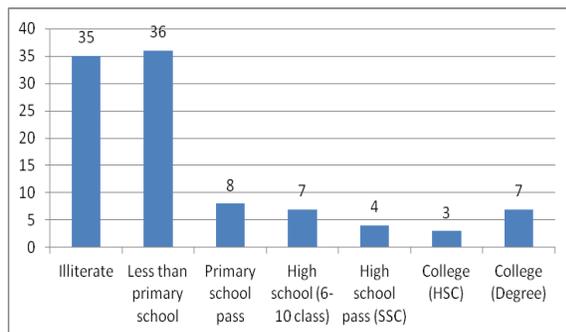


Figure 14: Respondent's education level (%) in Pattashi union

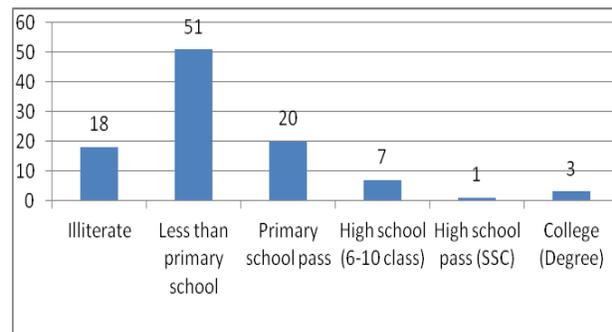


Figure 15: The climate changes observed by the community in Patharghata

was five and 3% of households had a monthly income below BDT 5000 (equiv to \$US 65) and another 68% had a monthly income between BDT 5000 and BDT 8000.

In relation to knowledge and observed change in climate only 6% of the respondents had ever heard of climate change in Zianagar Upazila. The details of perception and knowledge among the communities of Zianagar Upazila are presented in the figure 16. The figure indicated that the mentioned types of climate changes observed by the participants includes more floods (24%), more rainfall (20%) and increased temperature (17%) and 25% of responses was related to seasonal change.

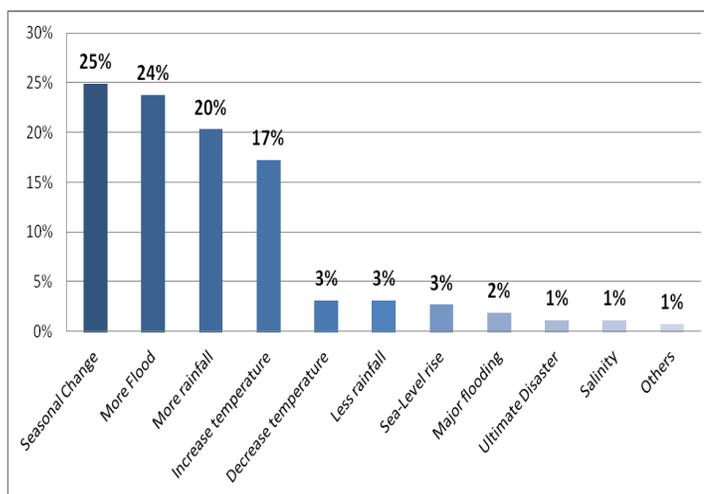


Figure 16: The climate changes observed by the community in Zianagar

In Patharghata, only 8% of the respondents had ever heard of climate change. The respondents of the survey mentioned different types of observed change of climate which included more floods (34%), more rainfall (31%) and seasonal changes (19%). Increased temperature was also mentioned 13% of the time (Figure 17).

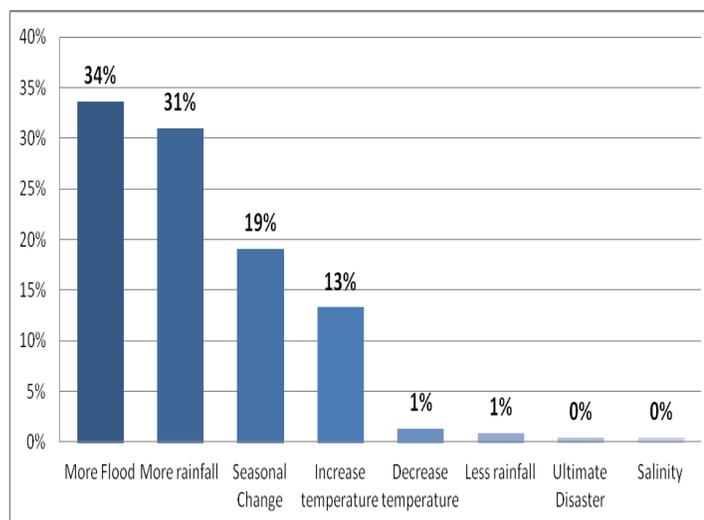


Figure 17: The climate changes observed by the community in Patharghata

Community workshops and interviewees provided more information about climate changes experienced in the community:

- The seasonal pattern and timing of rainfall and temperature was changed, particularly the rainy season. It was very hard to differentiate the six seasons of the country, some of the seasons has been disappearing e.g., spring, autumn. The winter season started later. The same also happened for monsoon but became unpredictable, erratic and intense
- Temperature decreased in winter and increased in summer
- Frequency and extent of natural extreme events have increased
- Increased intensity of flood and more areas were affected
- The storm surges were increased during cyclones
- Tidal inundation now higher at high tide with water moving further inland.
- Water logging has increased and have been lasting longer
- Increased sea level and salinity of connecting rivers and land

Community workshops in both field sites within the coastal region reported a changing pattern of climate, citing how the rainy season had changed – starting later and not always at the same time now every year – less predictable and that mentioning more extremes in temperature (cooler winters and warmer summers). Both communities indicated more intense rainfall, more flooding events and higher flood levels from extreme events.

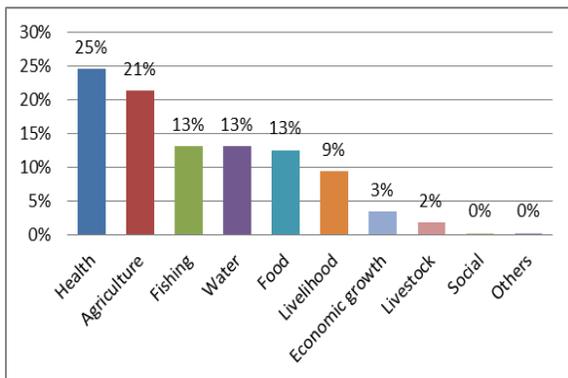


Figure 18: Sector mostly impacted due to climate change in Zianagar

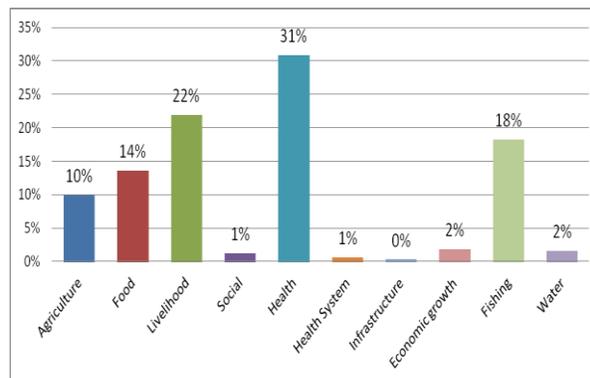


Figure 19: Sector mostly impacted due to climate change in Patharghata

Overwhelmingly, the key climate change impacts identified were via increased salinity and extreme events which had reported adverse impacts on agriculture and fishing and to a lesser extent health. The impacts of salinity on drinking water and infrastructure were also pointed out by community workshops in these two field sites. This community data was confirmed through the household survey results. In Zianagar the most reported impacts of climate changes were on health (25%), agriculture (21%), water, food and fishing (13% each), followed by livelihood (9%) (Fig. 18). In Patharghata, the most commonly reported impacts of climate changes were on health (31%), livelihood (22%), fishing (18%), food (14%) and agriculture (10%) (Fig. 19). Fishing was specifically mentioned more often in Patharghata compared with Zianagar. Reported impacts of climate change considering different sectors for Zianagar and Patharghata Upazila are presented in Fig. 18 and 19. More information on the specific climate change impacts on the communities were identified from the community workshops and informant interviews:

- Salinity of water was higher and has been increasing
- Salinity has impacted the drinking water technologies including the infrastructure (e.g. housing), agriculture and natural environment (e.g. trees dying)
- The impact on the agricultural sector was significant due to the heavy rainfall, cyclones and salinity
- Loss of trees and agricultural productivity due to high temperatures and water stress in summer
- Longer periods of water inland logging
- The saline water intrusion has been increasing and inundating more interior area as a result of increased disasters
- Erratic and irregular rainfall has reduced the agricultural productivity
- "Hilsha" fish production was reduced due to increased salinity in the river. Many in community rely on fishing but they found less fish in the river and sea

5.2.2 Meteorology and Extreme Events

The coastal areas of Bangladesh are different from rest of the country because of their unique geophysical characteristics. Coastal areas include coastal plain islands, tidal flats, estuaries and offshore waters. This coastal area represents an area of 47,211 km², 32 percent of the country's geographical area, wherein 35 million people i.e. 28 percent of the country's total population live at 6.85 million households. Global climate experts, including IPCC, warns that Bangladesh will face acute climate vulnerabilities, water related crises will be increased as the country is not high above from the mean sea level. Analysis of metrological data from 1977 to 1998 clearly shows annual sea level rise at the rate of 7.88 mm, 6 mm and 4 mm respectively in Cox's bazar, Chardanga at Hatiya and Hiron Point in Sundarban.¹⁸ The coastal areas of Bangladesh have already been facing salinity problem which is expected to be exacerbated by climate change and sea level rise, as sea level rise is causing unusual height of tidal water. In the dry season, when the flows of upstream water are significantly reduced, the saline water intrudes up to 240 kilometers from the coast. Presently, around 31 upazilas of Jessore, Satkhira, Khulna, Narail, Bagerhat and Gopalganj districts have been facing severe salinity problem. Agricultural activities as well as cropping intensities in those upazilas have been changing and now farmers can't grow multiple crops in a year.

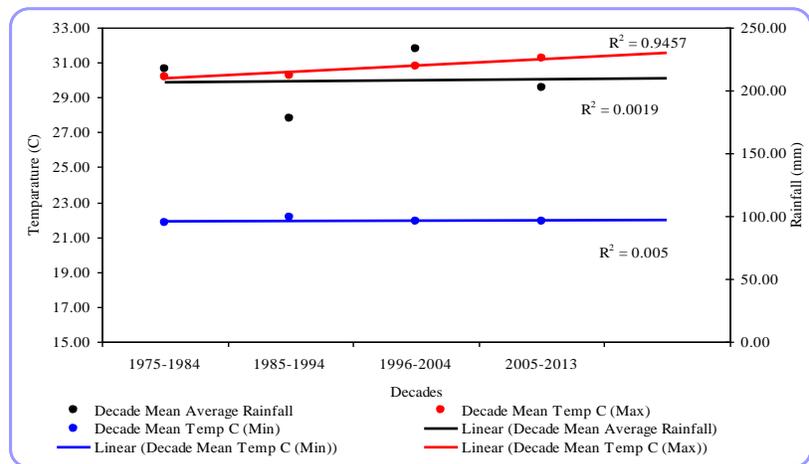


Figure 20: Decadal mean temperature and rainfall pattern in the coastal region

The temperature in the Khulna region has been increasing at a significant rate, particularly in recent years. The number of extremely cold nights has been decreasing and the heat index has been increasing. The sunshine duration has a decreasing trend and the humidity has an increasing trend. Rainfall has been increasing in terms of both magnitude and number of rainy days. However, the annual maximum rainfall and the number of days with high intensity rainfall have remained almost static. The annual maximum tidal high water level is increasing and the annual minimum low water level has been decreasing at a rate of 7 - 18 mm and 4 - 8 mm per year, respectively.¹⁹

Site specific temperature, rainfall and humidity data was unavailable. The nearest weather station was located in Patuakhali district. The distance from Zianagar and Patharghata upazila to the weather station is around 86 km and 35 km respectively. The long term temperature, rainfall and humidity trends were

¹⁸ Shamsuddoha Md. and Chowdhury R.K. (November 2007): *Climate Change Impact and Disaster Vulnerabilities in the Coastal Areas of Bangladesh*, Joint publication of COAST Trust and Equity and Justice Working Group and 3rd Edn. Dhaka, Bangladesh

¹⁹ Shahjahan M. et al (2013): *Hydro-Meteorological Trends in Southwest Coastal Bangladesh: Perspectives of Climate Change and Human Interventions*, American Journal of Climate Change, 2, pp 62-70, (<http://www.scirp.org/journal/ajcc>)

collected and decadal mean was calculated (Figure 20).²⁰ Trends provided in figure 20 indicated an increasing average maximum temperature. The participants of the workshop these Upazila mentioned that the region had been experiencing salinity in water and soil in the dry season, less rainfall, decreased temperature in winter and increases in summer and an overall change in seasons, relating to time of onset and duration. The community survey also confirms these findings.

5.2.3 Health Profile and Trends

A summary of the total number of cases recorded from 2012 to 2013 at the nearest upazila health complex of Zianagar and the total number of cases in 2014 of at the nearest upazila health complex Patharghata are presented in figure 21 and figure 22. The top 3 of the CSD conditions in this sub-district were dysentery, fever and cold. Stomachache, diarrhea and asthma are also contributing relatively high number of cases. It needs to be noted that the data should be treated with caution as a zero case number might not be a true indicator of disease presentations but rather an anomaly with data collection.

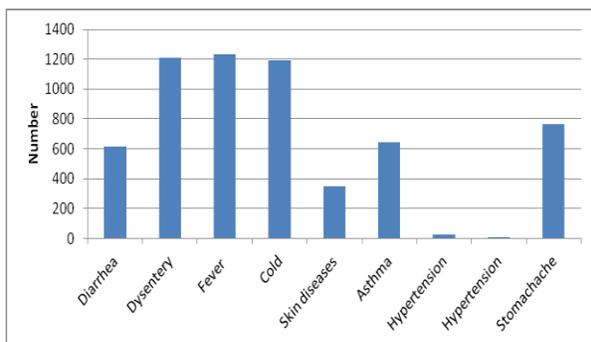


Figure 21 Health cases for the years 2012 to 2014 recorded for various climate sensitive health issues for the Zianagar Upazila

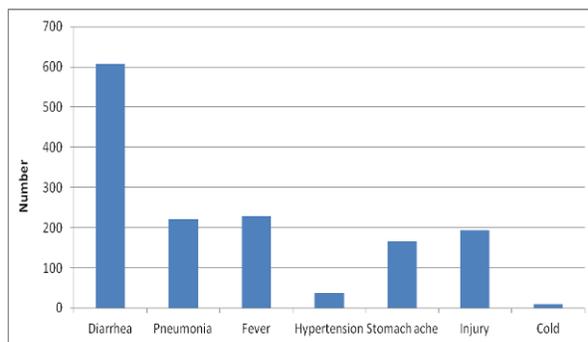


Figure 22 Health cases for the year 2014 recorded for various climate sensitive health issues for the Patharghata Upazila

In Zianagar Upazila out of the total number of 829 visits reported by household respondents (Figure 23), fever and diarrhea dominated (collectively contributing to 38% of total visits), followed by stomach ache, common cold, skin diseases, dysentery and jaundice.

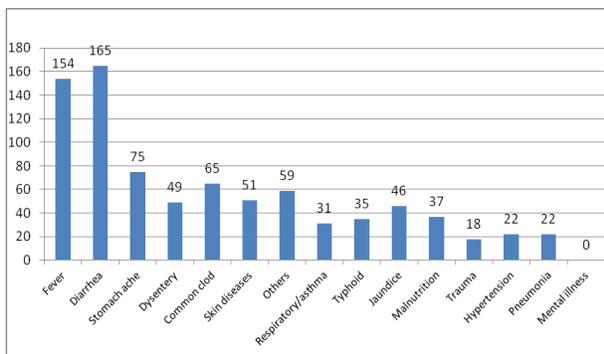


Figure 23 Community reported visits to a health service for a range of CSD conditions in Zianagar Upazila

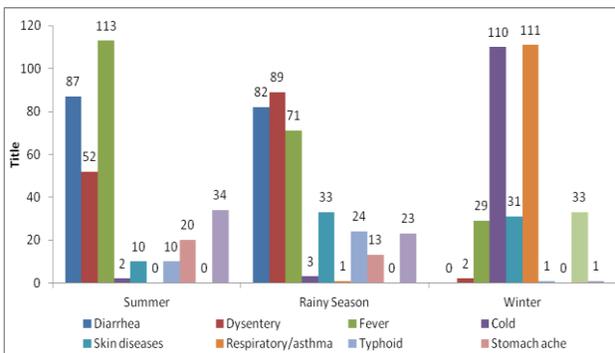


Figure 24: Seasonal distribution of commonly reported health conditions for which respondents seek health services in Zianagar Upazila

²⁰ Date Source Climate <http://www.barcapps.gov.bd/dbs/index.php>

Some distinct differences of different diseases existed considering different seasons in Zianagar Upazila as shown in figure 24. Overall, the number of cases was higher in the rainy season (34% of total) closely followed by in summer (33%) and winter (32%). In terms of health condition differences the patterns were similar in summer and the rainy season but quite different in the winter. Diarrhea and dysentery were the most common cases in summer and rainy seasons and a very few cases were noticed in winter. Jaundice also features in summer and rainy season but not so in winter. Respiratory/asthma conditions and pneumonia were the most dominant reason for a health centre visit in winter with very few cases of these in summer or rainy season. Skin disease visits were similar for the rainy and winter season, though fewer in number during winter. Stomach complaint visits were more common in summer and the rainy season.

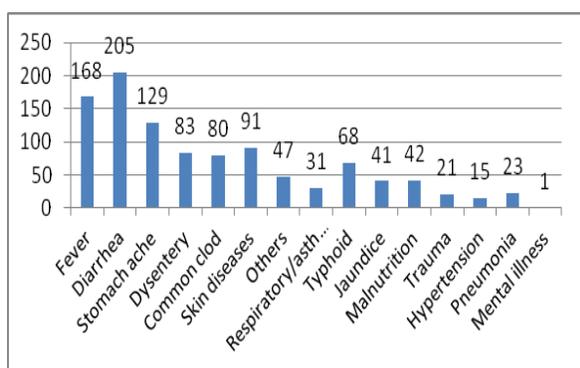


Figure 25: Community reported visits to a health service for a range of CSD conditions in Patharghata Upazila

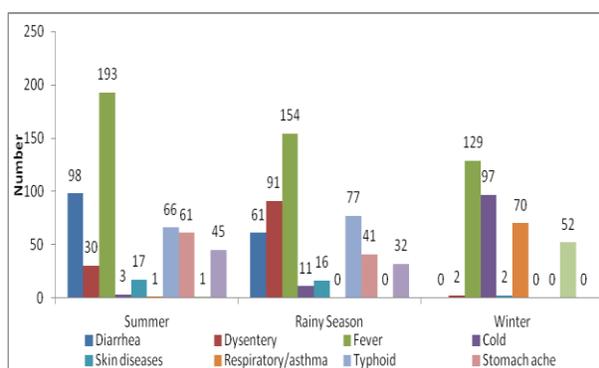


Figure 26: Seasonal distribution of commonly reported health conditions for which respondents seek health services in Patharghata Upazila

Of the total number of 1045 visits in Patharghata reported by household respondents (Figure 25) of which fever and diarrhea dominated (collectively contributing to 36% of total visits), followed by stomach ache, skin diseases, dysentery and common cold. A high percentage of visits regarding typhoid (6%) were also reported. The seasonal patterns of different diseases in Patharghata are shown in figure 26.

The highest number of visits were reported in the summer season (38%) followed by rainy season (36%) and winter (26%). Fever was the most commonly reported reason to visit a health service across all seasons, while typhoid, diarrhea, dysentery, jaundice, stomach ache and skin conditions were most commonly observed in both summer and the rainy season. In contrast, winter was dominated by colds, pneumonia and respiratory/asthma conditions (Figure 26).

Access to medical services will provide an overall situation of the vulnerabilities and more specifically the adaptive capacity of the respondents for addressing the health problem in relation to water and other climate. The figure 27 indicated that for Zianagar upazila the respondents most commonly went to the community health centre to access to the health services as well as treatment (49% of occasions), followed by the Upazila health complex (26%), and the district hospital (20%). But for Patharghata respondents, the Upazila health complex was the most commonly visited place (65% of visits) to access health treatment, followed by the community health center (33%) (Figure 28).

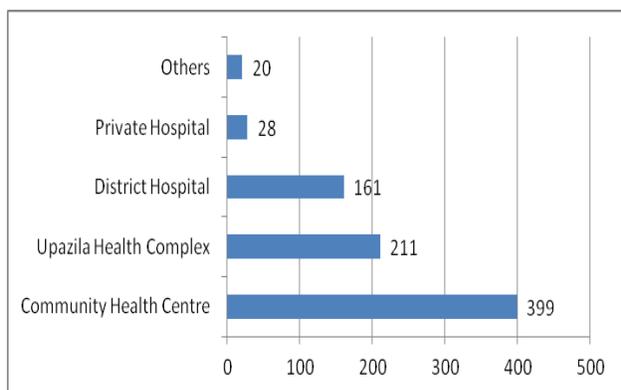


Figure 27: Health facility visited to receive treatment for reported health condition in Zianagar

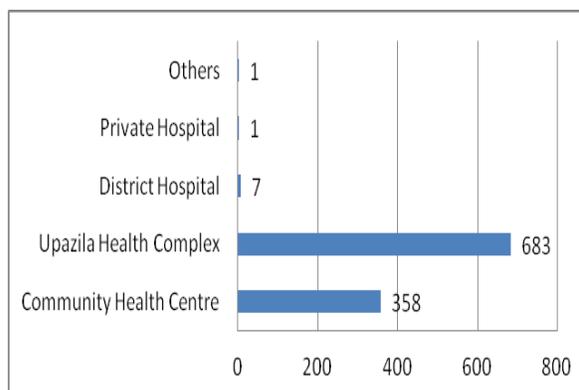


Fig 28: Health facility visited to receive treatment for reported health condition in Patharghata

When asked about how climate changes have been impacting on respondent's health, the respondents of both Zianagar and Patharghata upazila mentioned that the highest was for diarrhea. The full ranges of health issues identified by respondents are provided in figure 29. It is clear from the figure that respondents relate climate changes mostly to diarrhea and dysentery (combined 29%), jaundice (14%), fever (13%) and skin diseases (10%). In Patharghata, responses were quite evenly distributed for diarrhea (17%), fever (15%), skin diseases (14%), typhoid (14%), dysentery (14%) and stomachache (Figure 30).

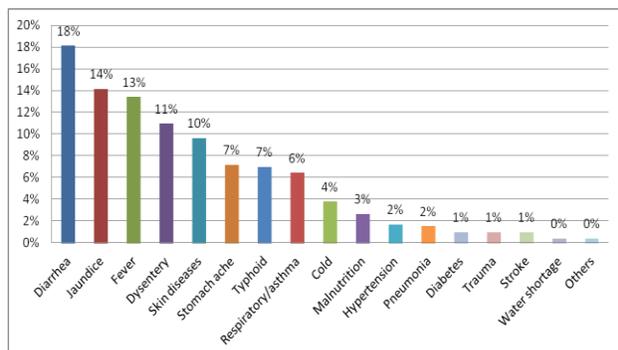


Figure 29 Community responses for related links between climate change and health impacts in Zianagar

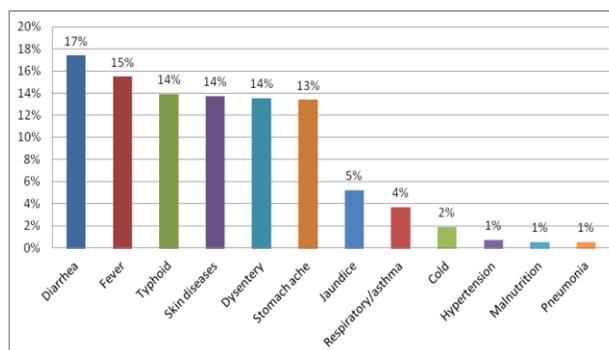


Figure 30 Community responses for related links between climate change and health impacts in Patharghata

The respondents of the community workshops provided more detailed responses about the links between climate changes and health issues some of which are presented in the following:

- Duration of illness has been becoming for longer period time
- Health impacts related to water quality included scarcity, increased diarrhoea among children. Children have been getting diarrhoea in winter (dry season) due to water scarcity and less access to safe drinking water source (groundwater table draw down, unavailability of water in ponds, PSF was not usable to drink)
- Stomach problems has been increasing due to salinity
- Children have been getting common cold in winter
- The other disease included high blood pressure/hypertension, coughs and colds, sleep problems due to too hot summer days, stroke, cold temperatures and elderly can't eat food because can't

taste it, not enough drinking water for pregnant mothers, respiratory problems due to unpredictable weather

- Community unable to link climate and health but they link skin disease to salinity and seasonal changes to ARI

Health professionals also provided general information on the health of the community and potential links with climate change:

- General health issues for this community included nutrition, environmental pollution, sanitation problems,, water related diseases (dysentery, diarrhoea, typhoid, hepatitis)
- Overall number of diarrhoeal cases has been declining but the prevalence of diarrhoea higher in dry season due to poor water quality and higher in some spatial areas. The most vulnerable population were children
- The NCDs (e.g., diabetes, obesity), ARIs, skin diseases, anemia, dysmenhorrea have been increasing
- Extreme events have been increasing the health risk significantly. The prevalence of health stroke has been increasing
- Increases rate in suicide among women in families where fishing was the main livelihood but due to less fishes the poverty increased as well as the tendency increased
- Scarcity of safe water was a major factor significantly contributing to the waterborne disease (diarrhoea, dysentery, stomach pain, typhoid) and water related disease (skin, stomach pain, dehydration)

Zianagar community workshop respondents indicated a mean distance of 1.4km (range of 0.05-10km) to the nearest hospital with an average time 0.63 hours (range of 0.05-2hrs). 67% of the respondents were satisfied with the service they had received. Mode of travel to hospital, cost of treatment, time taken to be treated are provided in Table 4. The table indicated that around 53% of visits cost above BDT 2000 and 75% of the visits were treated within 1 hour and 76% of visits are seen by a qualified doctor. The respondents of the Patharghata upazila reported that there was a mean distance of 2.47km (range of 0.5-7km) to the nearest hospital with an average time to reach the hospital of 0.75 hours (range of 0.15-1.3hrs). 46% of the respondents were satisfied with the service they received. Table 4 showed the mode of travel to hospital, cost of treatment and time taken to be treated. This table indicates 100% of visits cost above BDT 2000 and that only 52% of the visits were treated within 1 hour. 43% of response times to be treated were over 2 hours. A total of 15, 53% of visits were attended by a qualified doctor and 38% by a health assistant.

Table 4: Respondents access to the health service and cost involvement for treatment in the study Upazila

Indicators	Zianagar Upazila	Patharghata upazila
	n=100 (%)	n=100 (%)
Distance to nearest hospital (km), mean \pm SD; median (range)	1.40 \pm 1.61; 1 (0.05-10)	2.47 \pm 1.93; 2 (0.5-7)
Time to reach there (hour), mean \pm SD ; median (range)	0.63 \pm 0.51; 0.4 (0.05-2)	0.75 \pm 3.41; 1 (0.15-1.30)

Indicators	Zianagar Upazila	Patharghata upazila
	n=100 (%)	n=100 (%)
Mode of transportation		
<i>Bus</i>	1 (1)	0
<i>Rickshaw</i>	37 (37)	50 (50)
<i>Van</i>	8 (8)	14 (14)
<i>Private car</i>	0	0
<i>On foot</i>	11 (11)	5 (5)
<i>Others</i>	43 (43)	31 (31)
Cost of treatment		
<i>100-500 Taka</i>	0	0
<i>501-1000 Taka</i>	0	0
<i>1001-1500 Taka</i>	1 (1)	0
<i>1501-2000</i>	5 (50)	0
<i>>2000Taka</i>	93 (53)	100 (100)
Time to receive treatment		
<i>Immediately</i>	4 (4)	2 (2)
<i>30-60 minutes</i>	71 (71)	50 (50)
<i>60-90 minutes</i>	20 (20)	2 (2)
<i>90-120 minutes</i>	3 (3)	3 (3)
<i>>120 minutes</i>	2 (2)	43 (43)

5.2.4 General WASH Technology Profile

The available technologies in Zianagar and Patharghata upazila were shallow tube well followed by small number of rainwater harvesting unit and pond sand filter. Around 50% of the community collects water from canals/ rivers/ ponds for drinking household activities and cooking. Water quality was a key concern for this community and this was confirmed by community workshops and health and water official interviews. The key problem with quality related to salinity of tube well water – this not only made water poor quality, it also reduced the functionality of the tube wells. The poor quality tube well water meant that many people used canal/river/pond water for drinking and other household uses (e.g. cleaning) and

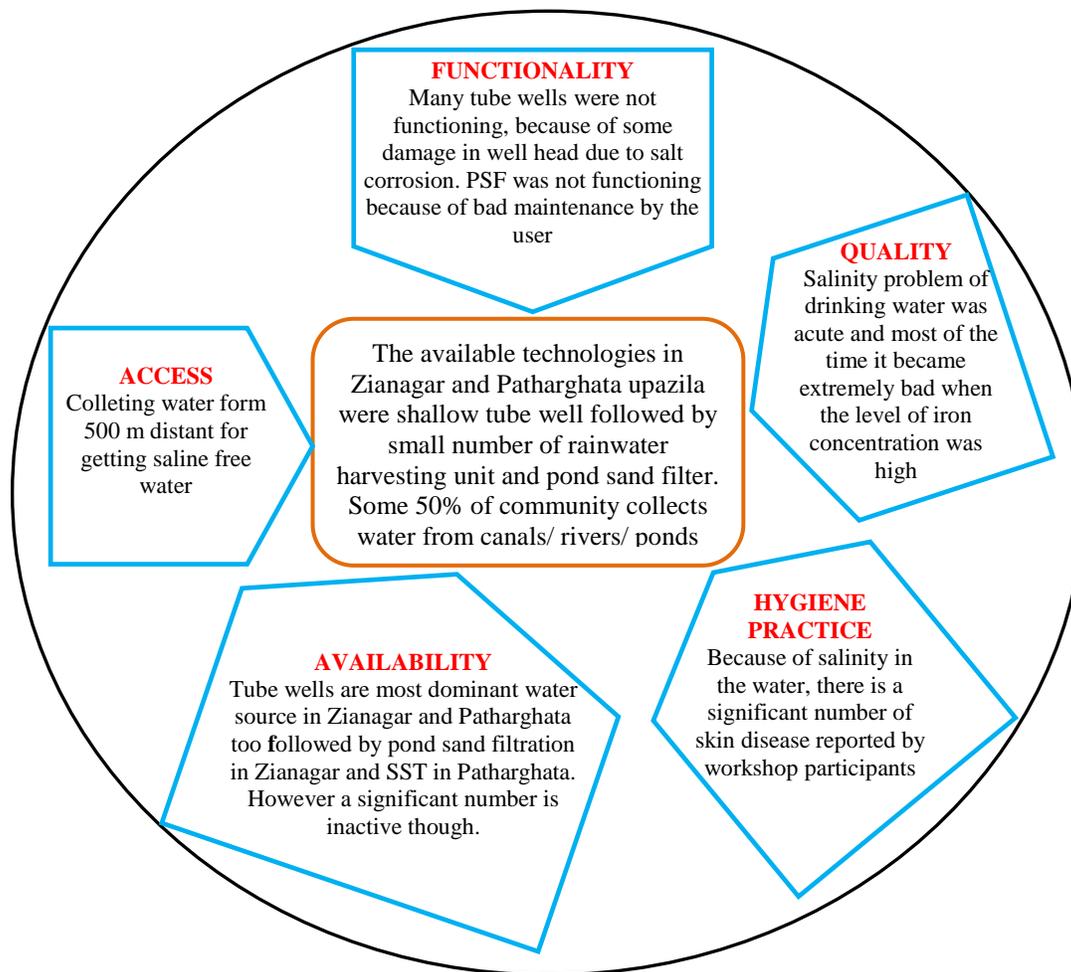


Figure 31: The matrix of impact of climate change and short term weather variation on water supply technologies as mentioned by the workshop participants qualitatively

even if they used safer alternatives for drinking (disinfection or rainwater), many still used pond water for cooking and cleaning and washing. The respondents of the survey were asked more specifically about the impact of climate change and short term weather variation on water quality and availability and all respondents mentioned that climate change had a large impact on water. 66% of respondents mentioned the poor water quality, 4% indicated water unavailability and 30% indicated both. 12% of respondents collected water from within their home and 72% collected water from within 500m.

Zianagar surveyed households respondents have numerous sources of water options. Pond water was the most common source for all uses, though tube wells and river water were also used for drinking. Rainwater was utilized by a small number of households in the summer and a very small number of households have access to piped supply water. Drinking water source information was also collected from the local DPHE office for the 3 unions of Zianagar upazila, one of which, Pattashi, corresponds to where the community workshop was conducted. Data for the sub-district is provided in Table 5. The Table 5 clearly illustrated that in Zianagar upazila shallow tube wells were the most common water source (72% of total water point sources) and a large percentage of them were inactive (26%). A limited amount of rainwater harvesting was utilized in the upazila and PSF technology was quite common.

Table 5: Drinking water sources and their status for 3 unions of Zianagar Sub-district

Source water type	Active	Inactive	TOTAL
Tube well (shallow)	670	234	904
Deep Tube well	104	2	106
VSST	0	0	0
SST	20	0	20
Rain water harvesting	0	0	0
Pond sand filtration (PSF)	133	0	133
TOTAL	927	236	1163

In Patharghata, 62% respondents indicated that poor water quality, 4% mentioned unavailability and 34% indicated both. A 3% of respondents collected water from within their home and 28% collected water from within 500m. The majority of the community people collected drinking water up to 1 km distance from their home. Table 6 summarizes the water sources for Patharghata sub-district from. Table 6 indicated that tube wells were the most common source of water in this sub-district (78%), followed by shallow tube wells and pond sand filters. Rainwater harvesting made only a minimal contribution to water sources. It was important to note from this table that a large percentage of both the shallow tube wells (65%) and pond sand filters (67%) became inactive and the peoples dependency on the surface water like ponds and khals has been increasing.

Table 6: Water sources and their status for all unions within Patharghata sub-district

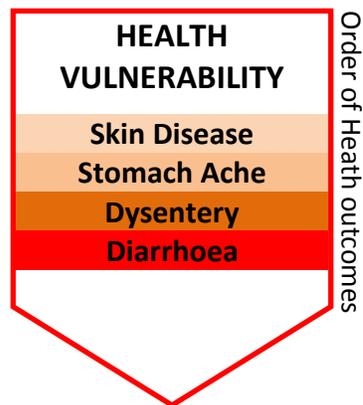
Source water type	Active (No)	Inactive (No)	TOTAL
Tube well	1820	46	1866
SST/DSST	324	616	940
Pond sand filter	180	372	552
Rain water harvesting	10	0	10
TOTAL	2334	1034	3368

5.2.5 Health Vulnerabilities

Water related issues were the most commonly cited health issue (in workshops and interviews) and interestingly, community and health experts reported that diarrhoeal cases were the highest during the

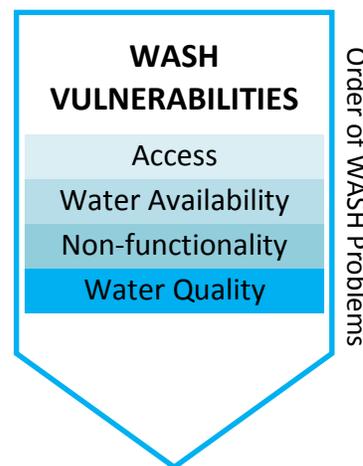
winter (dry season) due to water scarcity. The community people mentioned that when families used rainwater, disease was less. Other health issues mentioned by the community included stomach problems, skin disease, high blood pressure and hypertension (all potentially relating to water salinity), nutrition, jaundice, reproductive health issues, fever, pneumonia and colds. In Patharghata, the suicidal tendency among the women was increased (related to livelihood losses and poverty vulnerability) while in Zianagar, impacts of extreme events, sleeping problem due to high temperature.

The hospital data and community survey data from both sites confirmed that diarrhea and dysentery combined accounted for the most number of visits to a health service, though fever also contributed a large percentage of visits to hospital (hospital data and self-reported visits). In this coastal region, household survey data revealed that the visits to a health service for diarrhea and dysentery were much higher in the summer and rainy season suggesting a link between water qualities (contamination of usual supplies of water). This was in contrast to community and health professionals workshops who identified high rates of diarrhoea in the winter season. Other potential climate sensitive health issues self-reported through the household survey (and also appearing in hospital records) were stomach ache and skin diseases and seasonal breakdown suggests higher levels in the rainy and summer seasons in Patharghata and noticeably higher in the rainy and winter season in Zianagar. Despite self-reported seasonal data suggesting some seasonal patterns of climate sensitive health issues, long term annual trends for water borne illnesses in this region were not available and hence changes in water-borne illness cannot be attributed to changes in water availability with confidence.



5.2.6 WASH Vulnerabilities

Water quality was the primary concern for this community. There was sufficient water however, most of the sources of household water including drinking (e.g. shallow tube well) have become saline. There were no sufficient surface water treatment facilities or alternative water source (e.g. Rainwater harvesting) existed in the area. According to the DPHE data, there were numerous types water technologies available throughout the regions which included shallow tube wells, deep tube wells, rainwater harvesting and PSF. In Zianagar, 26% of the shallow tube wells were inactive (found from respondents of the survey and participants of the workshop) because of water quality mainly iron, arsenic and salinity. Very few number of rainwater harvesting systems existed in the upazila. The situation in Patharghata was worse because 65% of shallow tube wells, 67% of PSF and 2% of deep tube wells became inactive which reduced the coverage of safe water supply in the area. Self-reported water use data (from the household surveys of both field sites) illustrated that many households in this region were using pond or river water, not only for



cooking and washing but also for drinking in all seasons. These increased their health vulnerabilities significantly. The participants of the community workshop in Zianagar mentioned that 50% of the community people collected water directly from ponds/canals or rivers, few peoples disinfect the collected surface water surface water. Some peoples have rainwater harvesting unit but the reservoir size was not enough to supply water round the year especially in dry seasons. Water quality and non-functionality were the main vulnerabilities of the community in the region followed by availability and access.

5.2.7 Adaptive capacity of the communities

The overall health vulnerability for this community is likely to be high as adaptive capacity is limited due to poverty (Pattashi union of Zianagar upazila: 35.8% living in extreme poverty line and 49% in poverty line and Patharghata union of Patharghata upazila: 6.1% living in extreme poverty line and 12.9% in poverty line) and a high reliance on agriculture which needs to be predictable with consistent climatic variables such as sustained rainfall for production. The people of these communities were particularly vulnerable to water quality and extreme events. Some adaptations to the climate change including other changes were reported by the community in Zianagar. Migration (due to riverbank erosion and sea level rise) has been occurring in the area. One of the example of the adaptation was some households disinfect their own water and some mixed the stored rainwater with the tube well water to recue the salinity.

In addition, though difficult to assess high quality health data, dominance of diarrhea and dysentery in health services suggest existing vulnerabilities to water quality that require adaptation efforts to focus on providing alternative water supplies those are sustainable, maintainable and climate extreme event resilient. Some mental health impacts were also reported by health experts (in context of impacts on livelihood and poverty) and these need to be carefully monitored.

The rainy and summer season peaks of diarrhea and dysentery evident in the available hospital data and the household survey data suggest that communities in this region are already suffering from consumption and usage of contaminated water that is impacted most during the flood and rainy seasons. Though it is difficult to definitively attribute these seasonal peaks to climate change, it is possible that that consuming unsafe water from surface waters that are more likely to have high pathogen loads during flood and rainy periods contributes to these patterns. Inadequate sanitation (still open defecation) was also commonly mentioned by community and health experts and this can exacerbate the increased pathogen risk during the rainy season.

According to the interviews with health workers and the community, health services in Zianagar are not sufficient, for example the community health center requires a doctor and the diagnosis centre is too far away. Health staff identified key issues such as no inpatients at the hospital, insufficient staff, insufficient monitoring and supervision, better recording system, and insufficient health prevention activities. However, the community survey revealed that 67% of respondents were satisfied with the quality of the health service and the cost of attending a health service for 53% of respondents was over 2000 Taka. Health professionals specifically mentioned the need for improved awareness and motivation in the community.

Other common issues which were identified by health staff and the community that might reduce adaptive capacity in the area included poor sanitation, safe water supply and waste management practices. The issues like insufficient electricity, lack of a cyclone centre, food shortages, insufficient medicines, insufficient ambulances, and lack of community engagement were also identified as potentially reducing adaptive capacity. Very few existing relevant activities were identified for this area and the community identified this workshop was the first time this community had ever had a discussion about climate change. Future adaptation to health impacts from climate change were more nutritious food, more general community awareness about health, multipurpose cyclone center, more tree planting, more community meetings and improved planning and implementation of projects. Safe water provision, improved water storage and water management were mentioned by the community people, while water staff necessitates for more number of deep tube wells, PSFs and a water treatment plant.

In contrast to Zianagar, there was no specific feedback on adequacy of the health sector from the community in Patharghata except for the need for more staff in the community clinic and insufficient specialists. Interestingly though, household survey findings indicated that only 46% of respondents were satisfied with the services they received and 100% of visits cost more than 2000 Taka. The findings from interviewed health staff were that the general health structure and system was adequate with sufficient technical and support staff and medicines and that the health services in Patharghata were well equipped to cope with climate change and they had coped well with workload associated with Sidr and Aila. They did suggest that community clinic staff needed more training.

The community workshop identified adaptive deficit in the area of drinking water systems, communication systems and lack of electricity and needs for alternative livelihoods for fishermen and farmers, improved communication and general awareness of the people. They also indicated that there had been few climate change related projects in the area. Consistent with some of those issues identified by the community, health professionals suggested key needs for future adaptation to climate change were improved communications, improved transport, improved training for community clinic supervisors, community awareness and the need for alternative livelihoods.

Water professionals of Patharghata upazila mentioned that the polder's height need to be increased, more salt tolerant crops are required and water and sanitation systems needed to be improved. Consistent with Zianagar, water source improvements included more rainwater harvesting and improving operation and maintenance of PSF, establishment of more water treatment plans. Pond design was identified as an area of improvement, along with community waste management (consistent with Zianagar).

Communities in the coastal regions were heavily reliant on agriculture and fishing for their livelihoods making them particularly vulnerable to climate variability and long time climate changes. Zianagar upazila, in particular, has very high levels of poverty already which increased the vulnerability and consequently the reduced the adaptability. The ability of communities in this region to successfully adapt depends on either a change in their livelihoods, a change in the types of farming (e.g. more salt resilient livestock or crops), and/or provision of a more reliable, salt-free source of water for agriculture.

6.0 Overall Discussion

The impacts of climate change in any country are complex and difficult to assess due to a range of factors. Climate change impact is highly correlated with vulnerability which in climate terms is a function of the interaction between exposures to the environmental changes (e.g. Temperature, rainfall, extreme events, sea level rises), sensitivity to these environmental changes and their impacts (e.g. poverty, demographic features, population characteristics) and adaptive capacity which relates to technology, infrastructure, governance, finance and social factors. In the absence of large and comprehensive data sets on health and environmental relationships, one way to consider the impacts of climate change on health is to identify a relationship logic that combines empirical data specific to the setting and evidence from the global literature of general relationships between these intermediate impacts and health consequences. However, a qualitative summary of the impact of short term weather variability on WASH in the study area is presented in Table 7.

Table 7: Qualitative assessment of vulnerability related to drinking water sources

Impact Matrix (Vulnerabilities)		Coastal			Drought		
		Summer	Rainy	Winter	Summer	Rainy	Winter
Selected Variables for drinking water	Functionality	HIGH	LOW	HIGH	HIGH	LOW	HIGH
	Access	MED	LOW	MED	HIGH	MED	HIGH
	Availability	MED	LOW	MED	HIGH	MED	HIGH
	Quality	MED	LOW	HIGH	HIGH	LOW	HIGH

Note

1. 3= HIGH = poor or less or inadequate, 2 =MED = moderately poor and inadequate, 1=LOW= sufficient or adequate
2. Both the normal and extreme event's vulnerability considered for providing the rating
3. Secondary information was collected regarding the water quality form public health professionals and workers at upazila level. In coastal area salinity and FC were considered and only FC is considered in drought prone area for rating the overall water quality

Summary of findings for Sapahar, Naogaon: Drought prone

The vulnerabilities associated to climate change in drought prone site, Naogaon, Sapahar were reduced rainfall, reduced reliability of seasons (impacting drinking water supplies) agricultural productivity and livelihood. These also exacerbate the poverty in the area. In this area water unviability round the year led to sanitation and hygiene problems and the use of contaminated, untreated water, increased the risk of water-borne diseases. The increased diarrhea cases in the dry season may be related to the consumption and use of unsafe water. Long term annual trends for water borne illnesses in this region were not available and hence changes in water-borne illness cannot be attributed to changes in water availability with confidence.

The community survey data revealed that the tube wells are the dominant water source for drinking and pond water is the most common source for cooking and washing. However, despite the diversity of water sources identified by the DPHE water source audit, some of them have very limited coverage (e.g. central water supply) many of them are not active at all (e.g. Tube wells) and many are not active during certain periods of the year (e.g. ponds, ring wells and rivers/canals). The problem of insufficient water for

drinking in this area is compounded by the domination of agriculture for livelihoods and the reliance of natural rainfall for agriculture which had impact on food supply and nutrition and impacts on mental health.

This study has identified that the existing health system including the health infrastructure was inadequate to address the climate related health impacts at large as only 27% of respondents were satisfied with the quality of the health service and the cost of attending a health service. Health staff suggested that there are currently insufficient staff and logistical resources (more doctors and paramedics needed) and from a climate change perspective there are behavior change challenges.

This study has indicated that there will be significant challenges in this community for adapting to climate change as there is an existing adaptation deficit, particularly in relation to sustainable water supply. *Ensuring safe, accessible and sustainable water supply (throughout the year) appeared to be the biggest challenge for this community particularly given the projections for more drought years and hotter temperatures for northern Bangladesh.*

Summary of findings for Coastal areas: Zianagar: Pirojpur and Patharghata, Barguna

The vulnerabilities of the coastal communities associated with climate change identified were increased extreme rainfall, more frequent and more extensive flooding, extreme temperatures (hot and cold) and sea-level rise. Changes in seasonal patterns were also frequently mentioned. Agriculture and livelihood, water quality and health were the most reported impacts. The key problem with water quality related to salinity of tube well water and it not only made poor quality of water, but also reduced the functionality of the tube wells as well. The poor quality tube well water meant that many people used (often untreated) canal/river/pond water for drinking and other household uses (e.g. cleaning) and even if they used safer alternatives for drinking (disinfection or rainwater), many still used pond water for cooking and cleaning and washing. Inadequate sanitation (still open defecation) was also commonly mentioned by community and health experts and this can exacerbate the increased pathogen risk during the rainy season.

Diarrhoea and dysentery were the most common hospital visits (based on community household survey data and hospital data) though different seasonal patterns were identified by different data collection methods. Identifying seasonal patterns in diarrhoea may provide clues to their cause and this should be investigated in future studies. Long term annual trends for water borne illnesses in this region were not available and hence changes in water-borne illness cannot be attributed to changes in water availability with confidence.

Water quality was the primary concern for this community. Self-reported water use data illustrated that many households in this region has been using pond or river water, not only for cooking and washing but also used for drinking and they have been doing so in all seasons. There was sufficient water but some sources of water (e.g. Shallow tube well) have become saline and there was not sufficient systems for treatment of surface waters (some limited household disinfection). It was found from the community workshop that families who have rainwater tanks have less number of disease incidences. In addition, water technology data provided by DPHE professionals indicated that many water supply points designed to improve access to good quality water e.g. PSF or tube wells, were not functioning well.

Providing infrastructure and/or introducing systems that can be easily maintained and ensure safe water quality all year round and to be resilient to extreme events appears to be the biggest challenge for this community, particularly given the projections for more flooding, increased sea-level and more intense extreme events in Bangladesh. Engaging with the community to consider alternatives (like rainwater harvesting) and to use efficiency measures to increase their utility throughout the year will be important.

Information on a range of climate sensitive diseases was sought for the purposes of addressing the key objectives of this study. They are included in Appendix 3. As data quality was considered a big challenge, multiple data collection methods were used to ‘paint’ a picture of climate changes and associated impacts in three field sites representing drought and coastal communities. The findings indicated that climate changes have been observed by all these communities, with common reports which were related to changing in seasons, hotter temperatures and changes in rainfall. In the coastal communities, increased extreme events, increased distribution of water logging, increased storm surges and increased salinity were reported. The common impacts identified were livelihood, environment, water and health, though water featured most commonly and consistently across all groups and interviewees. Health issues were dominated by diarrhoea and dysentery in all sites, though in drought-prone Naogoan, dust related problems and mental health concerns were also raised, while in the coastal sites, skin conditions and hypertension were also mentioned (relating to saline conditions).

There were two distinctive but related impacts of water from climate changes that relate to water quantity and water quality. Some parts of Bangladesh are more prone to drought due to less precipitation and in these areas, water quantity dominates the concerns. When water becomes scarce, alternative, sometimes poor quality water sources were used by the community people which leads to health impacts, water use practices, potentially reducing hygiene practices (e.g. personal hygiene, cooking and washing) and these then enhances an additional health risks. In addition, water quantity problems impact on food production which also have impacts on food choices and food security which also contribute to health risks for the population.

In some coastal areas of Bangladesh (e.g. the two sites investigated in this study: Zianagar, Pirojpur and Patharghata, Barguna) water quality was the primary concern which was in relation to increased load of pathogens and salinity both in ground and surface water. In these areas, communities faced difficult choices to drink untreated ‘sweet water’ that put them at risk of water-borne diseases, or to drink salty water that may lead to high blood pressure or kidney disease. Furthermore, the salinity impacted the food production followed by livelihoods and has been exacerbating existing poverty.

Overall health vulnerability for these communities was likely to be high as adaptive capacity was limited by the amount of poverty. Health system's capacity was identified as being insufficient in Zianagar - health staff identified key issues such as no inpatients at the hospital, insufficient staff, insufficient monitoring and supervision, better recording system, and insufficient health prevention activities, though in Patharghata health resources were considered adequate and able to cope with the potential changes ahead related to climate changes. Water and sanitation however remained as considerable barriers to adaptation in these communities.

Furthermore, communities in these coastal regions are heavily reliant on agriculture and fishing for their livelihoods making them particularly vulnerable to climate variability and longer time climate changes. The ability of communities in this region to successfully adapt will depend on sourcing sustainable and safe drinking water supplies and either a change in their livelihoods, a change in the types of farming (e.g. more salt resilient livestock or crops), and/or provision of a more reliable, salt-free source of water for agriculture. This study found that there will be significant challenges in this community for adapting to climate change as there was an existing adaptation deficit, particularly in relation to water quality.

7.0 Study Limitations

This study collected data as much as possible within the available timeframe. It included qualitative data collected through workshops and interviews, quantitative data, specifically from designed household survey and gathering of water and health data that was available to represent as closely as possible the geographical area of interest. In the absence of a comprehensive, large scale study that collects primary data, or availability of high quality secondary data, the multiple types of data collected helps to provide a picture for drought and coastal areas of the climate change vulnerabilities, particularly in the context of WASH and health and the potential for adaptation. Multiple data collection methods also allowed for triangulation of data sources to identify whether consistencies in information exist.

The workshops and interviews provided much rich information on community and expert perceptions of current climate variability, the types of impacts climate changes were having on the community, including water supply and safety and to a more limited degree the current capacity of the community to adapt to these impacts now and in the future. Community and informant discussions were limited to a maximum of 2 hours which in particular, limited the amount of structured discussion of adaptive capacity and future adaptation needs and challenges. More focused workshops/interviews on this aspect with a more diverse group of decision-makers would have provided more rich data and enhanced the depth of analysis of this component of the project.

The household survey instrument used to collect data from a larger sample of householders provided some useful information on community vulnerability, health system access and types of health conditions commonly experienced. It provided insights into the characteristics of the communities that other data collection methods could not. Though sample size was small (n=100 for each field site), data from the survey served to support some of the data collected through other methods (e.g. literature and limited hospital data). The survey was also constrained by traditional factors that limit these types of surveys – recall bias, question design and specificity. Measures to improve survey validity included some piloting and refinement (though somewhat limited due to time constraints) and training of field staff.

One of the biggest limitations for this study was identifying reliable data sources of health useful to identify changes in climate sensitive diseases over many years (in order to identify if certain climate related health issues were changing over time) and within years to identify if seasonal changes occurred which might link to changes in water quality and supply. Though some hospital data was collected, problems with length of available data and inconsistent availability of health parameters (over time and

across hospital regions) makes difficult to interpret and hence results should be examined with caution. Further, though some health records are now available through community health clinics, not all clinics collect the same data, in the same way and for the same parameters and they have only been collecting data for a few years. Furthermore, no electronic records were available at this level, and due to time and budgetary constraints hardcopy records were not examined. Another limitation of this study was that due to time and budgetary constraints meteorological data for these two areas was not obtained from the Bangladesh meteorological department but collected from different internet resources.

This project utilized a qualitative method of assessing overall vulnerability of the study regions. This method is highly subjective and is informed by limited data and to some extent poor quality. Hence caution should be taken when utilizing this information for decision-making but the study serves to provide a preliminary assessment.

8.0 Recommendations

The following recommendations are made on the basis of the study in three field sites across the drought and coastal area of Bangladesh.

- ***Sapahar, Naogaon (drought prone):*** Investment is required for providing sufficient water that fits the purpose, with a priority given to the drinking water. The restricted water supply for agriculture was also associated with indirect health impacts relating to nutrition and mental health and as such significant work is required to assess how the community can adapt to these more broad impact changes.
- ***For Zianagar and Patharghata (coastal):*** Investigation of utility of existing water supplies (e.g. PSF and deep tube wells) to either fix or replace and comprehensive assessment of alternative supplies that can provide sustainable supply of water that is fit for purpose and resilient to extreme events. The impacts of salinity on the broader issue of livelihoods also require assessment of adaptation strategy.
- ***For all communities:***
 - Improved consideration of health prevention activities within the health services to include behavior change around sourcing of safe water, fit-for-purpose use of water, sanitation and hygiene and waste management to help build resilience in the community and assist with adaptation to climate changes.
 - Improved community engagement to identify current coping strategies and to collectively work out ways to better adapt to the future impacts of climate change.
 - Improved multi-sectoral engagement (environment, health, water, agriculture) to respond to the many challenges that climate change is already bringing to these vulnerable communities.
 - Capacity building in the local government about climate change, potential impacts and adaptation options.

The broader recommendations to enhance vulnerability assessments and evidence base for adaptation to health in Bangladesh include:

- A system for climate sensitive disease surveillance system needs to be established to enable local vulnerability assessments. This system should include:
 - A set of climate sensitive disease/health indicators, including potential vulnerable populations (e.g. age, gender sensitivities)
 - An awareness in upazila health staff of the importance of routine diagnosis, recording and collection of data
 - Reporting of such data to higher tiers of the health system to allow for improved decision making at higher levels
 - Quality assurance measures to ensure high standards of collection of data and reporting
 - Daily data to allow for seasonal and cyclical patterns of CSD monitoring
- A larger study of more drought-prone and coastal communities, using diverse data collection methods (similar to this small scale study), better routine health data, increased adaptive capacity assessment in order to inform national climate change and health adaptation strategy development.

Appendix:

Appendix 1

Workshop format and questions: Climate change and health vulnerability and adaptation
Designed for community level workshops

1. Introduction and welcome

- introducing CEPH Team
- workshop purpose and format

Component 1 - climate change experience

Introduction – the science is clear – the globe is facing climate change at a rate and scale faster than has been observed in a long time. This change is already being experienced in many places around the world.

1.1 What is your experience with changing climate in your community? Please share with us your observations and experiences and wherever possible, please provide evidence to support your beliefs.

May need to prompt – rainfall, temperature, extreme events, and sea level rise

Are there any particular changes that are consistently pointed out indicating the strongest level of awareness/occurrence?

Component 2 – climate change impacts

You have mentioned many climate changes. Climate change can impact on us in many direct and indirect ways.

2.1 How are the climate changes you mentioned impacting on your lives?

Consider prompting if necessary in the areas of: health, livelihood, economic, social.

We are particularly interested in the issue of water.

2.2 Where does this community currently source its water for:

- a. drinking?
- b. other household uses?
- c. crops and livestock?

2.3 How have these climate changes impacted on:

- i) water supply?
- ii) drinking water quality?

2.4 We are also interested in health issues.

Identify health issues from list already mentioned and probe for any more – ask for evidence for why these health impacts have been mentioned? How do they know? What climate changes are these health impacts specifically linked to (directly or indirectly?)

2.5 Are there any populations that are particularly vulnerable to these impacts?

Explore them with examples and ask why.

2.6 What are the top 3 health issues for this community that relate to changes in climate?

Component 3A – Capacity of existing systems to cope with or adapt to climate changes

There are many structures and systems that are vital to support our communities and lives – they include communications, transport, energy (electricity), agriculture, water, law enforcement, healthcare, emergency management, employment.

We cannot change the climate easily or the types of environmental impacts climate change will bring, but we can reduce the impacts on our lives by making sure our systems can cope with and adapt to the changes ahead.

3.1 In this community, how strong/how effective are these structures to support individuals and communities to cope with the changing climate conditions you mentioned?

3.2 Which of them are most important in helping to cope and adapt to current changes?

Try and get a top 3

3.3 Which of these structures/systems are working well to help the community cope with climate change?

3.4 Why are they working so well?

Document explanations and include examples.

3.5 Should these climate changes you have mentioned continue and increase in the future, what would need to be done to continue to positively support and assist your community?

Prompt with key themes and relevant examples if necessary : policy and legislation, technology, public education, infrastructure, surveillance and monitoring, decision-support tools

3.6 Which of these structures/systems are NOT working well and not assisting your community to cope with climate change?

3.7 Why not?

Prompt with explanation with examples..

3.8 Should these climate changes continue and increase, what would need to be done to improve these structures and systems so they can positively support and assist your community in the future?

Component 3B – Capacity of existing health systems to cope with or adapt to climate changes

An effective health system is made up of many components and has many functions. They include:

- strong leadership and policy direction,
- adequate numbers of health workers and workers appropriately trained,
- sufficient, appropriate and accessible treatment facilities and medicines,
- health information and education,
- risk assessment capabilities, surveillance and monitoring of health determinants and diseases, and
- collaboration with other sectors.

3.9 From your experience and observations, is the current health structure and system adequate to support the needs of your community in coping with climate change?

If yes, describe why, including identifying areas of strength

If no, describe why not, including which areas require improvement and why.

3.10 Should these climate changes continue and increase, what would need to be done to improve the health structures and systems so they can positively support and assist your community in the future?

Component 4 – Existing management/policy/projects for climate change

4.1 Can you identify any specific projects, policies or processes that have been adopted within your community to assist you to manage these climate changes?

- probe their effectiveness – are they working? Evidence? If not, why not.
- Any specific ‘water’ projects?
- Any specific ‘health’ projects?

4.2 do you think they will be sustained in the future?

- yes – why?
- no, why not?

Component 5 - future needs for adaptation

There are many things that we have discussed today that reflect your own experiences, observations and roles in the community. Thinking about the key impacts that your community/family has experienced/observed about climate change and understanding that these impacts are likely to increase in the future,

5.1 Identify 3 things that you believe need to happen to improve the ability of your community to adapt to climate change.

Appendix 2

Interview questions: Climate change and health vulnerability and adaptation

Designed for collection of health/water information from:

Group 1:

- Doctor (in-charge) at the Union Health and Family Welfare Centre/Community clinic
- Doctor (Upazila Health and Family Planning Officer and Residential Medical Officer) at the Upazila Hospital
- Sub-assistant engineer (DPHE)

Group 2:

- Health Assistant and/or Family Welfare visitor
- Community Pharmacist
- Water technician (DPHE)

Focus on: Climate change and health sensitive disease –local issues, data availability, health system capacity

1. Introduction

- introducing CEPH Team
- interview purpose and format

2. Interviewee information

Name:

Position:

Formal qualifications:

Description of role:

How long in this role in this community:

3. Community profile

- age demographics
- migration – in and out
- key diseases and issues,
- livelihoods,
- community networks and cohesion,
- others?

4. Community health including climate sensitive diseases (assessment of change, relationship with environment/climate, data availability, vulnerable populations)

4.1 Based on your experience, observations and discussions with your community, can you please identify the key health issues in this community

4.2 Any formal analysis of health status or compilation of statistics available?

4.3 Have you noticed any CHANGES in health conditions, in the past 5-10 years?

- are there new types of health issues you haven't noted before?
- Are there increases in any particular health conditions over time that you have observed?
- Are there any particular geographical areas within your community that are presenting with higher numbers of cases/conditions?
- Are there any particular sub-populations within your community that are presenting with higher number of cases/ conditions?

4.4 Has the community you work with discussed with you their thoughts about links between their health conditions and environment/climate changes?

4.5 Are there any particular climate changes that you believe are most important from a health perspective?

- what is this assessment based on?

4.6 Existing data collection systems in the community

Who collects health data?

About what?

What is the level of detail? Age of case/patient, gender, location, comorbidities?

How is it stored?

Who is it reported to?

Are there any policies that govern data quality?

Go through checklist as a prompt after discussing first.

Env determinant	Health issue	Data availability	Data needs/comments
Saline water consumption	<ul style="list-style-type: none"> • Hypertension • Gastro-intestinal irritation • Reproductive health issues (eg. pre-eclampsia) • Kidney disease 		
Saline water usage	<ul style="list-style-type: none"> • Skin conditions – eg dermatitis • Skin infections 		
Sourcing clean water – haulage of water	<ul style="list-style-type: none"> • Musculoskeletal injuries 		
Drinking ‘clean water’ instead of salty	<ul style="list-style-type: none"> • GI – illness – diarrhoea and cholera 		
Not enough water	<ul style="list-style-type: none"> • Dehydration • headache • Kidney disease 		
Drought - undernutrition	<ul style="list-style-type: none"> • Susceptibility to other illnesses – eg diarrhoea 		
Drought- malnutrition	<ul style="list-style-type: none"> • Anaemia 		
vectors	<ul style="list-style-type: none"> • Dengue fever • chicangunya • Kalazar • Others? 		
Extreme heat	<ul style="list-style-type: none"> • Dehydration • Heat stroke • Fainting • CVD 		
Extreme cold	<ul style="list-style-type: none"> • CVD • Respiratory illness 		
Extreme weather events – cyclones (links with food and water and vectors above)	<ul style="list-style-type: none"> • Injury –debri • Drowning 		
drought	<ul style="list-style-type: none"> • Mental health • - depression, anxiety, suicide, 		
Climate related?	<ul style="list-style-type: none"> • ? hookworm 		

Component 5 – Capacity of existing health systems to cope with climate changes

An effective health system is made up of many components and has many functions. They include:

- leadership and governance,
- financing (enough and targeted to need),

- adequate numbers of health workers and workers appropriately trained,
- sufficient, appropriate and accessible technologies, treatment facilities and medicines,
- health information and education,
- surveillance and monitoring of health determinants and diseases and risk assessment capabilities, and
- collaboration with other sectors.

5.1 From your experience and observations, is the current health structure and system adequate to support the needs of your community

a) in general?

Explain areas of deficit, strength

b) in coping with climate change?

Explain areas of deficit, strength – prompt with list above.

5.2 Should these climate changes continue and increase, what would need to be done to improve the health structures and systems so they can positively support and assist your community in the future?

5.3 What would be the challenges for making these changes?

5.4 Now thinking about other types of systems (other than health) – what is required to support the health sector to effectively manage the impacts of climate change:

Now....?

In the future?...

Component 6 Future needs for adaptation

6.1 What are the most important things that you believe need to happen to improve the ability of your community to adapt to the health consequences of climate change.?

7.0 Water related questions

7.1 where does this community currently source its water for:

a. drinking?

b. other household uses?

c. crops and livestock?

7.2 How has climate change impacted on:

i) water supply?

ii) drinking water quality?

7.3 Do you believe from your experience, observations and discussions with the community that there is a relationship between water quality and or supply and health?

Please explain your reasons and any evidence to confirm this view

7.4 What are the future needs to ensure that adequate water supply and quality are provided in this community?

Appendix 3

List of CSDs

Env determinant	Health issue	Vuln populations	How measured?	Data characteristics
Saline water consumption	<ul style="list-style-type: none"> • Hypertension • Gastro-intestinal irritation • Reproductive health issues (eg. pre-eclampsia) • Kidney disease 	Pregnant women	<ol style="list-style-type: none"> 1. UHFWC data 2. UHC data 3. Pharmacy data 4. Doctor/HA&FWA qualitative 5. Community Health Survey 	
Saline water usage	Skin conditions – eg dermatitis Skin infections	Women (inc. exposure)	<ol style="list-style-type: none"> 1. UHFWC data 2. Pharmacy data 3. Doctor/ HA&FWA qualitative 4. Community Health Survey 	
Sourcing clean water – haulage of water	Musculoskeletal injuries	Women (inc exposure)	<ol style="list-style-type: none"> 1. Community health survey 2. Doctor/ HA&FWA qualitative 	
Drinking 'clean water' instead of salty	GI – illness – diarrhoea and cholera	Children elderly	<ol style="list-style-type: none"> 1. UHFWC data 2. UHC data 3. Pharmacy data 4. Doctor/ HA&FWA qualitative 5. Community Health Survey 	
Not enough water	Dehydration headache Kidney disease	Children elderly	<ol style="list-style-type: none"> 1. UHFWC data 2. UHC 3. Pharmacy data 4. Doctor/ HA&FWA qualitative 5. Community Health Survey 	
Drought - under nutrition	Susceptibility to other illnesses – eg diarrhoea	Children Pregnant women	1. Community health survey – food consumption patterns –seasonal, types, quantity	
Drought- malnutrition	Anaemia	Children Pregnant women	1. Community health survey – food consumption patterns –seasonal, types, quantity	
vectors	Dengue fever chicangunya Kalazar Others?	Children Pregnant women ?	<ol style="list-style-type: none"> 1. UHFWC data 2. UHC data 3. Pharmacy data 4. Doctor/HA&FWA qualitative 5. Community Health Survey 	
Extreme heat	Dehydration Heat stroke Fainting CVD	Pregnant women Children Elderly labourers	<ol style="list-style-type: none"> 1. UHFWC data 2. UHFWC data Doctor/HA&FWA qualitative 5. Community Health Survey 	
Extreme cold	CVD Respiratory illness	Elderly children	<ol style="list-style-type: none"> 1. UHC data 2. UHFWC data 3. Doctor/HA&FWA qualitative 4. Community Health Survey 	
Extreme weather events – cyclones (links with food and water and vectors above)	Injury – debri Drowning	Elderly Children Disabled Pregnant women	1. Community health Survey	
drought	Mental health - depression, anxiety, suicide,	Male farmers	<ol style="list-style-type: none"> 1. UHC 2. Pharmacy 3. Doctor/HA&FWA qualitative 4. Community Health Survey 	
Climate related?	? hookworm		<ol style="list-style-type: none"> 1. UHFWC data 2. UHC data 3. Pharmacy data 4. Doctor/ HA&FWA qualitative 5. Community Health Survey 	

Appendix 4

Vulnerability and adaptation to climate change in coastal and drought prone areas of Bangladesh: WASH and health

Survey questionnaire

A. Introduction:

1. Name:

2. Age:

3. Sex: M F

4. Address:

Vill-

Union:

Upazila:

Dist:

5. Current employment: |__|__|

Govt. Job=1; NGO job=2; Small business (Shop owners at local community)=3; Medium size business (Shop owners at upazila/ district level...)=4; Big business (Factory owners, stock, supplier etc)=5; Farmers=6; Fisherman=7; Day laborer=8; Student=9; Housewife=10; Jobless=11

6. Monthly Income: |__|

Less than BDT 5000=1; 5000-8000=2; 8000-12000=3; 12000-20000; 20000 or more=4

7. How many people share a kitchen in your house?(Family members):

8. Number of earning family members living in your house?

9. Education: |__|

Illiterate (ask if the interviewee can write or read)=1; Primary School=2; High School=3; College=3; University=4; Other (Arabic, non-formal education), pls specify...)=5

B. General health and health system:

1. Have you or any of your family members experienced any health issues/illness within last 1 y

Yes=1 ; No=2

If yes, pls go to table below.

Who in your family has suffered from illnesses within last 1 year	What are those illness/diseases (Fill up with disease code)	How many times in the last 1 year	Did any require hospitalization?	How many times hospitalization	Which hospital
Yourself __	__	__	__	__	_ _ _
	__	__	__	__	_ _ _
	__	__	__	__	_ _ _
Husband __	__	__	__	__	_ _ _
	__	__	__	__	_ _ _
	__	__	__	__	_ _ _
Children below 5 years __	__	__	__	__	_ _ _
	__	__	__	__	_ _ _
	__	__	__	__	_ _ _
Children 5- 18	__	__	__	__	_ _ _

years __	__	__	__	__	__	__
	__	__	__	__	__	__
Children above 18 years __	__	__	__	__	__	__
	__	__	__	__	__	__
	__	__	__	__	__	__
Father-in-law __	__	__	__	__	__	__
	__	__	__	__	__	__
	__	__	__	__	__	__
Mother-in-law __	__	__	__	__	__	__
	__	__	__	__	__	__
	__	__	__	__	__	__
Brother-in-law __	__	__	__	__	__	__
	__	__	__	__	__	__
	__	__	__	__	__	__
Sister-in-law __	__	__	__	__	__	__
	__	__	__	__	__	__
	__	__	__	__	__	__
Others __ Pls specify.....	__	__	__	__	__	__
	__	__	__	__	__	__
	__	__	__	__	__	__

Illness/Diseases: Diarrhoea=1; Dysentery=2; Fever=3; Cold=4; Skin Diseases=5; Respiratory disease/asthma=6; Dengue=7; Malaria=8; Kalazar=9; Hypertension=10; Kidney diseases=11; Typhoid=12; Mental illness=13; Stomachache=14; Malnutrition=15; Diabetes=16; Heart disease=17; Cancer=18; Injury=20; Heat stroke=21; Dehydration=22; Others (Pls specify)=23

Hospitalization: Yes=1; No=2

Name of the hospital: Upazila Health Complex (UHC) =1;
District Hospital (DH) =2;
Private Hospital (PH) =3;
Others (Pls specify.....)=4

2. How far away from your house is the nearest hospital? Kilometres

3. How long does it take to get there? Minutes/hours

4. How do you go there (transport)? |__| |__| |__|

Bus=1; Rickshaw=2; Van=3; Private car=4; On foot=5; Others (Pls specify....)=6

5. Generally, how much money does it cost to be treated? |__|

100-500tk=1; 500-1000tk=2; 1000-1500tk=3; 1500-2000tk=4; 2000-2500=5; 2500 and above=6

6. On average how long does it take before you are treated once you arrive? |__|

Immediately=1; 30-60mints =2; 60-90mints=3; 90-120mints=4; More than 120 mints=5

7. Who usually treats you/family members? |__| |__| |__|

Kabiraj=1; HA=2; FWV=3; Traditional practitioner=4; SACMO=5; Qualified doctor=6; Pharmacy man=7; Others (Pls specify...)=8

8. From where do you buy medicine? |__| |__| |__| |__|

Pharmacy shops=1; Hospital=2; Traditional healer=3; Others (Pls specify...)=4

9. Are you satisfied with the service from hospital/doctor?

Yes=1; No=2

If, yes, why?

If, no, Why?

C. Climate change: Experience

1. Have you heard/know about climate change?

Yes=1; No=2

2. Which of the following changes have you noticed in your community?

Increased temperature=1; Decreased temperature=2; More Rainfall=3; Less Rainfall=4; More droughts=5; Longer drought=6; Bigger flood=7; More floods=8; More Famine=9; Sea level rise=10; More severe extreme events=11; More extreme events=12; Increased salinity=13; Others(Pls specify...)=14

3. In your community, what types of areas of life have these changes impacted on?

(pls check each one that applies)

Agriculture=1; Food=2; Livelihood=3; Social=4; Health=5; Health system=6; Infrastructure=7; Economic growth=8; Fishing=9; Water=10; Livestock=11; Others (Pls specify...)=12

4.

Do you believe seasons of Bangladesh have influence on illness?	Which seasons	Which disease/health issues
<input type="checkbox"/>	Summer <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
	Rainy season <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
	Winter <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
	Others (Pls specify....) <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>

Yes=1; No=2

Illness/Diseases: Diarrhoea=1; Dysentery=2; Fever=3; Cold=4; Skin Diseases=5; Respiratory disease/asthma=6; Dengue=7; Malaria=8; Kalazar=9; Hypertension=10; Kidney diseases=11; Typhoid=12; Mental illness=13; Stomachache=14; Malnutrition=15; Diabetes=16; Heart disease=17; Cancer=18; Injury=20; Heat stroke=21; Dehydration=22; Others (Pls specify)=23

D. Climate change and water:

1.

Questions	Dry Season	Wet season
Where do you get water for drinking?	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Where do you get water for drinking?	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Where do you get water for drinking?	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>

Source of water:

Tube well=1; Deep tube well=2; Supply water=3; Ponds=4; Rivers/Canal=5; Rainwater harvesting=6; Bottle water=7; Others (Pls specify...)=8

2. Where do you get water for agriculture (if, applicable):

Tube well=1; Deep tube well=2; Supply water=3; Ponds=4; Rivers=5; Rainwater harvesting=6; Others (Pls specify...)=7

3. Do you believe that climate change has impacted on water?

Yes=1; No=2

If yes,

4. What type of impact?
Quality=1; Quantity=2; Both=3

5. how far away is the water ce that you use for drinking?
In my home=1; Within 500 m=2; Within 1 km=3; Within 3km=4; Within 5 km=5; beyond 5km =6

6. Do you think the water you use has impacted on your health?
Yes=1; No=2

If yes,

7. What are those impacts?
Diarrhoea=1; Dysentery=2; Fever=3; Cold=4; Skin Diseases=5; Hypertension=6; Kidney diseases=7;
Typhoid=8; Stomachache=9; Injury=10; Others (Pls specify...)=11

E. Climate change health perspective:

1. Do you believe that climate change has impacted on the health of your community or your family?
Yes=1; No=2

If yes, explain why.... (Explore the types of health impacts, who has suffered, and how the health illness was diagnosed and treated).

2. What health issues do you believe are related to climate change?
(THIS IS A GENERAL QUESTION – NOT RELATED TO INDIVIDUAL HEALTH PROBLEMS...)

Illness/Diseases: Diarrhoea=1; Dysentery=2; Fever=3; Cold=4; Skin Diseases=5; Respiratory disease/asthma=6; Dengue=7; Malaria=8; Kalazar=9; Hypertension=10; Kidney diseases=11; Typhoid=12; Mental illness=13; Stomachache=14; Malnutrition=15; Diabetes=16; Heart disease=17; Cancer=18; Injury=20; Heat stroke=21; Dehydration=22; Others (Pls specify)=23

3. From your observations/experience which groups of people suffer most from climate change health impacts?

Children=1; Women=2; Pregnant women=3; Elderly people=4; Disable/handicap=5; Others (Pls specify...)=6

4. As per your experience, do you believe, there has been an increase in illnesses in your family/community during last 5 years?
Yes=1; No=2

If yes,

5. What are those illnesses?

Illness/Diseases: Diarrhoea=1; Dysentery=2; Fever=3; Cold=4; Skin Diseases=5; Respiratory disease/asthma=6; Dengue=7; Malaria=8; Kalazar=9; Hypertension=10; Kidney diseases=11; Typhoid=12; Mental illness=13; Stomachache=14; Malnutrition=15; Diabetes=16; Heart disease=17; Cancer=18; Injury=20; Heat stroke=21; Dehydration=22; Others (Pls specify)=23

Thank you for participating in this community health survey

