Research Paper

On

Water born Diseases Caused by Using Surface Water

Habitat for Humanity International-Bangladesh

Dhaka HRC (North) Office

13/Ka/1 (2nd floor)

Police line, Jail Road

Mymensingh-2000, Bangladesh

ACKNOWLEDGEMENTS

Acronyms	
FGD	Focus Group Discussion
HFHI-B	Habitat for Humanity International - Bangladesh
NGOs	Non-government Organizations
UNICEF	United Nations Children's Fund
WaSH	Water Sanitation and Hygiene
WHO	World Health Organization

Glossary	
Disease burden	Disease burden is the impact of a health problem in an area measured by financial cost, mortality, morbidity, or other indicators. It is often quantified in terms of quality-adjusted life years (QALYs) or disability-adjusted life years (DALYs), which combine the burden due to both death and morbidity into one index. This allows for the comparison of the disease burden due to various risk factors or diseases. It also makes it possible to predict the possible impact of health interventions.
Environmental exposure	Environmental exposure is the level of employees' exposure to pollutants in their work environment.
Union	The Union Parishad is the smallest but most important unit of local government in Bangladesh. It is formed at the village level of the country where more than 70 per cent of the population lives.
Upazila	The districts of Bangladesh are divided into sub districts called Upazila Parishads, or Thanas.
Dry season	In Bangladesh, the months of November -Marchare considered the dry season where rainfall rarely occurs.

Abstract

The research hypothesized that the disease burden from inadequate water, sanitation, and hygiene practices in selected unions of Mymensingh, Madhupur and Durgapur Upazilas of Bangladesh would be the infection of various diseases, principally diarrhea and skin diseases, and usually caused in conjunction by other risk factors or diseases. Inthis study, the disease burden was primarily finding out from the baseline survey and then it was justified with some economic and demographic characteristics to understand the dynamics of the diseases. For that purpose, two models has been drawn up: the baseline survey model to predict the water born diseases and the follow up survey or risk assessment model to find the association with different water uses in the household. For the assessment, some field-based scenarios have been developed to identify risk factors, obtained mainly from the follow up survey. We hypothesized that the disease burden from inadequate water, sanitation, and hygiene resulting in diarrhea and skin diseases occurred widely in the study area and that this burden is largely preventable. Other water and sanitation related diseases remain to be evaluated.

1.0   Introduction

Water-borne Disease is transmitted or spread through contaminated water. Pathogenic microbes and some parasitic organisms are responsible for various diseases. Such infectious pathogens survive and spread in the environment using various strategies. The main source of spread is through water. Diarrheal diseases in particularly are carried through the medium of water. These diseases account for about 12% of all illnesses in Bangladesh

Bangladesh is a country with about 130 million people living in an area of 148,393 square kilometers, making the country one of the most densely populated in the world. Economically, Bangladesh is in a less than an enviable position. Over 80% of the population of Bangladesh live in the 64,000 villages of this agrarian country. Villages lack good sanitation and clean drinking water; open defecation is common all over Bangladesh. Villages are also beset with numerous other problems such as poor communication, lack of electricity, inadequate health services various other inadequacies.

Clean water is a pre-requisite for reducing the spread of water-borne diseases. It is well recognized that the prevalence of water-borne diseases can be greatly reduced by provision of clean drinking water and safe disposal of feces. Bangladesh is fortunate to have available hand operated tubewell water, which is provided to over 80% of the village population; but the number operational tubewells available during the dry period is a matter for another study.

Ensuring poor people's access to safe drinking water and encouraging personal, domestic and community sanitation and hygiene will improve the quality of life for millions of individuals worldwide. Better management of water resources to reduce the transmission of vector-borne diseases (such as viral diseases carried by mosquitoes) and to make water bodies safe for recreational and other uses can save many lives. It also has extensive direct and indirect economic benefits, from the micro-level of households to the macro-perspective of national economies. The global importance of water, sanitation and hygiene for development, poverty reduction and health is reflected in the United Nations Millennium Declaration, in particular its eight Millennium Development Goals, in the reports of the United Nations Commission on Sustainable Development (WHO,2010).

1.1   Research objectives

The main aim of the research is to examine the water born diseases in the study area in the following priorities:

1. Quantify the disease burden among the communities of Mymensingh, Madhupur and Durgapur.
2. Understand hygiene behavior of the communities to find out the dynamics and causes of diseases.
3. Assess the risk element and different groups of the community vulnerable to the disease burden.

1.2   Hypothesis

Self-reported diarrhea and skin disease were expected to be significant waterborne diseases in the study area. During the field observation, it was found that significant number of households used pond water for their bathing, cooking and washing did not maintain proper hygiene Low usage of safe drinking water as well as water required for other aforesaid daily activities were also found to be in short practice during dry season. It was hypothesized that due to the unavailability of deep tubewells or other secure sources of water, people in the area were forced to use pond water and other contaminated sources of water. The effect from the use of unprotected water causes various water born diseases like diarrhea and skin diseases.

1.3   Study area

The study area covers selected unions of Mymensingh, Madhupur and Durgapur. The details of the study area are listed below:

- Mymensingh: Mymensingh Sadar, Aqua, Gohailkadi, Dhapunia and Khagdohor.
- Madhupur: Aronkhola, Aushnara and Madhupur Sadar.
- Durgapur: Chondigor, Kakoirgora Durgapur Sadar and Durgapur Municipality (Birisiri).

1.4   Methodology

A simple baseline survey was conducted to gather information on diarrhea, skin diseases, water and sanitation related infrastructure during the HFHI-B WaSH project in 2010. To predict the characteristics of the entire population, all disease-affected households were taken for further investigation and observation. As a result, 30 disease-prevalent households were

selected from each of the three Upazilas studied (Mymensingh, Madhupur and Durgapur) and taken for observation and follow up survey. The initial baseline survey was conducted in the period ofJanuary 15 – May 31, 2010. Observational study and FGDs were done among these 30 households. Surface water was tested to identify the cause of self-reported occurrences of disease in areas where the prevalence of skin disease and diarrhea was relatively high. Close observation of families' hygiene behavior has also been given as field based evidence.

1.5   Variable characteristics

Age, sex, education, level of income and average family size of the study respondents were considered independent variables in the study. Age is categorized into two groups, as under-5 and 5 and above years. Educational status was grouped into two broader categories, as literate and illiterate. Persons who reported they attended school were considered as literate, otherwise they were illiterate. Economic status was stratified into five classes according to income range of less than 3,000, 3,000-4,999, 5,000-9,999, 10,000-15,000 and 15,000 plus taka. Although later it is categorized as ultra-poor, poor and non-poor for the purpose of analysis. For details about the categorizations, please see HFHI-B WaSH baseline report 2010.

1.6   Literature review

Every year globally, 10.8 million children die before they turn 5 and 70% of them die before they turn 1. Thought child mortality has declined since 1980, it still remains high due to diarrhea, malaria and other water born diseases. It is well known that diarrheal disease is one of the leading causes of illness and death in young children in developing countries, especially Bangladesh and most countries of south Asia (Umesh D. Parashar, *et,al* 2003).

In Bangladesh, a total of 1,106,000 deaths can be attributed to water, sanitation and hygiene issues. Among them, 109,000 deaths are directly caused by water related diseases. Diarrheal diseases alone are the major causes of death from water related diseases in Bangladesh inducing 60,000 deaths per year. Hence, it is a major disease burden in Bangladesh that costsnumerous lives each year.

Information on disease burden relating to risk factors rather than diseases is likely to be more relevant for policy making because it may involve large scale actions to be undertaken to reduce these risk factors. As a result of increasing interest in such risk factors, the World Health Organization is currently involved in assessing the disease burden of about 20 risk

factors in an internally consistent way. Six of these risk factors focus on environmental and occupational health concerns, one of which is water, sanitation, and hygiene. It was found that the worldwide risk factor accounted for 5.3% of all deaths and 6.8% of all DALYs.

2.0   Profile of the study participants

Among the study participants, the proportion of men and women was more or less equal. The under-5 children comprised 9.86% of the total population. The majority of the participants were literate and 16.9% of the household participants were non-poor (Table 1). The proportion of illiterate and ultra poor participants was significantly higher in Madhupur and Durgapur compared to Mymensingh.

Table 1: Profile of the study participants (Baseline-2010)

Demographic Characteristics	Mymensingh (%)	n	Madhupur (%)	n	Durgapur (%)	n
Sex						
Women	50.21	1412	48.50	1323	48.34	1313
Men	49.79	1401	51.50	1405	51.66	1403
Age Group						
< 5 years old	9.17	258	7.04	192	11.05	300
≥ 5 years old	90.83	2555	92.96	2536	88.95	2416
Literacy rate						
Literate	83.72	2167	80.10	2185	81.13	2447
Illiterate	16.28	646	19.90	543	18.87	569
Economic condition (According to Income)						
Ultra poor	7.43*		5.56*		4.15*	
Poor	20.57*		29.10*		29.73*	
Non Poor	72.00*		65.34*		66.11*	

* Household (Mymensingh= 700, Madhupur= 701 and Durgapur= 602), Source: Baseline survey, 2010

2.1   Prevalence of self-reported water born diseases of last three months

Diarrhea and skin disease were the major disease burden in the study area with an average of 23.85% and 6.38% households reporting their prevalence. In Madhupur and Durgapur, a significant level of malaria and typhoid was also found.

Table 2: Prevalence of self-reported water born diseases during baseline

Disease information of last three months	Mymensingh (%)	Madhupur (%)	Durgapur (%)
Diarrhea	24.6	35.2	11.7
Skin diseases	9.3	6.6	3.2
Hepatitis	1.0	0.4	0.2
Typhoid	0.4	5.1	6.1
Malaria	0.1	4.8	2.2
Polio	0.4	0.0	0.2
Other's	0.7	6.6	16.0
None	58.8	40.3	53.4
Don't know	4.5	0.9	7.2
Total	100.0	100.0	100.0

Source: Baseline survey-2010

2.2   Predictors of waterborne diseases

To find the predictors of the prevalence of waterborne diseases, two models were constructed. The model I represented the baseline survey, model II was the risk assessment from the follow-up information. The two models were consistently designed but assessed different characteristics of the study participants. However, in model II, additional hygiene condition and behavior was assessed during the study period. It indicates that at baseline, under-5 year old children were more likely to report diarrheal events and over 5 year old men and women were more likely to be affected by skin diseases. Among the under-5, the probability of reporting diarrhea was significantly higher at both points of time. Non-poor were less likely to report waterborne diseases compared to the ultra poor and poor both at baseline and follow-up (Table 3 and 4). The disease event was found most frequent among illiterate than literate participants in both models. Overall it can be said that children and illiterate household members were mostly affected by water born diseases in the study area.

Table 3: Diagnosis of the prevalence of disease among different groups in different criteria from baseline survey-2010

Criteria		Mymensingh						Madhupur						Durgapur					
		Total diarrhea & Skin disease	n	Diarrhea	n	Skin Disease	n	Total diarrhea & Skin disease	n	Diarrhea	n	Skin Disease	n	Total diarrhea & Skin disease	n	Diarrhea	n	Skin Disease	n
Economic condition																			
Ultra poor		6.67	16*	5.75	10	9.09	6	5.02	14*	100.00	14	0.00	0	8.33	8*	5.21	5	3.13	3
Poor		19.17	46*	17.82	31	22.73	15	33.69	94*	82.98	78	17.02	16	29.17	28*	20.83	20	8.33	8
Non Poor		74.17	178*	76.44	133	68.18	45	61.29	171*	83.63	143	16.37	28	62.50	60*	53.13	51	9.38	9
Literacy																			
Literate		27.92	67*	67.16	45	32.84	22	43.73	122*	65.57	80	34.43	42	28.13	27*	16.67	16	11.46	11
Illiterate		72.08	173*	74.57	129	25.43	44	56.27	157*	98.73	155	1.27	2	71.88	69*	62.50	60	9.38	9
Age group																			
Ultra poor & Poor	> 5 years old	15.42	37*	14.58	35	0.83	2	24.73	69*	23.30	65	1.43	4	23.96	23*	18.75	18	5.21	5
	≥ 5 years old	10.42	25*	2.50	6	7.92	19	13.98	39*	9.68	27	4.30	12	13.54	13*	7.29	7	6.25	6
Non Poor	> 5 years old	40.83	98*	38.33	92	2.50	6	41.22	115*	39.07	109	2.15	6	42.71	41*	40.63	39	2.08	2
	≥ 5 years old	33.33	80*	17.08	41	16.25	39	20.07	56*	12.19	34	7.89	22	19.79	19*	12.50	12	7.29	7

* Among total samples (Mymensingh= 700, Madhupur= 701 and Durgapur= 602)   Source: Baseline Survey, 2010

Table 4: Prevalence of self-reported water born diseases during follow up-2011

Disease information of last three months	Mymensingh						
	Total %	Poor & Ultra poor	Non poor	Literate	Illiterate	> 5 years old	≥ 5 years old
Diarrhea	60.00 (18)*	72.22	27.78	11.11	88.89	77.78	33.33
Skin diseases	30.00 (9)*	55.56	44.44	11.11	88.89	22.22	77.78
Typhoid	6.67 (2)*	100.00	0.00	50.00	50.00	50.00	50.00
Malaria	3.33 (1)*	100.00	0.00	0.00	100.00	0.00	100.00
n	30						
	Madhupur						
Diarrhea	43.33 (13)*	76.92	23.08	30.77	69.23	69.23	30.77
Skin diseases	26.67 (8)*	62.50	37.50	25.00	75.00	25.00	75.00
Typhoid	16.67 (5)*	40.00	60.00	40.00	60.00	20.00	80.00
Malaria	13.33 (4)*	75.00	25.00	50.00	75.00	0.00	100.00
n	30						
	Durgapur						
Diarrhea	46.67 (14)*	50.00	50.00	42.86	57.14	71.43	28.57
Skin diseases	40.00 (12)*	58.33	41.67	41.67	58.33	25.00	75.00
Typhoid	10.00 (3)*	66.67	33.33	33.33	66.67	33.33	66.67
Malaria	3.33 (1)*	100.00	0.00	100.00	0.00	0.00	100.00
n	30						

* Total number of events found   Source: Follow up survey, 2011

3.0 Assessing the risk and risk factors of the community

In the study, diarrhea and skin diseases were most prevalent and frequently found water born diseases. It was found in the baseline survey that among the diseases, diarrhea was the most common at 55.5%, 20% for skin diseases followed by 17.3% for typhoid. These percentages equate to a significant number of people when taken into account the populous nature of the study area. Under this circumstance, the basic investigation, field observation and follow up survey was done by understanding the

- Source of water used by the households for drinking and other daily activities
- Condition of sanitation
- Defecation practice and hygiene behavior.

To understand the aforesaid situation in the second model, the baseline survey result was taken into consideration to analyse the risks associated with inadequate water, sanitation and hygiene in the study area. The first aim was to determine the household's main source of drinking water, which served as an indicator for whether a household's drinking water was safe. The assumption was that only certain types of drinking water sources were likely to deliver safe drinking water that met their basic health needs. In terms of self-reported water born diseases, several factors related to water, sanitation and hygiene were investigated to identify the cause of water born disease in the study area. The model II (Risk assessment model) has been ascribed a relative risk value of 1.0. To illustrate the major differences between the baseline and follow up surveys, in the follow up model the pathogen load was mostly transferred from land to water, with insufficiently treated sewage being discharged to surface waters or potentially contaminating drinking water. The field survey results are analyzed in the following sections.

3.1 Drinking water sources

During the baseline survey assessment it was found that people were on average 98% risk free from unsafe drinking water and they have improved drinking source of water. But after the assessment of the follow up survey it was found that the water source which was used for drinking water, contain the risk elements iron and arsenic in most of the tubewells in Durgapur and Mymensingh. Many household do not have their own tubewell so they have to haul water from neighbors' houses located usually more than 150 feet away in distance. During the collection and carry of water, the water could become contaminated as they were not aware of this possible contamination.

Table 5: Assessment of risk (per person) based on baseline survey-2010

Criteria of containing risk	Mymensingh	Madhupur	Durgapur	Risk (Baseline-2010)
Use of improved drinking water sources	0.97*	0.99*	0.98*	Low
Distance of water source	Average 86.36% have access within 150 feet	Average 90% have access within 150 feet	Average 80.20% have access within 150 feet	Low
Water treatment found	1%	6.41%	1.16%	High
Sanitation facilities	0.86*	0.93*	0.91*	Low
Family members having shared facilities of latrine	0.29*	0.24*	0.32*	High
Unclean latrine	0.64	0.67	0.49	High
Bad smell found in the latrine	0.66	0.25	0.51	High
Larine physically not usable	0.01	0.12	0.32	Low
Shoes kept near the latrine	0.00	0.04	0.04	Low
Open defecation	0.03	0.05	0.06	Low

* Risk limit of household members out of one (1)

3.2   Condition of sanitation and hygiene behavior

Table 5 indicates that a risk is noted in all the selected indicators, especially in sanitation sharing facilities as well as cleanliness of latrine. Many households were using physically damaged latrines that have a high risk of transmitting pathogens to the environment. The condition was mostly found among the ultra-poor and poor groups. It was also found that use of sanitary latrines was low across the poor groups. In each indicator a considerable number of households were found to have unclean latrines and tube wells. During the follow up study, it was found that the incidence of open

defecation was higher amongst members of ultra poor households compared to non-ultra poor households, so the risk was also higher for the community (Table 5 and 6). This finding is in line with findings of the baseline study, which claimed a 1% difference in open defecation practice between the ultra poor and non-poor households.

Table 6: Assessment of risk (Per person) based on follow up survey-2011

| Criteria of containing risk | Follow up (March-2011) | | | | | | Risk (follow Up-2011) |
| | Mymensingh | | Madhupur | | Durgapur | | |
	%	n	%	n	%	n	
Use of improved drinking water sources	0.57*	120	0.62*	117	0.42*	135	High
Distance of water source	Average 46.67% have access within 150 feet	30 (HH)	Average 70.17% have access within 150 feet	30 (HH)	Average 25% have access within 150 feet	30 (HH)	High
Water treatment found	0.00 %	30	0.00 %	30	0.00 %	30	High
Lacks Sanitation Facilities	0.21*	120	0.23*	117	0.24*	135	High
Family members having Shared facilities of latrine	0.24*	120	0.29*	117	0.29*	135	High
Unclean latrine	0.57*	30	0.67*	30	0.70*	30	High
Bad smell found in the latrine	0.67*	30	0.80*	30	0.77*	30	High
Larine physically not usable	0.30*	30	0.23*	30	0.33*	30	High
Shoes not kept near the latrine	0.90*	30	0.97*	30	0.93*	30	High
Open defecation	0.17*	30	0.20*	30	0.23*	30	Low

* Risk limit of household members out of one (1)   **Source: Follow up survey-2011**

4.0   Scenario analysis

The below scenarios look at possible methods of contamination and transmission of water borne diseases in the study area.

Scenario I: Transmission through drinking water

Transmission of water borne diseases can be caused by drinking water that contains fecal–oral pathogens, arsenicosis, fluorosis, and other sources. It is found in drinking water quality test (table 7) that tubewell water contains iron as well as arsenic in some extent. Iron is most significantly found in all over the area. Households are habituated with drinking water containing arsenic, iron and coliform.

Further, few people have been found in the study area who use proper water purification systems. Most households are purifying the water in unhygienic and unsafe ways. From this the source water becomes contaminated.

4.1   Consequence

The contamination may come from two different sources of pathogens. First one is natural contamination from under the ground and second one is unhygienic method of water purification that adds the coliform bacteria that causes diarrhea and skin diseases.

Table 7: Water quality in the study area of pathogen levels

Water quality parameter	Unit	Bangladesh standard for Drinking water	WHO Guideline values, 2004	Mymensingh	Madhupur	Durgapur
Arsenic (As)	mg/l	0.05	0.01	0.374	<MDL	0.40
Iron (Fe)	mg/l	0.03-1.0	0.03	5.5	0.2	6.5
Total Coliform (TC)	CFU/ 100ml	0	0	0	2	10

Source: Labrotory test result, 2011

Scenario II: Transmission caused by lack of water linked to inadequate personal hygiene

Maintenance of personal hygiene is a must for good health and knowledge of elementary cleanliness is much more required in a community. Neglect causes problems communities may not even be aware of. It is found in the study area that many household members were taking their food with unclean hands and do not wash their hands after defecation properly as most toilets do not have sufficient hand washing materials and water. The most important feedback found was from women about their menstrual hygiene. They said that due to the scarcity of water they cannot properly maintain their menstrual hygiene and the cleanliness of the latrines. Further every external part of the body like skin, teeth, hands, nails, feet demands a basic amount of attention on a regular basis. These are the route of transmission of pathogens inside the body. But very few people in the study area were identified to maintain personal hygiene properly. These were the causes of diarrhea and skin diseases in the study population.

Figure 1 : Fecal–oral pathogen transmission through domestic use of water and hygiene behaviour.   Source: follow up survey, 2011

4.2   Consequence

In scenario II it was found that infectious diseases like diarrhea and skin disease were the largest contributors to the disease burden from using unprotected and contaminated surface water in the study area (Gondhopa, Mymensingh). In this situation, pathogens enter not only in water, they are also transmitted through food as actual exposure occurs at the household or individual level.

Scenario III: Transmission caused by poor personal domestic hygiene

This includes person-to-person transmission of fecal–oral pathogens through food-borne transmission as a result of poor hygiene, or use of contaminated water for cleaning. In the study area, many households remained unaware about proper domestic hygiene behavior. They used contaminated sources of water for washing their dishes, plates and other household cooking pots that are used for food serving. The dishes carry the fecal-oral pathogens and cause diarrhea and skin diseases as well as other water born diseases. However, inadequate

Figure 3: Fecal–oral pathogen transmission to human body through food and domestic use of water

Unprotected pit latrine connected with the pond water

Figure 4: contamination of human excreta in water

access to tubewell water and scarcity of water during the dry period force them to use these types of contaminated water sources. During FGD and observation most of the cases for disease were found in families that experience this. The families also remain exposed to more fatalistic diseases as they continue to use these water sources due to insufficient access to safe water sources.

4.3   Consequence

Scenario III shows the paths of pathogen transmission into the human body through their dishes. Here environment is not the main problem. The problem remains as the household members are not aware about the contamination of water. It cannot entirely be attributed to water, sanitation, and hygiene because it is also transmitted through food at an individual level (by sewage, or seepage form pit latrine). As a result, diarrhea is most common in these households.

Scenario IV: Transmission through contact with water (through bathing or swimming)

In the study area, most ponds contain algae (table 8) and other vectors proliferating organisms. Due to use of pond water for bathing and swimming, transmission of vector proliferating organisms is very easy as the pond water is stagnant. So the events of skin disease are high. During the study it was observed that on average 90% male and female household members use pond water for bathing, washing and swimming.

Figure 5: Fecal–oral pathogen transmission through contact with water (through bathing or swimming) and consequence of contaminated water.

The children, aged more than 5 years old (especially who are capable of swimming) use pond water for bathing and swimming. The male members use pond water when tubewell water becomes scarce during dry season. There is also psychological resistance by many male members who said that if they have their bath in tubewell, it does not feel thorough as many parts of the body still remained unwashed.

Table 8: Quality of pond water

4.4   Consequence

In the study area, the pond water contained excessive COD, BOD, DO and algae and people use this water for bathing and for other daily activities. So the incidence of skin diseases and other water related diseases was relatively high compared to other non-water born diseases.

Water quality parameter	Unit	Bangladesh standard for Drinking water	WHO Guideline values, 2004	Mymensingh	Madhupur	Durgapur
Chemical Oxygen Demand (COD): Dichromate	mg/l	4	-------	18	59	33
Biochemical Oxygen Demand (BOD5)	mg/l	0.2	-------	4	18	6
Dissolved Oxygen (DO)	mg/l	6	-------	2.72	4.85	6.36
Chlorophyll_a	µg/l	-------		32.3	102.5	4.6
Algae	mg/l	-------	50	2164	6868	308.2

The most remarkable feature is that people who were using this pond water were suffering from different water related diseases but they did not know the reason of their sufferings.

5.0   Exposure scenarios

Regarding water, sanitation, and hygiene, we used four exposure scenarios, defined in Table 9. Different fecal–oral pathogen levels in the environment are associated with different scenarios, influencing the risks of contracting fecal–oral infections. To reflect this, four of the scenarios are associated with fecal–oral pathogen level in the environment. A low to medium level is characterized by more than 98% coverage in improved water supply and sanitation and/or a regional annual incidence of diarrhea of < 0.3%/person/year (Sanitation Assessment, 2000). The exposure categories are selected according to available information on exposure–risk relationships and information from the follow up field study.

Table 9: Selected exposure scenario

Scenario	Description	Environmental fecal–oral pathogen level
Scenario I	No improved water supply and no improved water source in the study area so water supply is not routinely controlled	Very high

Scenario II	Lack of basic sanitation facilities and practices and water supply is not routinely controlled	Very high
Scenario III	Basic sanitation but no improved water supply and poor personal and domestic hygiene and water supply is not routinely controlled	Very high
Scenario IV	Low water availability leadding to the presence of transmission of diarrheal and skin disease through surface water	Very high

As the study participants were exposed to all of the scenarios, the risk level for diseases in the community was very high . Pathogens transmitted from the environment or by different agents like humans and animals can harm all members in the community. The poor hygienic conditions and behaviors can transmit diseases across groups; the risk will not remains inside the literate, illiterate poor, non poor group but the entire community.

6.0   Result and discussion

This study demonstrated that the prevalence of waterborne diseases was significantly high due to unimproved water supply and water source at household level. The prevalence of waterborne diseases at baseline and follow-up was more or less the same for groups of differing economic status and literacy level. This signifies that the disease incidences have a specific trend which might be an outcome of lacking of water and hygiene related issues. Evidence shows that the educational status and health outcomes are strongly associated.

Diseases related to water, sanitation, and hygiene disproportionately affect poorer members of society. The reasons behind this are complex and interconnected. The estimate presented here represents the disease burden due to water, sanitation, and hygiene from a selected group of illnesses. As we have shown, quantification of the disease burden due to water, sanitation, and hygiene is a complex task because of

- The numerous interrelated causes leading to transmission of water-related diseases (source factors, pathway factors, behavioral factors)
- The complex exposure patterns at household and community level.
- The scarce information on the risk factor–disease relationship

In terms of a "true" picture of the disease burden due to surface water use, poor sanitation, and hygiene, the hypothesis may have some limitations due to

1. The pathogen transmission path may not follow in the same manner as it was described and may have another route.
2. Many of the diseases are not numerable and do not have exposure with use of surface water.
3. All risk factors may not be accurate and may vary region to region due to the diversity of geographic location, physiography, culture etc.

7.0   Recommendation

The assessment found that poor and illiterate areas were mostly affected by water born diseases, therefore increasing their economic level and literacy can help reduce the prevalence of disease. Then they may be more able to adopt better hygienic practices. They will be able to afford to buy appropriate commodities such as soaps for managing hygiene. Similarly, it may be anticipated that persons who attended school are more aware of susceptibility of diseases, thereby more likely to pursue preventive measures. A disparity between socioeconomic statuses in the prevalence of diarrhea is found in this research. Some important recommendations are;

- To reduce waterborne diseases in rural areas water, sanitation and hygiene intervention provide a substantial role. By providing the alternative water source or sufficient supply of safe water, the incidences of disease can be reduced.
- Children are mostly affected by water born diseases and it can be due to the fact that knowledge on child healthcare is inadequate among the caregivers. So caregivers need hygiene education.
- In the baseline survey it was found that very few people have the access to proper medical facilities. By giving the medical and health care facilities, cases of diseases can be reduced. Under this circumstance under-5 children need the urgency to get these medical conditions irrespective of economic status.

8.0   Conclusion

Improvements in drinking water quality appear to be of significant benefit to health when improvement is secured close to the point of use—that is, in the household. So supply of water at household level can play a vital role to reducing water born diseases and save many children's live. On the other hand understanding the preventable nature of the diseases associated with risk factors such as inadequate water sanitation and hygiene, provides a basis

for evidence-based decision-making. Implementing interventions at local scale may have a national impact on health. Therefore interventions to reduce water borne diseases will depend heavily on funding as well as cooperation of all government and non government organizations.

References

Ahmed S (2007). An assessment of the impact of flood on sanitation in rural Bangladesh, RED Working Paper-7, Research and Evaluation Division, BRAC, Dhaka, Bangladesh.

Annette P, David K, Lorna F, Jamie B (2002). Estimating the Burden of Disease from Water, Sanitation, and Hygiene at a Global Level, Environmental Health Perspectives, Volume110, Number 5, May 2002.

Bern C, Martines J, de Zoysa, Glass RI (1992). The magnitudes of the global problem of diarrhoeal disease: a ten-year update. Bul WHO 7:705-14.

BRAC (2008). WASH Programme of BRAC: Towards attaining the MDG targets- baseline findings, Research and Evaluation Division, BRAC, Dhaka Bangladesh. available at: www. bracreseacrh.org.

Climate Change Cell (CCC) (2008). Climate change adaptation research- climate change and health impacts in Bangladesh. DOE, CDMP, DFID and UNDP, Bangladesh. Available at: www.climatechangecell-bd.org. [accessed on March 4, 2011].

Ejemot RI, Ehiri JE, Meremikwu MM, Critchley JA (2008). Hand washing for preventing diarrhea. Cochrane Database Syst Rev 23.1- CD004265

Emch M (1999). Diarrheal disease risk in Matlab, Bangladesh. Soc Sc and Med 49: 519-30.

Fewtrell L and Colford JM Jr (2005). Water, sanitation and hygiene in developing countries: interventions and diarrhea-a review. Water Sci Technol 52:299.

Fewtrell L, Kaufmann RB, Kay D, Enanoria W, Haller L, Colford JM Jr (2005). Water, sanitation and hygiene interventions to reduce diarrhea in less developed countries: a systematic review and meta-analysis. Lancet Infect Dis 5:42-52.

Hoque B (2003). Hand washing practices and challenges in Bangladesh. International JEHR 13:S81- S87.

Lee W, Stoeckel J, Jintaganont P, Romanarak T, Kullavanijaya S (1991). The impact of communitybased health education program on the incidence of diarrheal disease in southern Thailand. Southeast Asian Journal of Tropical Medicine & Public Health 22: 548-56.

Lewin S, Norman R, Nannan N, Thomas E, Bradshaw D (2007). Estimating the burden of disease attributable to unsafe water and lack of sanitation and hygiene in South Africa. SAMJ 97:755-62.

Murray CJL, Lopez AD.(1996). The Global Burden of Disease. Cambridge, MA:Harvard School of Public Health, WHO, World Bank.

Narayan S and Sarah B (2005). The prevalence of diarrheal disease among Brazilian children: trends and differentials from 1986 to 1996. Soc Sci and Med 60: 923-935.

Prüss A, Kay D, Fewtrell L, Bartram J (2002). Estimating the burden of disease from water, sanitation and hygiene at a global level. EHP 111: 537-42.

Rana M (2009). Effect of Water, Sanitation and Hygiene Intervention in Reducing self-reported Waterborne Diseases in Rural Bangladesh, Research and Evaluation Division, BRAC Centre, 75 Mohakhali, Dhaka 1212, Bangladesh, www.brac.net/research. [last assessed, April 21, 2011]

Umesh D. Parashar, Joseph S. Bresee, & Roger. Glass (2003). The global burden of diarrhoeal disease in children, Bulletin of the World Health Organization 2003, 81 (4).

WHO (2004). The burden of waterborne diseases. World Health Organization.

WHO (2008). The global burden of diseases 2004, available at: http://www.who.int/healthinfo/global_burden_disease/GBD_report_2004update_part4.pd [accessed on May 29, 2009].

WHO/ UNICEF (2010), Progress on Sanitation and Drinking-water: 2010 Update, WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation. 20 Avenue Appia, 1211 Geneva 27, Switzerland, ISBN 978 92 4 156395 6.

Observation particulars (Tool pack)

Problems	Probability of Correlation with (Questions)	Verification need
Diarrhoea, Skin diseases	- Water (Surface sources) - Contamination of ground water source may cause disease - Latrine condition and defecation practice - Hygiene practice - Seasonality of diseases	Analysis of Water Quality Parameters both Surface and Ground water (Physical, Chemical, Biological)
Many household don't have own tube well and latrine and don't have access to safe water and latrine.	From where they collect water.	From where they collect safe water or are this types of people use unsafe water and latrine.
Distance of water source	- Causes that make them use other source of water (Pond, lake, canal, river) - Time of water collection - Amount of water have to carry in each day - Does it impact on the health of the women or female members? - Is there any sexual harassment during water hauling	Physical verification and FGD is will bring the answer.
Use of unsafe water and unsafe water carrying elements (e.g. pots, jars, buckets).	- What types of jars, buckets, pots, and containers are used for water carrying? - Regularity of cleanliness. - Distance of tube well related to latrine and other susceptible sources of water like (Congested pond, canal)	Do the household use unsafe and unclean water hauling containers?
Seasonality of water	- Water Dry season. - During flood or rainy season. - Which source use?	Find the Seasonality of water, what source of water use in dry season.
Lack of Water, Sanitation and hygiene knowledge	- Types of latrine used by the family member. - Physical fitness of latrine. - Children defecation Practice - When child gets diarrhea care givers only give ORS. Why don't	Disease may cause form the damaged latrine. So verification is need to identify is people using the damaged latrine?

	they go for health service?	
Lacking of Hand washing behavior	• hand washing behavior (After child defecation, before eating, before preparing food,) • what types of washing materials used (Soap, ash)	Need to verify the hand washing behavior.
Latrine condition and cleanliness	• Damaged or unsafe latrine may pollute the environment and people may affect. • Diarrhea and skin disease may cause due to use of unclean latrine.	Area wise physical verification and analysis is needed. Need to understand the sharing facilities. Diarrhea and other diseases may found in these particular households.
Gender discrimination	• In the case of water carrying and latrine cleaning about 80% female member of household is responsible where male has negligible participation. • Does it hamper the education of child especially female children?	Need to identify the causes.
Problem of waste management	• Household waste pollutes the environment and cause diseases.	Physical verification to identify the intensity of problem.
Lack of knowledge about water harvesting system	• Is the community familiar with any water harvesting system or process (if yes what types). • If no then why • What source and system of water is safe and affordable for them.	

Water, Sanitation and Hygiene promotion in Bangladesh						
Habitat for Humanity International-Bangladesh						
Dhaka HRC (North)						
Basic question for FGD						
FGD with	Community people	Male		Female	Date:	
	Leader	Male		Female	Time:	
	Adolescent girls	Female			Place:	
	PNGO, Govt. representatives	Mix (Male& Female)				
Main objectives	**Objectives of the FGD**	**Information we have already got**	**Causes**	**Does it have any negative effect on health or other sectors**	**What initiatives household take as alternatives to cope with the situation**	**According to them what is the best solution of the problem**
Main objectives of the FGD	What types of problems related to water prevails in the area					

Main objectives	Objectives of the FGD	Information we have already got	Causes	Does it have any negative effect on health or other sectors	What initiatives household take as alternatives to cope with the situation	According to them what is the best solution of the problem
Main objectives of the FGD	Find out the causes of Water born diseases (Diarrhea, Skin diseases etc)	Diarrhea and Skin Disease prevails in the study area				
		Lack of Water, Sanitation and hygiene knowledge				
		Some house hold use pond, lake and sometimes household have to travel more than 150 feet				

Main objectives	Objectives of the FGD	Information we have already got	Causes	Does it have any negative effect on health or other sectors	What initiatives household take as alternatives to cope with the situation	According to them what is the best solution of the problem
Main objectives of the FGD	Find out appropriate water harvesting system	Seasonality of water. Ask the question to find out is there any scarcity of water (Summer, winter) if yes then learn details				
		About 95% people use tube well water and no other water sources				

Main objectives	Objectives of the FGD	Information we have already got	Causes	Does it have any negative effect on health or other sectors	What initiatives household take as alternatives to cope with the situation	According to them what is the best solution of the problem
Main objectives of the FGD	Find out appropriate water purification system	No water purification system				
Cross cutting issues and objectives	Gender issues	81% female members are involve for house hold water carrying and for cleaning latrine				
	Latrine cleanliness	43% in Mymensingh and 32% in Durgapur clean their latrine once in a week and 21% in Mymensingh, 14% in Madhupur and 11% in Durgapur clean their latrine in a month				

[33]

Main objectives	Objectives of the FGD	Information we have already got	Causes	Does it have any negative effect on health or other sectors	What initiatives household take as alternatives to cope with the situation	According to them what is the best solution of the problem
Cross cutting issues and objectives	Health service	Only 5.11% house hold go for health services				
	Latrine conditions	In Madhupur and Durgapur 41.83% household use off set (Joint water seal) and 24.97% use off set (without water seal) latrine. Many people use pit and hanging latrine.				
		In Mymensingh 2.60%, in Madhupur 4.18% and in Durgapur 3.65% household don't have latrine				