INSTALLATION OF A SIMPLE WATER TREATMENT UNIT AT KALIGONJ REGION AND ASSESSMENT OF DALYS LOST DUE TO DIARRHEOA

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ABSTRACT

The South-western coastal region of Bangladesh is composed of Satkhira, Khulna, Bagerhat and parts of Jessore districts. On 25th May 2009, the 'Cyclone Aila' hit into the south-west coastal region. Aila devastated all the drinking water sources and caused destruction to sanitation facilities. In this context, till recent time, many people are compelled to drink such polluted water without any sort of purification and consequently suffer from water borne diseases. Diarrhoeal disease is one of the leading causes of morbidity and mortality in developing countries, especially among children under the age of five. The Disable Adjusted Life Years (DALY) is a time-based measure that combines years of life lost due to premature mortality and years of life lost due to time lived in health states less than ideal health. In study areas microbiological water quality in two sources was found to be varied in the range of 70~360 N/100mL as faecal coliform. In this case, DALYs lost was found to be 0.028 for three months period before the installation of water treatment unit. A simple water treatment unit or household filter was developed and installed at three locations of the study area. Ceramic candle which made with locally available and cheap materials as rice bran, clay soil and water was used into treatment unit. The efficiency of bacteria removal through these filter units were found to be around 99%. In the study area, almost all households were found to have individual toilet facilities while few households had shared toilets. Field survey on toilet facilities in the study area identified that there were 63.27% simple pit latrines, 30.61% pour flush latrines and remaining 6.12% inhabitants had no toilet facilities. This study arranged awareness development programs to alert the community specially women regarding safe sanitation and hygiene practices with a view to reducing the diarrhoeal diseases. The awareness development campaign on hygiene practices in this study area had vividly increased the use of soap and ash for hand washing after defecation to about 9.3% and 16.28% respectively. In this case, DALYs lost was found to be decreased significantly to 0.0057 for three months time period after the installation of water treatment units as well as consciousness development about improved sanitation and hygiene practices. Overall, improvement in DALYs lost was found to be 81% with facilitating safe drinking water, improved sanitation and hygiene practices.

Keywords: *Cyclone Aila*, *Diarrhoea, Disable Adjusted Life Years (DALYs), Water treatment unit*

1. INTRODUCTION

The Disability Adjusted Life Years (DALY) is a measure of overall disease burden, expressed as the number of years lost due to ill-health, disability or early death (WHO, 2002). In 2012, an estimated 229300 deaths in Africa and 207800 deaths in Southeast Asia were reported due to unsafe drinking water while in the same time period the death toll was 1700 in Europe and 6400 in Americas (WHO, 2014). On the other hand, due to inadequate sanitation the reported deaths were found to be 126300 in Africa, 123300 in Southeast Asia, 400 in Europe and 2400 in Americas (WHO, 2014). A total of 297000 deaths can be attributed to inadequate hand wash. Among children the burden is even higher: 25% of child deaths and 22% of the disease burden among children are attributable to WASH related diseases (Pruss-Ustun and Bos *et al.*, 2008). In an attempt to estimate the total burden of WASH, Gunther and Fink (2013) estimated that between 0.6-1.7 million child deaths per year could be prevented with improved access to water and sanitation. However, according to recent estimates from the significant Global Burden of Disease 2010 study (Lim and Vos *et al.*, 2012) only 1% of the total burden of disease worldwide and 4% of the disease burden among children worldwide is attributable to WASH. However, while WHO considers that 88% of diarrheal deaths can be attributed to unsafe water, sanitation and hygiene, the Institute for Health Metrics and Evaluation (IHME) estimates that unimproved water and sanitation are responsible for only 23% of diarrheal deaths in 2010. This difference is due more to differing methodologies than development. IHME considers that there is no disease burden from use of 'improved' water and sanitation facilities, although it is widely recognized that improved water sources frequently deliver unsafe drinking water, especially in developing countries. In Bangladesh, one third of the total child death burden is due to diarrhea.

Every year, a rural child suffers on an average from 4.6 episodes of diarrhoea (Piechulek *et al.*, 2003) from which about 230,000 children die. Acute diarrhoeal diseases are the major causes of infant morbidity and mortality, where 1 in 10 children die before their fifth birthday in Bangladesh (Petri *et al.*, 2000).

Cyclone Aila hit the south-western coast of Bangladesh on 25th May 2009. The affected people are still suffering from shortage of pure drinking water. During Aila, high tidal surges contaminated all fresh water sources with polluted saline water. One study by Haque *et al.* (2010) revealed that all the households use rain water as primary source and 77.14% households use sweet pond water as secondary source for drinking and cooking purposes. Most of tube wells are affected by saline and/or arsenic. Rainwater harvesting may be a probable alternative solution. But seasonal variation in rainfall pattern, proper storage of rainwater and public acceptances are some of the issues that need to be adequately addressed. Bacteriological contamination in pond water is another big problem. The use of pond sand filter (PSF) could not remove 100% pathogens from contaminated surface water. Due to inundation of safe water sources people had to go far away for the collection of safe water for drinking purpose (Kumar and Masud, 2010). Nevertheless, Household Water Treatment and Safe storage (HWTS) systems are proven, low-cost interventions that have the potentials to provide safe water to those who will not have access to safe water sources in the near term, and thus significantly reduce morbidity due to waterborne diseases and improve the quality of life. A study by Mwabi *et al.* (2013) in Africa showed that ceramic filter efficiency for bacteria removal was approximately 100%. Studies in Cambodia have shown that use of ceramic filters led to a reduction in diarrheal disease by 50% (Brown and Sobsey, 2007). Ceramic water filters are one point-of-use water treatment technology that is effective in reducing bacterial contamination in water and reducing the risk for diarrhea (Clasen *et al.*, 2004). Safe drinking water is defined in the Human Right to safe drinking water as "water free from micro-organisms, chemical substances and radiological hazards that constitute a threat to a person's health" (UNGA, 2010). However, the WHO GDWQ (Guideline for Drinking Water Quality, 2011) acknowledges that "100 % free" is not achievable, and that it is most effective to define the public health target to achieve. This can be done in terms of additional infections due to water (e.g. not more than 10-4 infections through drinking-water) or – more accurately – in terms of disability-affected life years, i.e. DALY (e.g. not more than 10^{-5} DALY per person and year), which essentially are infection rates multiplied by a factor describing the severity or degree and duration of disability caused on average by infection. At present, as basic infrastructure for wide surveillance of water sources is unavailable, a household water management approach appears to be the most attractive short term intervention (Fewtrell *et al.*, 2005 & Mintz *et al.*, 2001). In this context, this study aims at developing and installation of a simple household type water treatment unit for safe drinking water along with awareness development for improved sanitation and hygiene practices in the cyclone Aila affected Kaligonj region and hence assessment of the improvement in DALYs lost with the adopted intervention.

2. MATERIALS AND METHODS

2.1 Existing Situation of Study Area and Household Selection

Kaligonj upazila area of 333.79 sq km is located in between 22˚19' and 22˚33' north latitude and in between 88˚58' and 89˚10' east longitudes. Existing drinking water sources include: tubewell 84.49%, tap 2%, pond 8.80% and others 4.71%. The level of arsenic in the shallow tubewells and saline contamination in both shallow and deep tubewells waters were acute in this upazila. On the other hand, 42.91% of dwelling households of the upazila use sanitary latrines and 48.36% of dwelling households use non-sanitary latrines; 8.73% of households do not have latrine facilities (BBS, 2007). According to Ministry of Health and Family Welfare 2014, coverage of households having access to safe drinking water was 89% and household sanitation coverage 79%. Improved sanitation facilities are likely to ensure hygienic separation of human excreta from human contact. Improved sanitation can reduce 16 – 69% of diarrhoeal diseases. To wash hand with soap and safe water after defecation or before the preparation of food reduces the risk of diarrhoeal disease by 40% (WHO, 2014). Khaliskhali and Basontopur are more vulnerable and saline affected areas. Surface and ground water both are affected by saline. Most of the villagers are compelled to use this water without any sort of purification. Some inhabitants collect their drinking water from nearby village's PSF by walking/ using local vehicle from about 3-5 km. Field survey on toilet facilities in the study area identified that almost all households have been using toilets but most of the toilets are not safe with regards to sanitary standards. Questionnaire survey in this study were identified that, most of the people had been using only water for hand washing after defecation and hence became vulnerable to various diseases. Three households were randomly selected in this Aila affected Kaligonj region for the installation of developed water treatment unit and awareness development for improved sanitation and hygiene practices and hence to evaluate the improvement in DALYs lost.

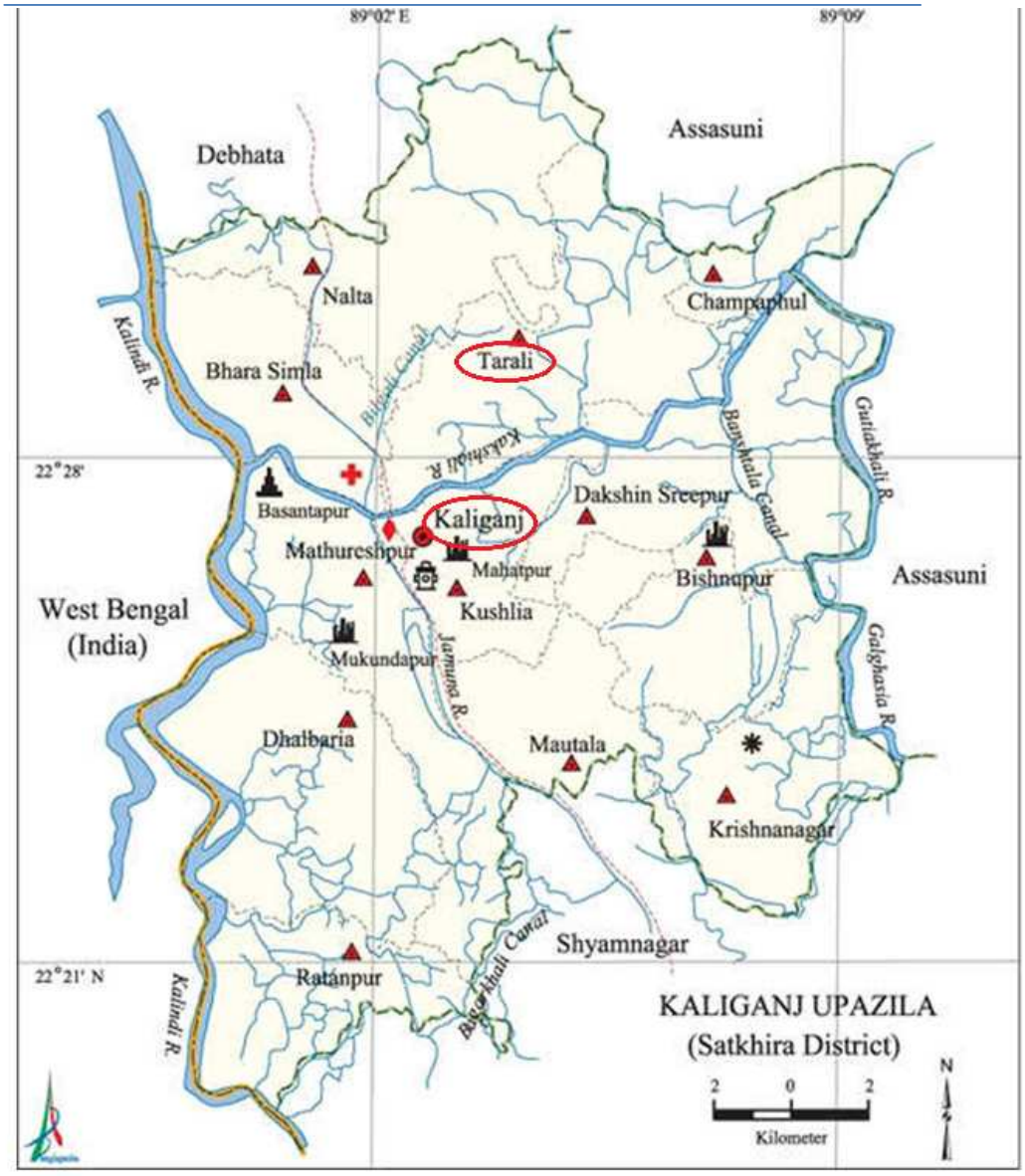

Figure1: Kaligonj Upazila (Study area) Map

2.1.1 The Intervention

The filter was made with locally available and cheap materials as rice bran, clay soil and water (Kumar *et al.*, 2012).Oven-dry soil was grind with hammer. Then soil and rice bran was screened through 0.5 mm and 1 mm sieve respectively. Soil (640g for 1 filter) and rice bran (160g for 1 filter) was taken in ratio of 80:20. Soil and rice bran was mixed homogeneously with water to make dough. Then dough was placed around the bar of the dice and two pieces of PVC pipe were pushed by hand from both sides to make cylindrical shape. Next the pipes were taken off and the surface of the filter was polished with water. The total frame was then toppled down to remove the dice. The resulting cylindrical ceramic filters were hollow with one side open. This soft filter was then dried in the sun for at least 3 days. The air dried filters were burnt in potter kiln at 900 to 1000℃. After continuous burning for 6 to 8 hours, the kiln was kept to cool down. After some hours the filters were taken out from the kiln. The final ceramic filters had a height of 10 cm and a thickness of 2 cm. Ceramic candle installed in the bottom of first chamber. Brick chips were used on candle up to 2 inch. Both chamber and brick chips were washed by water before the installation. Brick chips were washed until to stop red colour. Both the brick chips and container chamber were washed by hot water for 3 times. The raw water flows downward through the ceramic filter element into the lower collection chamber. The capacity of each container was around 10 L.

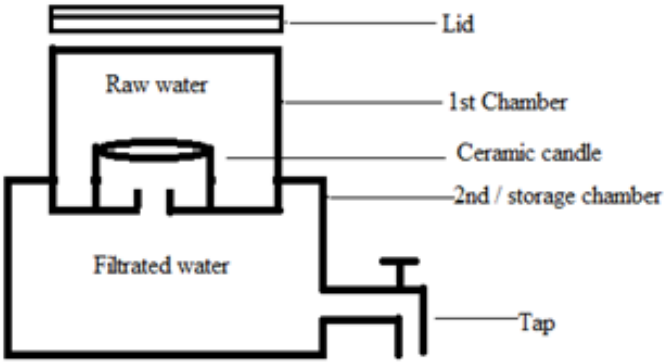

Figure 2: Developed Household Water Treatment Unit (HWTU)

2.1.1.1 DALYs calculation

The disability-adjusted life year (DALY) is an increasingly used population health metric (Murray *et al.,* 2013; Dev-leesschauwer *et al.*, 2014). DALYs are healthy life years lost, calculated by adding the adjusted number of years lived with disability (YLDs) and the number of years of life lost due to premature mortality (YLLs):

$$DALY = YLD + YLL \quad (1)$$

In where,
YLL = Number of death (N) *Life expectancy at the age of death (L_1)
YLD = Number of cases (I) *Duration till remission or death (L_2) *Disability weight (DW)
The developers of the preliminary DALY defined six disability classes based on presumed deficits in physical functioning (Table 1), from a reduction of at least 50% in functional ability to perform at least one recreational, educational, reproductive, or occupational activity (disability class 1) to needing assistance with activities of daily living such as eating, personal hygiene, or toilet use (disability class 6). Medical experts assigned a weight to each class, on a scale of 0 (perfect health) to 1 (death).

Table 1: Definitions of six classes of disability will be used in determining DALYs and the weights assigned to each (WB, 1993).

Class	Description	Weight
1	Limited ability to perform at least one activity in one of the following areas: recreation, education, procreation or occupation	0.096
2	Limited ability to perform most activities in one of the following areas: recreation, education, procreation, or occupation	0.220
3	Limited ability to perform most activities in two or more of the following areas: recreation, education, procreation, or occupation	0.400
4	Limited ability to perform most activities in all of the following areas: recreation, education, procreation, or occupation	0.600
5	Needs assistance with instrumental activities of daily living such as meal preparation, shopping, or housework	0.810
6	Needs assistance with activities of daily living such as eating, personal hygiene, or toilet use	0.920

3. RESULTS AND DISCUSSION

Water borne diseases can be reduced by improving water quality and preventing casual use of other unimproved sources of water. For instance, simple filtration and disinfection of water at the household level dramatically improves the microbial quality of water, and reduces the risk of diarrheal disease at low cost. Main purposes in this study, to remove bacteria through a simple household type water treatment unit installation and improvement of DALYs lost. After installation, these filters were monitored and samples had been collected 3 times for each month. Water quality parameters like pH, Colour, Turbidity, Dissolved Oxygen (DO), Chloride, Alkalinity, Hardness, BOD_5, COD, TC, and FC were tested and reported in table 2.

Table 2: Lab test results for the water quality parameters in raw and treated water

SL No	Parameters	Unit	Raw Water		Filtrated Water			Bangladesh
			Unit 1 & 2	Unit 3	Unit 1	Unit 2	Unit 3	standard
01	pH	-	8.50	7.61	7.20	7.01	8.34	6.5 – 8.5
02	Colour	Pt.Co	0	696	0	0	0	15
03	Turbidity	NTU	15.5	92.4	1.74	2	2.71	10
04	DO	mg/l	8.93	5.65	7.46	7.67	7.58	6
05	BOD_5	mg/l	1.99	1.73	0.23	0.08	1.2	0.2
06	TC	N/100 ml	170	410	2	0	0	0
07	FC	N/100 ml	70	360	0	0	2	0
08	COD	mg/l	256	512	192	192	160	4
09	Salinity	mg/l	70	2030	72.5	67.5	1210	150 - 600
10	Hardness	mg/l	319	1365	180	171	926	200 - 500
11	Alkalinity	mg/l	100	155	125	110	80	100

The fringe of raw water sources of unit 1 and 2 high and strongly bonded. Still now villagers are using this water as drinking purposes without sort of any purification. As result water quality parameters satisfactory well. The raw water source of unit 3 was situated at besides of garbage, cowshed and fish firm. As result, DO was found below than 6 mg/l. Hardness, alkalinity were found 1365 and 155 mg/l respectively. A main purpose of this filter unit was to remove / reduce bacteria. In this study, TC and FC was found after filtration around 0 N/100ml for unit 2. Wash brick chips hot and cool water until to remove red colour, keep these chips about 2 inch on filter candle, Use clean cloth as cover on lid of the filter unit and hygiene practices were involved to get good result.

3.1 Sanitation and Hygiene Practices

In the study area, almost all households were found to have individual toilet facilities while few households had shared toilets. Field survey on toilet facilities in the study area identified that there were 63.27% simple pit latrines, 30.61% pour flush latrines and remaining 6.12% inhabitants had no toilet facilities in Kaligonj coastal region. Improved sanitation facilities and change of the habits are not likely within a short time. However, this study arranged three times awareness development programs to alert the community specially women regarding safe sanitation and hygiene practices with a view to reducing the diarrhoeal diseases. Before the installation of household water treatment unit (HWTU) and awareness development programs, only 5.41% of the population used soap and 10.81% used ash for hand washing after defecation. However, the awareness development campaign on hygiene practices in this study area had vividly increased the use of soap and ash for hand washing after defecation to about 9.3% and 16.28% respectively. Figure 3 and 4 shows that toilet and hand wash status respectively.

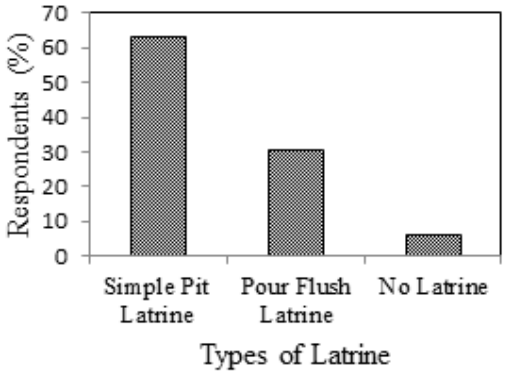

Figure 3: Status of different types latrine

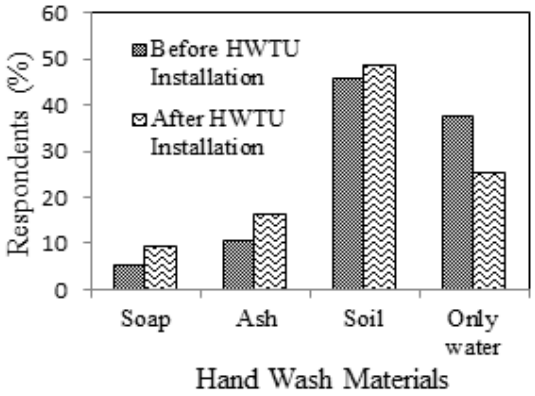

Figure 4: Status of hand wash after defecation

3.1.1 Disable Adjusted Life Years (DALYS)

Table 3: DALY's lost before installation of HWTU

				Morbidity										Mortality		
				Diarrhoea affected in last 3 month before installation												
				1st		2nd		3rd			Disability Weight					
Unit	No. of users	Male / Female	Age	Times	Affected days	Times	Affected days	Times	Affected days	Avg. duration	1st	2nd	3rd	Suffered	Gender	Age when died
1	1	M	35	-	-	1	2	1	2	2	-	0.096	0.096	-	-	-
	2	F	30	1	2	-	-	1	2	2	0.096	-	0.096	-	-	-
	3	M	76	-	-	1	2	1	3	2.5	-	0.096	0.4	-	-	-
	4	M	10	1	3	1	2	1	2	2.3	0.22	0.096	0.096	-	-	-
	5	F	6	1	3	-	-	1	4	3.5	0.22	-	0.22	-	-	-
	6	F	6	1	2	1	-	-	2	2	0.096	-	0.096	-	-	-
2	1	M	40	1	2	-	-	2	2	1.3	0.096	-	0.096	-	-	-
	2	F	30	-	-	2	3	1	2	1.67	-	0.096	0.096	-	-	-
	3	M	18	1	2	-	-	1	1	1.5	0.096	-	0.096	-	-	-
	4	M	15	1	2	1	2	-	-	2	0.096	0.096	-	-	-	-
	5	F	14	1	4	1	2	-	-	3	0.4	0.096	-	-	-	-
3	1	M	45	1	2	-	-	2	4	2	0.096	-	0.096	-	-	-
	2	F	40	1	2	1	3	-	-	2.5	0.096	0.22		-	-	-
	3	F	70	1	4	1	2	-	-	3	0.4	0.096	-	-	-	-
	4	M	20	-	-	1	2	1	2	2	-	0.096	0.096	-	-	-

Total disable adjusted life years (DALYs) lost before installtion of household water treatment unit (HWTU) was found to be 0.028 for a time period of three months. No mortality was occured due to diarrhoea during study

period. During dry season it is found that the rate of morbidity was increased. Then extra care is needed, someone is admitted in health care.

Table 4: DALY's lost after installation of HWTU

				Morbidity										Mortality		
				Diarrhoea affected in last 3 month before installation												
				1st		2nd		3rd			Disability Weight					
Unit	No. of users	Male / Female	Age	Times	Affected days	Times	Affected days	Times	Affected days	Avg. duration	1st	2nd	3rd	Suffered	Gender	Age when died
1	1	M	35	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	F	30	-	-	-	-	-	-	-	-	-	-	-	-	-
	3	M	76	-	-	1	2	-	-	2	-	0.096	-	-	-	-
	4	M	10	-	-	-	-	-	-	-	-	-	-	-	-	-
	5	F	6	1	4	-	-	-	-	4	0.22	-	-	-	-	-
	6	F	6	-	-	-	-	1	2	2	-	0.096	-	-	-	-
2	1	M	40	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	F	30	1	2	-	-	-	-	2	0.096	-	-	-	-	-
	3	M	18	-	-	-	-	-	-	-	-	-	-	-	-	-
	4	M	15	-	-	1	2	-	-	2	-	0.096	-	-	-	-
	5	F	14	1	2	-	-	-	-	2	0.096	-	-	-	-	-
3	1	M	45	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	F	40	-	-	1	1	-	-	1	-	0.096	-	-	-	-
	3	F	70	1	2	-	-	-	-	2	0.096	-	-	-	-	-
	4	M	20	-	-	-	-	-	-	-	-	-	-	-	-	-

Installation of the HWTU along with awareness development campaign on hygiene practices had been undertaken in this research work and with this initiative the DALYs lost was found to be decreased to 0.0057 for the same time period of three months.

3.1.1.1 DALYs improvement

Community education approach is required in order to establish an upgrading scheme at the grassroots level. It is not easy to create an understanding among illiterate people on the relation between the consumption of contaminated drinking water, hygiene practices and the effect of invisible pathogens on human health. The awareness on the importance of treating water before the consumption and adequate hygiene practices such as washing hand with soap however needs to be established before people will use a water treatment method. Such processes for changing habits and establishing new behaviors require much time and intensive coaching from community workers. In this study, we tried to develop awareness among selected households about safe drinking water and its storage, sanitation and hygiene practices besides the installation of a simple water treatment unit. Before the onset of this initiative, DALY's lost were found to be 0.013, 0.0074 and 0.0081 respectively of unit 1, 2 and 3 for three months of time period. After the installation of water treatment units as well as awareness development programs, DALY's lost had been found to be around 0.0033, 0.0016 and 0.0008 respectively for unit 1, 2 and 3 for the same time period of three months. Thus, DALY's development was achieved around 74.6%, 78.4% and 90.2%, respectively for unit 1, 2 and 3 of study areas. Figure 5 shows DALYs development.

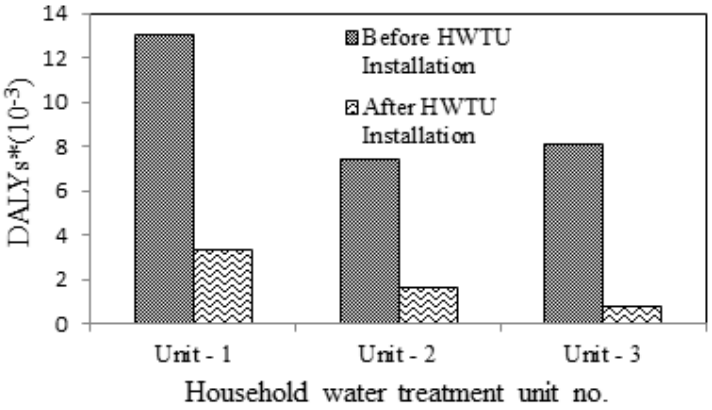

Figure 5: DALYs lost comparison between before and after installation of HWTU

4. CONCLUSIONS

Based on three months period of pilot study in three households at the south-west coastal region of Bangladesh, it was observed that diarrheal disease had been reduced around 81% through campaign of hygiene practice and installation of a simple water treatment unit in which bacteria removal efficiency was around 99% and other parameters such as colour, pH, turbidity, hardness etc. were within the satisfactory limit of Bangladesh standards for drinking water. So this study found that promotion of simple water treatment unit and campaign on safe hyeigene practices is very effective intervention in reducing DALYs lost due to diarrheal disease.

REFERENCES

BBS (2007). Bangladesh Bureau of Statistics Field report of Kaliganj Upazila, *URL: http://en.banglapedia.org/index.php?title=Kaliganj_Upazila_%28Satkhira_District%29.* Access on: 21.03.13

Brown, J., and Sobsey, M. (2007). Local Drinking Water Filters Reduce Diarrheal Disease in Cambodia: A Randomized, Controlled Trial of the Ceramic Water Purifier.

Clasen, T., Brown, J., Suntura, O., Collin, S., and Cairncross, S. (2004). Reducing diarrhea through household-based ceramic filtration of drinking water: a randomized, controlledtrial in Bolivia.Am J Trop. Med. &Hyg. 70(6): 651-657

Devleesschauwer, B., Havelaar, A. H., Maertens, N. C., Haagsma, J. A., Praet, N., Dorny, P., Duchateau, L., Torgerson, P. R., Van Oyen, H., and Speybroeck, N. (2014). Calculating disability-adjusted life years to quantify burden of disease. Int J Public Health. doi:10.1007/s00038-014-0552-z

Fewtrell, L., Kaufmann, R. B., Kay, D., Enanoria, W., Haller, L., Colford, J. M. (2005). Water, Sanitation & Hygiene interventions to reduce diarrhoea in less developed countries: a systematic review and meta-analysis, *The Lancet Infectious Diseases*, 5(1), 42-52.

Gunther, I., and Fink, G. (2013). Saving a Life-Year and Reaching MDG 4 with Investments in Water and Sanitation: A Cost-Effective Policy? European Journal of Development Research 25(1).

Haque, M. A., Haque, A., and Ansari, M. S. (2010). Water, Sanitation and Health status of Aila affected coastal area of Bangladesh. Bangladesh J.Environ.Sci., Vol. 19, 51-56, 2010.

Kumar, F. M., Quazi, H. B., Shafiquzzaman, M., Jewel, K. G., and Reza, S. M. (2012). Performance of iron oxidation ceramic filter units with different iron sources for arsenic removal from highly contaminated groundwater.

Kumar, U., Baten, M. A., Masud, A. A., Osman, K. S., and Rahman, M. M. (2010). Cyclone Aila: One Year on Natural Disaster to Human Sufferings. Unnayan Onneshan, 16/2, Indira Road, Dhaka-1215, Bangladesh.

Lim, S. S., Vos, T., et al. (2012). A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010. The Lancet 380(9859): 2224-2260.

Mintz, E., Bartram, J., Lochery, P., and Weglin, M. (2001). Not just a drop in the bucket: Expanding access to point-of-use water treatment systems. *Public Health*, 91(10), 1565-70.

Mwabi, J. K., Mamba, B. B., Momba, M. N. B. (2013). Removal of waterborne bacteria from surface water and groundwater by cost effective household water treatment systems: A sustainable solution for improving water quality in rural communities of Africa. Water SA vol.39 n.4 Pretoria Jan.2013.

Murray, C. J., Vos, T., and Lozano, R., et al (2013). Disability-adjusted life years (DALYs) for 291 diseases and injuries in 21 regions, 1990–2010: a systematic analysis for the global burden of disease study 2010. *Lancet* 380:2197–2223.

Petri, W. A. J. R., Haque, R., Lyerly, D., and Vines, R. R. (2000). Estimating the impact of amebiasis on health.*Parasitological Today*,16, 320-321.

Piechulek, H., Sabbir, A., and Aldana, M. J. (2003). Diarrhea and ARI in rural areas of Bangladesh. SouthEast Asian J Trop Med Public Health, Vol 34, No. 2 June 2003.

Prusss-Ustun, A., Bos, R., Gore, F., Bartram, J., (2008). Safer water, better health: costs, benefits and sustainability of interventions to protect and promote health. ISBN 978 92 4 159643 5. World Health Organization, Geneva, 2008.

UNGA (2010). Report of the independent expert on the issue of human rights obligations related to access to safe drinking water and sanitation, Catarina de Albuquerque. Addendum: Progress report on the compilation of good practices. A/HRC/15/31/Add.1. New York, Human Rights Council.

WHO (2014). Preventing diarrhoea through better water, sanitation and hygiene.
URL: http://www.who.int/water_sanitation_health/gbd_poor_water/en/, Access on: 20.4.15

WHO (2002). Death and DALYS estimates for 2004 by cause for WHO member states: persons all ages. *URL:*http://www.who.int/healthinfo/global_burden_disease/estimates_country/en/, Access on: 21.03.13

World Bank (1993). World development report: investing in health. New York: Oxford University Press.*URL:*http://www.nap.edu/openbook.php?record_id=5513&page=14, Access on: 01.04.13