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ACRONYMS

ADB : Asian Development Bank
APSU : Arsenic Policy Support Unit
BBS : Bangladesh Bureau of Statistics
BL : Baseline
DTW : Deep Tubewell
EL : End Line
FO : Field Organizer
GLM : General Linear Method
GoB : Government of Bangladesh
IMEC : Independent Monitoring and Evaluation Cell
IRC : International Research Centre
JMP : Join Monitoring Programme
LGD : Local Government Division
LIC : Low Income Country
MDG : Millennium Development Goal
MICS : Multiple Indicator Cluster Survey
ML : Midline
MNRE : Ministry of Natural Resource and Environment
NGO : Non Government Organization
OR : Odds Ratio
PA : Programme Assistant
PRA : Participatory Rural Appraisal
RC : Relative Change
RED : Research and Evaluation Division
SMC : School Managing Committee
SPSS : Statistical Package for Social Science
STW : Shallow Tubewell
UN : United Nations
UNICEF : United Nations Children's Fund
VIP : Ventilated Improved Pit
VWC : Village Wash Committee
WASH : Water, Sanitation and Hygiene
WHO : World Health Organization

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The Authors

EXECUTIVE SUMMARY

Background

It is evident that the risk of death can be lessened by ensuring access to safe water, sanitation and improved hygiene practices. With this propitious wisdom, BRAC WASH programme envisage improvement in health by ensuring access to safe water, sanitation and by providing hygiene education to all including men, women, adolescent girls and boys, and children. But it is given that poverty and physical facilities for life living and the environment act as impediments towards improving this situation. Thus, to overcome such constraint and to improve health status of the rural poor, BRAC WASH programme has been launced in 150 *upazilas* (sub-districts) in three phases effective middle of 2006. The BRAC Research and Evaluation Division conducted baseline, midline and end line surveys in 50 *upazilas* of the first phase. The study evaluated the impact of the programme on various issues related to water, sanitation and hygiene at household and educational institutions.

Methods

We followed a cross-sectional comparative design between baseline (2006), midline (2009) and end line (2011) statuses. Fifty *upazila* of the first phase of BRAC WASH I programme were selected for baseline, midline and end-line surveys. These *upazilas* were known as low performing areas in terms of water, sanitation and hygiene coverage compared to the national average. Thirty thousand households from 50 *upazilas* were selected in two steps: i) 30 villages were selected from each *upazila* by cluster sampling, and ii) 20 households were chosen systematically from each village. The end line survey covered 26,404 households. Moreover, to know the status of using tubewell water use and water safety practices, the surveys were conducted in 11 arsenic-prone *upazilas* from the first phase of programme in southern Bangladesh. Data were collected from 6,600 households, 600 from each *upazilas* in each survey. Besides, during baseline survey 2,395 educational institutes were surveyed using a pre-tested questionnaire. However, for operational convenience during midline and end line surveys, the number of institutes was reduced to 1,487 and 1,189, respectively. The respondents were the adult female members of the households who had knowledge of day-to-day household activities related to water, sanitation and hygiene. Female respondents were chosen because they are usually responsible for collecting and storing water and maintenance of latrines at households. Data were collected from them through direct interview using pre-tested questionnaire. The matched households in all the three surveys were included in the analysis. Chi-square and t-tests compared the differences between indicator values.

Results

The analysis of the study result reveals that over 97% of the households across the survey area used tubewell water for drinking, while it was least used for bathing in

both rainy and dry seasons. The use of tubewell water for food preparation significantly increased over time, which is one of the prior concerns of World Health Organization for improvement of health. The proportion of arsenic-free own tubewell increased from baseline (57.8%) to midline (60%) and to end-line (64.6%) ($p<0.001$), but decreased for shared tubewells across the surveys. Households using sanitary latrines increased significantly at midline (41.5%) and end line (57.4%) from baseline (31.7%) respectively. Proportion of physically verified clean latrines increased significantly from baseline (33.4%) to midline (50.8%) to end line (53.3%). The study also reveals that availability of sanitary latrines in educational institutions increased to 98% in end line from 91% in baseline. The number of educational institutions installed separate latrines for boy and girl students significantly increased from 46% in baseline to 60% in end line. The absenteeism of girl students during menstruation has been reported to be reduced from 44% in baseline to 33% in end line. Self-reported hand washing practice with soap after cleaning child's bottom significantly improved from baseline to end line (18% vs. 30%). Gap between knowledge and practice still exists in hand washing practices. Moreover, the study reports that majority of the women (over 82%) were responsible for water collection from all types of tubewells, while involvement of other members significantly increased over the years. The tendency of cleaning tubewell platform and household latrines was higher among women than men. The prevalence of water-related diseases significantly reduced from 9.4% in baseline to 7.1% in midline and to 2.3% in end line ($p=.000$). Under-five children were more likely to have inflicted with water-related diseases across the surveys according to the analyzed result. Users of safe water for bathing were less likely to have water-related diseases.

Conclusion

Despite the progress in the use of tubewell water for different purposes, some technical challenges emerged as arsenic contamination in tubewell water, unmarked tubewell for arsenic or non-arsenic, no treatment of water before drinking. A number of households shifting from sanitary to unsanitary practices by removing water seal from the latrines over the years has become a matter of concern towards the growth of sanitation coverage. A good number of factors such as poverty, lack of awareness, and shortage of water induced households to adopt such unsanitary practices. The gap between knowledge and practice existed among the respondents. However, to transform the knowledge into practice and practice into habit, continuous learning process through more frequent cluster meetings, home visits by programme organizers, and practical demonstration of some practices are imperative. Women still play significant role in water collection and cleaning of tubewell platform and household latrine. Increased involvement of other family members in household activities would open up the opportunity for women to be involved in productive activities. Evidence reveals that significant reduction in the prevalence of water-related disease has been found. But challenge remains to continue on improved and sustained hygiene practices.

Chapter 1

Studies on the impact of BRAC WASH-I interventions: An overview

Nepal C Dey and Sifat-E-Rabbi

Introduction

BRAC WASH (Water, Sanitation and Hygiene) programme aims to facilitate, in partnership with the government of Bangladesh and other stakeholders, the attainment of the targets of UN Millennium Development Goals (MDG) related to water and sanitation focusing underprivileged groups across the country and thereby improve the health situation and enhance equitable development.

The MDG for water and sanitation is to halve the proportion of people without sustainable access to safe drinking water and basic sanitation by 2015. Based on the goal to halve the percentage of people without access in 1990, the MDG targets are for 89% and 70% of the population to have access to water and sanitation, respectively by 2015. It is well reported that the government of Bangladesh has a national target to achieve 100% of the population to have access to safe water by 2011, and access to basic sanitation by 2013. In the early 1990s, the coverage of safe water sources reached 97%, but the detection of the widespread arsenic contamination of groundwater reduced this figure to about 74% in 2006 (GoB and UNDP 2009), while arsenic adjusted figure was 86% in 2009 (GoB 2012). However, due to inconsistent definition and interpretation, it is difficult to figure out an accurate measure of sanitation coverage. Based on the Multiple Indicator Cluster Survey (MICS) report of 2009, the national sanitation coverage in terms of basic sanitation was 80.4%, 54.1% for improved sanitation, and 51.5% for hygienic sanitation. Significant achievement has been achieved in reducing open defecation from 42% in 2003 to 6% in 2009 (LGRD 2011). According to the Household-Income Expenditure Survey (HIES) open defecation has dropped from 11.3% in 2005 to 4.4% in 2010 (BBS 2011). High vulnerability to climate change effects and arsenic contamination of groundwater are major environmental issues that act as obstacles for the progress of WASH activities.

The intervention of the first phase of WASH I aims to ensure access to sanitation services for 17.5 million people, promotion of safe hygiene behaviour through an education campaign for 37.5 million people, and provision of safe drinking water for 8.5 million people living in 150 *upazilas* (sub-districts) throughout the country (Kabir *et al*. 2010). BRAC WASH initiatives improve water supplies and sanitation and promote hygiene in households, schools and at community level. The WASH programme especially addresses the status and access to safe water and sanitation for the ultra poor (WASH Research Team 2008). It was reported in a previous study

that the ultra poor were more exposed to arsenic contamination than expected. The findings also reveal that there were no specific policies for the ultra poor to access safe water consumption. As a pro-ultra poor approach, WASH has been found effective in this regard (Neelim 2008).

The water component of the programme aims to promote use of safe water. Under this component, the BRAC WASH programme has been working for i) deep tubewell installations mostly in arsenic-affected areas, ii) loan support to construct tubewell platforms, and iii) testing water quality of tubewells that falls under the programme in 35 arsenic contaminated areas. Besides, installation of piped water supply, arsenic removal filters, and pond sand filters were also provided in selected areas. To increase the access of safe water in the underserved areas, BRAC installed piped water supply system and multiple-headed deep tubewells, and provided pond sand filters and arsenic removing household based filters. During this period 3,966 deep tubewells, 5 piped water supply systems, 647 arsenic removal Sono filter, and 16 pond sand filters were installed. In September 2011, BRAC WASH in coordination with other stakeholders has covered 1.9 million population, either by providing new water sources or by repairing existing ones, where about 0.6 million people got increased access to safe drinking water. It also implemented various community outreach activities like awareness raising, advocacy campaign and community capacity building by informing people about safe water use and developing water safety measures. Considerable improvement was found in the case of arsenic-free tubewell water use and safety practices including putting cover on water jar during transportation and storage of water at household of WASH intervention areas (Dey *et al*. (2012).

The total sanitation coverage increased from 33 to 83% in 150 *upazilas* up to September 2011. With the assistance of Village Wash Committees (VWC), to avoid bias and ensure transparency, BRAC WASH provides loans and subsidizes latrines for the poor and hardcore poor respectively. During this period, loans were provided to 157,881 families while 732,181 households received fully subsidized latrines. As an outcome, the use of hygienic latrine coverage increased by converting unhygienic latrines into hygienic ones. With WASH's technical support, around 1.9 million households are now use hygienic latrine facilities by changing or fixing water seal at a minimum cost. A total of 25.9 million people gained access to sanitary latrine facilities in 150 *upazilas* by September 2011. To ensure the availability of latrine materials and quality control, 1,546 rural sanitation centres were established up to September 2011 considering one in each union with an initial provision of working capital for the entrepreneurs.

The overall strategy of the programme is centred on sustainable behaviour change which was implemented through community organization, institutional mobilization and capacity development. Different types of behaviour change and communication materials were used in hygiene education sessions. Both hygiene education and promotion strategies were followed in the programme. As the programme ended in April 2011, the follow-up sessions were organized for the audience based on household monitoring done by the programme staff till September 2011. During the

total programme period, 1,414,224 male, 13,616,021 female, 1,437,349 adolescent boys, 2,433,054 adolescent girls and 1,998,748 children meetings were held. Hygiene education and promotion sessions were also conducted in 131,243 government primary schools, 62,820 non-government primary schools, 52,300 secondary schools, 16,223 *madrassa,* and 182,966 BRAC schools.

Study conducted by Akter and Dey (2012) in 50 *upazilas* revealed that if 16.9% shared latrines were included with improved facilities (67.2%), the total sanitation coverage would be 84.1% in BRAC WASH intervention areas. Breaking the water seal as a barrier towards increasing sanitation coverage has been found due to water shortage and lack of consciousness. Female members are mainly responsible for hygienic maintenance of household latrines. Hanchett *et al.* (2011) emphasizes households' behaviour change to improve quality of sanitary latrines. Thus increased motivation about use and benefit of sanitary latrines, involvement of other family members in hygienic maintenance of latrines and financial support by NGOs were found effective to increase sanitation coverage. According to expert from NGO Forum, beside capital investment, proper attention should be paid on innovation of sanitation technology considering regional difference. In spite of recent increase of capital investment in water and sanitation sector, setting priority still remains a challenge (Saha 2013). Improved sanitation practices and hygiene behaviour of students may contribute to the overall hygiene and sanitation situation of the community leading to reduced disease burden. Recent study reveals that a gap between knowledge and practice in hand washing still persists although it reduced significantly from baseline to end line (Rabbi and Dey 2013). Study recommended long term and extensive initiatives can aware people about the effectiveness of hand washing.

Besides, provision of improved water and sanitation coupled with menstrual hygiene education at schools can prevent absenteeism or dropout of adolescent girls from schools. Considering these, WASH programme, undertook an intervention for educational institutions in its catchment areas. The interventions include partial financial support to secondary schools to establish separate latrines for girls and imparting hygiene education to students and teachers. Ghosh and Karim (2011) study assessed the impact of BRAC WASH programme's interventions on water, sanitation and hygiene practices in educational institutions in the programme areas. Overall, the availability of sanitary latrines in educational institutions increased to 98% in end line (2011) from 91% in baseline (2006). It was also found that the use of sanitary latrine among the students and teachers increased significantly in end line survey compared to baseline. The number of educational institutions having had installed separate latrines for boy and girl students significantly increased from 46% in baseline to 60% in end line. The absenteeism of girl students during menstruation was reported to reduce from 44% in baseline to 33% in end line survey.

The Research and Evaluation Division (RED) of BRAC conducted a baseline survey in 2006-2007 to understand the pre-programme status vis-à-vis the impact evaluation of the programme in the selected WASH I programme areas. Subsequently, after two years of the baseline survey a midline survey was done in mid-2009 (April-June)

to assess the changes. Finally, after five years of intervention an end-line survey was conducted during December 2009-March 2010 to see the impact of the programme. This monograph covers only seven important studies out of many on the impact of BRAC WASH I interventions in some important issues focusing water, sanitation and hygiene associated to improve the health condition.

The programme has also started implementing the second phase under WASH II. New method of conducting surveys and collecting data is being employed by WASH. The data will be processed by Sensemaker – pattern detection software that facilitates analysis of large quantities of narratives.

Methods

The study followed a cross-sectional comparative design between baseline (2006), midline (2009) and end line (2011) statuses. The BRAC WASH I intervention has covered a total of 150 *upzilas* (sub-district) in three phases, 50 *upazila* in each phase, starting from end of 2006 (Figure 1.1). A total of 50 *upazila* of the first phase of BRAC WASH I programme were selected for baseline, midline and end line surveys. These *upazilas* were known as low performing areas in terms of water, sanitation and hygiene coverage compared to the national average.

Sampling

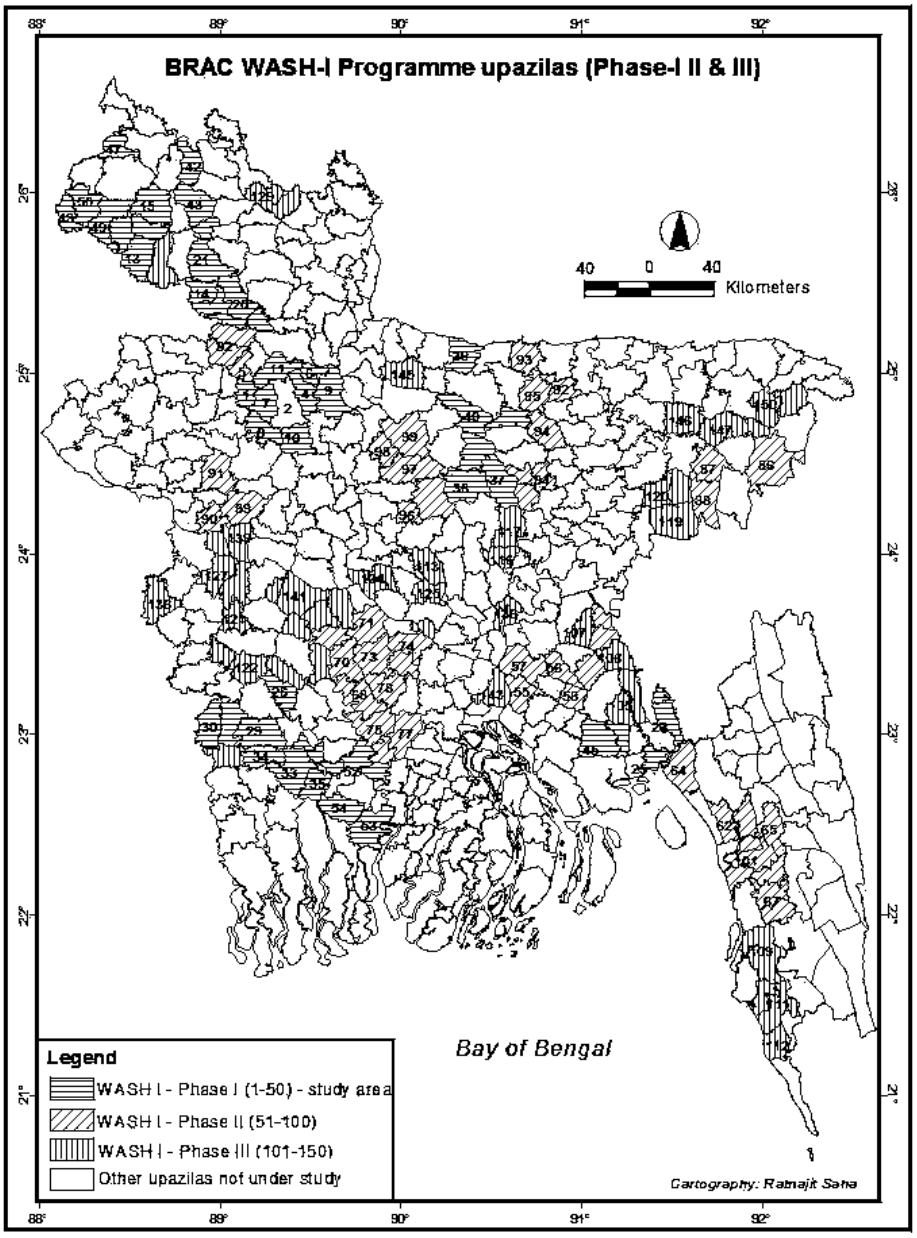
From each *upazilas*, 30 villages were selected using the systematic sampling method, followed by 20 households from each of the 30 villages for the study. Thus, 30,000 households were selected through a two-stage sampling procedure for interview. In the midline, the same households were surveyed after two years of implementation the BRAC WASH I programmes. The end line survey covered a total of 26,404 households. The households which were missed in midline and end line survey (due to death, displacement and absenteeism) were not considered and thus the number of the households comes down in the midline than end line from baseline.

Data collection techniques and tools

Data for the baseline were collected during November 2006–June 2007 and for the midline during April-June 2009, using a pre-tested structured questionnaire. Possible variables were physically verified. In both surveys, respondents were the adult female members of the households who had knowledge of day-to-day household activities related to water, sanitation and hygiene. Female respondents were chosen because they are usually responsible for collecting and storing water and maintenance of latrines at households. BRAC WASH I programme promotes household hygiene practices through involving the female members of the households. The administrative heads or the acting heads of educational institutes were interviewed for the institutional survey. And for the mosques the respondents were the committee members, followed by *muazzins* and *imams*. The questionnaire was pre-tested in the baseline and modified and edited in the midline on the basis of

feedback received before finalization. Informed consent was obtained from the participants.

Figure 1. Study area



Conceptual issues

The economic statuses of households were classified as ultra poor, poor and non-poor (Seraj 2008). Ultra poor are those who are landless or homeless and have less than 10 decimal of agricultural land, no fixed source of income; poor are those who have up to 50 decimal of land (agricultural and homestead) and sell manual labour for living; households that do not fall in any of the other category are called non-poor.

Enumerators

The enumerators were selected based on educational qualifications and previous experience. The selected enumerators were went through a rigorous training on data collection for seven days in the head office followed by a field test for 2 days to accustom with the survey procedure and questionnaire. A training manual containing instructions for data collection was given to the enumerator.

Data collection and quality control

After the completion of training, the field management unit divided the enumerators into several groups where each group consisted of more than five members. Each group comprised of at least two female and two male members. The assignment for each group was to complete not less than 5 questionnaires for household in a day along with educational and religious institutes. Enumerators are instructed to complete all the questionnaires in the field and cross-check each other's before finalizing the day work. The supervisor's duty was to identify inconsistencies of the total questionnaires and re-interviewed if necessary. In addition they were also told to verify 5% of the previous weeks' filled-up questionnaires. The field managers checked the quality of each interview by randomly picking 12 completed questionnaires of a particular day and visited the field to verify answers of some previously selected questions. Whenever any such issues became evident a re-interview was conducted on the following day for the necessary amendment.

The responsibility of field coordinator was to supervise overall field activities. Field coordinator was the contact person for the WASH research team. Field coordinator is also responsible to document all the inquiries from the field for immediate dissemination to the concerned researchers. He also maintained a log book of field activities. Besides, a team of core researchers monitored the field activities closely by visiting some selected field locations to ensure the correct way of sampling and data collection and minimize the problem arose in the field.

Data management and analysis

Filled-in questionnaires were edited and coded for computer entry under the close supervision. Twenty percent of the questionnaires were re-checked for consistencies. After rechecked the data were disseminated to researcher for analyses. The relative change (RC) between baseline (BL) and midline (ML) statuses was calculated using the formula {(ML-BL)/BL}*100. The analysis was performed

using different version of SPSS. Chi-square test compared the significance of differences between baseline and midline statuses, and between different economic groups.

Ethical considerations

Informed verbal consent was obtained from each respondent. Each respondent was assured that he/she could withdraw from the interview at any time, and any refusal would not affect his/her receiving any services from BRAC. Strict confidentiality was maintained in data handling.

Outline of the chapters

This monograph is composed of seven chapters. First chapter deals with design, methods and chapters outline. The second chapter illustrates the effect of WASH interventions in water use and safety systems in the programme areas. The third chapter explains the impact of BRAC WASH Programme in sanitation coverage and practice at households. The fourth chapter describes the impact of BRAC WASH programme on knowledge and practice of hygiene, compared to benchmark status. The fifth chapter demonstrates women's role in managing household water-hygiene and sanitation. Chapter six describes the changes of BRAC WASH I programme brought in water, sanitation and hygiene in educational institutions and chapter seven explores the impact of the WASH programme on the prevalence of water-related diseases among population in the programme catchment areas.

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Chapter 2

Use of tubewell water for different purposes at household level: safety practices in rural Bangladesh

Nepal C Dey, Fazlul Karim and Sifat-E-Rabbi

ABSTRACT

The study compared the effects of BRAC WASH I (Water, Sanitation and Hygiene) programme in the use of tubewell water and water safety practices at household level among baseline, midline and end line survey statuses. The surveys were conducted in 11 arsenic-prone *upazilas* (sub-district) from the first phase of programme in southern Bangladesh. Data were collected from 6,600 households, 600 from each sub-district in each survey. These were selected in two steps using the 30-cluster sampling method: In step 1- 30 villages were drawn from each of the 11 *upazilas*, and in step 2- from each village, 20 households were chosen systematically. However, by physical verification in the sampled households, 3,410 tubewells were found at baseline (2007), 3,453 at midline (2009) and 4,374 at end line (2011) surveys. Chi-square and T-tests compared the differences between indicator values, and binary logistic regression identified the determinants of outcome variable. Almost all the households (over 97%) across the surveys used tubewell water for drinking, and it was least used for bathing in both the rainy and dry seasons. The proportion of arsenic-free own tubewell increased from baseline (57.8%) to midline (60%) and to end line (64.6%, $p<0.001$), whereas it decreased for shared tubewell across the surveys. Significant improvement was found in the construction of concrete-built tubewell platforms (63% vs. 69% vs. 73%) and their cleanliness (31% vs. 40% vs. 65%) in all surveys. Considerable improvement in putting cover on water jar during transporting and storage of water was found across all surveys. Analysis revealed that ownership of television appeared to be the most significant factors influencing water safety practices followed by better economic status, higher level of education, and service of household heads. Since around one-fourth of the tubewells was contaminated with arsenic, therefore effort should be taken to prevent it for the safety of water.

Key words: BRAC, MDG, Tubewell, Ultra poor, WASH, Water safety, Arsenic

INTRODUCTION

Access to safe drinking water is essential to health, a basic human right and a component of effective policy for health protection (WHO 2011). Ensuring access to safe drinking water is the greatest challenge for most developing countries to attain Millennium Development Goals. According to the WHO guidelines, safety of drinking water includes; prevention of water source pollution; selective water harvesting; control over water source; treatment prior to distribution; protection during distribution; and safe storage within the home and in some circumstances, treatment at the point of use (WHO 2005). During the last decade, expanded activity in agriculture and manufacturing has not only increased the demand for water, but has also contributed to pollution of surface and groundwater. Safe water is required for all usual domestic purposes (WHO 2011) while inadequate water supply prevents good sanitation and hygiene practices (Hunter *et al*. 2010). Globally, eight out of ten people who are still without access to an improved drinking water source live in rural areas (UN MDG Report 2010). Though Bangladesh has made significant progress in ensuring access to improved water supply to its people, regional and socioeconomic disparity in access to quality water exists across the country. About 20% people stil don't get safe water (JMP 2012). Tubewell as an improved source of water in rural Bangladesh, higher sanitation coverage, and better primary healthcare have contributed to a significant drop in the mortality rate from diarrhoeal diseases (GoB and UNDP 2009). The discovery of widespread arsenic contamination of groundwater has effectively lowered access to improved drinking water from 97% to 74% of the population in 2004 (WHO and UNICEF 2006). It is a matter of great concern that the presence of arsenic in drinking water increased the mortality rate in Bangladesh (Tan *et al*. 2010). Although Bangladesh is on track to achieve the MDG target on access to safe drinking water, 13% of its population is still drinking arsenic contaminated water beyond permissible limit (0.05 mg/l) (GoB and UNICEF 2010). However, proper design and placement of tubewell, maintaining a safe distance from latrine and waste dumping point, ditch/ponding, sound platform without cracks, and firmly attached of hand pump and maintenance of the headwork are identified as the sanitary indicators for safe water (Luby *et al*. 2008). Though at a low-level, around 29% of tubewells in low lying areas of Bangladesh are contaminated with faecal bacteria caused mainly by poor maintenance of the tubewell surroundings (Hoque 1999; Islam *et al*. 2001, Hoque 2006; Luby *et al*. 2008; GoB and UNDP 2009; Islam *et al*. 2001). However, access to safe drinking water is hindered by a number of factors such as basic hygiene knowledge, social position, water quality (due to presence of arsenic, point and non-point sources of pollution, etc.), declining of groundwater levels (Dey *et al*. 2010; UNICEF 2010).

Previous study showed that access to improved water sources and water safety measures increased significantly after 2 years of BRAC WASH programme (Dey and Ali 2010). However, some impediments to 100% safe water use found during programme interventions. The RED (Research and Evaluation Division) of BRAC carried out a baseline to assess the pre-programme status of water, sanitation and was followed-up by midline and end line surveys for assessing the impact.

OBJECTIVES OF THE STUDY

The general objective of the study was to assess the effect of WASH interventions in different indicators relative to water use and safety systems in the programme areas over the years. The specific objectives were to:

- assess and compare the changes in the use of tubewell water for different purposes at household level;
- assess the practice of water safety measures (at source, transportation, storage) including awareness of water treatment (cleaning/purifying) at household level;
- identify the issues for further attention to reach 100% safe drinking water coverage at household level.

MATERIALS AND METHODS

Study design and area

This study followed a cross-sectional comparative design between baseline (2007), midline (2009) and end line (2011) statuses. All the 11 arsenic prone *upazilas* (*upazilas*) from the 50 *upazilas* of the first phase of BRAC WASH I programme were selected for baseline, midline and end line surveys. The study area is shown in Fig. 2.1. These *upazilas* were known as low performing areas in terms of water, sanitation and hygiene coverage compared to the national averages.

Sample size

The sample comprised of 6,600 households, 600 from each *upazilas* as described by Seraj (2008).

Sampling procedure

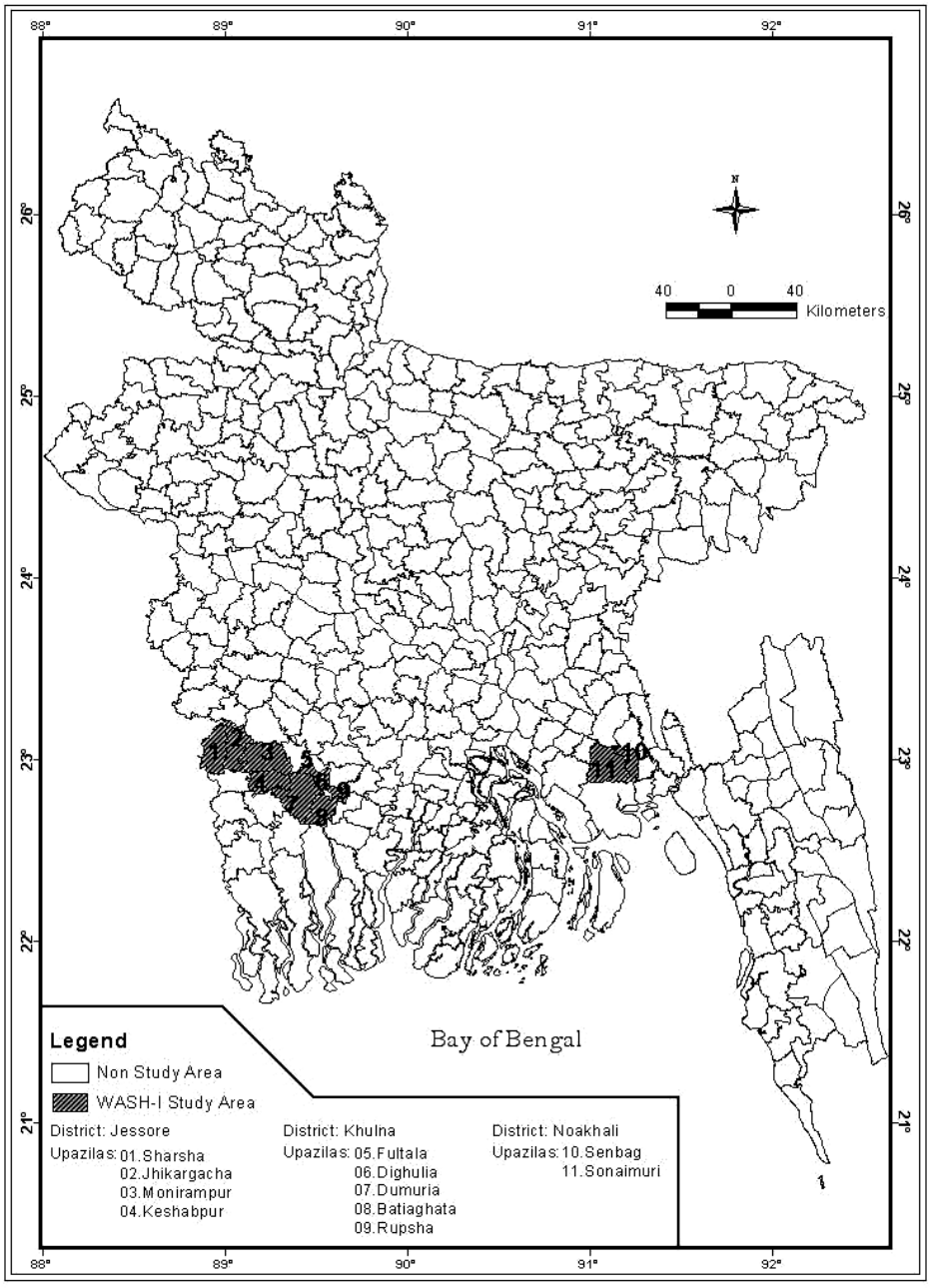
The ultimate sample households were selected in two steps: In the first step, using the 30 cluster sampling method, 30 villages were selected, and in the second step, 20 households were selected systematically. A total of 6,593 households were interviewed at baseline, 1% non-participation was found. In midline, 5,995 households were interviewed, 10% lost from the baseline survey. The end line survey visited 5,759, 2% lost from the midline survey. Reasons of lost to follow-ups were unavailability of the respondents during the time of data collection, displacement by river erosion or shifting of households, etc. In the selected villages and households, 3,410 tubewells (installed in cooperation with different agencies including BRAC WASH I programme) were found at baseline, 3,453 tubewells at midline and 4,374 tubewells at end line by physical verification.

Major variables

Water use patterns both in dry and rainy seasons, availability of tubewell water, water safety at source including position of tubewell compared to latrine, tubewell platform-

concrete built or not, cleanliness of tubewells platform, drainage system of tubewell water, water safety at transportation and storage, an awareness of water treatment, and risk of tubewell.

Figure 2.1. Study area



The rural water is being supplied basically from own tubewell, shared tubewell, public tubewell, whereas urban water supply adopts piped/tape water from deep tubewell. A tubewell is called own tubewell when only one household used to collect water for their daily uses. When a tubewell is used by a group of households, like neighbour and/or relatives, who may or may not follow any particular time to collect water are called shared, and public tubewell is open for all and have no time restriction for collecting water. According to JMP of WHO/UNICEF, improved water sources were categorized as: (a) water piped into dwelling, plot, or yard; (b) other improved sources including public taps, protected springs, hand pump, and rainwater harvesting. The level of arsenic concentration in the tubewell water higher than the Bangladesh standard for drinking water (0.05 mg/l) called arsenic contaminated tubewell.

Data management and analysis

The filled questionnaires were edited for completeness and consistency at BRAC Head Office by a group of trained field interviewers. These were analyzed using the SPSS software version 14 under the supervision of the senior researchers. The analysis was performed on the matched households in all the three surveys (5,759 in each survey, giving a total of 17,277 households). Chi-square and T-tests compared the differences between indicator values, and a binary logistic regression identified the determinants of outcome variable.

RESULTS

Socioeconomic and demographic profile of study samples

Socioeconomic and demographic profiles of the area are presented in Table 2. Over 34% of respondents never went school, 30% attended at primary level followed by 31% at secondary level in both surveys. Most households were non-poor (68%), significantly higher than baseline (54%). Perceived economic conditions (deficit, balance, and surplus in annual income/expenditures) of households were almost similar across the surveys. The main occupation of the respondents were household work (93%) almost similar across the surveys and most of them were married (92%). The proportion of respondent aged ranged 11-30 and 31-40 was similar both at end line survey than baseline (32%), but the proportion above 50 years increased from baseline to end line (7.8% vs. 13.7%) (Table 2.1).

Table 2.1. Socioeconomic and demographic profile of study samples

Indicators	Baseline (2007)	Midline (2009)	End line (2011)	p-value
	(a)	(b)	(c)	(a) vs. (c)
Education				
Never schooling	35.2	35.9	33.5	<0.521
Primary level	31.3	30.1	30.6	<0.440
Secondary level	30.9	31.5	33.0	<0.730
Higher Secondary and above	2.6	2.5	2.9	<0.611

(Table 2.1 continued...)

(...continued Table 2.1)

Indicators	Baseline (2007)	Midline (2009)	End line (2011)	p-value
	(a)	(b)	(c)	(a) vs. (c)
Economic status of households				
Non-poor	54.2	54.2	68.4	<0.001
Poor	29.5	29.5	17.2	<0.001
Ultra poor	16.3	16.3	14.4	<0.001
Perceived economic status of households				
Deficit	38.9	45.6	40.2	0.521
Equilibrium	39.6	37.5	39.1	0.000
Surplus	21.5	16.9	20.7	0.462
Main occupation of household head				
Household work	93.6	93.3	93.0	<0.321
Others	6.4	6.7	7.0	<0.011
Marital status of respondents				
Married	93.3	93.3	92.0	<0.001
Widow	4.5	4.5	6.2	<0.001
Unmarried	1.4	1.4	0.9	<0.001
Others (separated & divorced)	0.8	0.8	0.9	<0.01
Age of respondents (Years)				
11-30	40	43.0	31.2	<0.001
31-40	32.5	31.3	32.1	<0.001
41-50	19.7	18.0	23	<0.601
51-above	7.8	7.7	13.7	<0.001
N		5759		

Sources of water used for different purposes

Sources of water used for different purposes during rainy and dry season are presented in Table 2.2 and 2.3, respectively. Most households both in the rainy and dry seasons used tubewell water for drinking (over 97%) in all the surveys. The use of tubewell water for cooking in the rainy season significantly increased from 63% at baseline to 69% at midline to 75% at end line (<0.001). Likewise, it increased from 64% at baseline to 72% at midline and 76% at end line in the dry season (<0.001), While surface water use for cooking decreased from baseline to mid line and end line surveys in both the seasons (Table 2.2-2.3). Tubewell water was relatively least used for bathing in both the dry and rainy seasonis in all surveys.

Table 2.2. Sources of water use for different purposes during rainy season (%)

Use of water in different purposes	Baseline 2007	Midline 2009	End line 2011	p-value		
	(a)	(b)	(c)	(a vs. b)	(b vs. c)	(a vs. c)
Drinking						
Tubewell water	98.9	97.8	99.3	0.000	0.000	0.000
Supply water	0.3	0.3	0.3	0.000	0.009	0.000
Surface water	0.8	2.1	0.4	0.000	0.000	0.000

(Table 2.2 continued...)

(...continued Table 2.2)

Use of water in different purposes	Baseline 2007	Midline 2009	End line 2011	p-value		
	(a)	(b)	(c)	(a vs. b)	(b vs. c)	(a vs. c)
Cooking						
Tubewell water	62.4	68.7	75.3	0.012	0.000	0.000
Supply water	0.2	0.1	0.4	0.000	0.003	0.000
Surface water	37.4	31.2	24.3	0.000	0.116	0.000
Washing utensils						
Tubewell water	55.3	61.7	64.7	0.000	0.014	0.000
Supply water	0.1	0.1	0.3	0.000	0.192	0.000
Surface water	42.5	38.2	35.0	0.000	0.000	0.000
Cleaning after defecation						
Tubewell water	63.2	70.7	69.2	0.000	0.000	0.000
Supply water	0.6	0.3	0.5	0.000	0.000	0.000
Surface water	36.2	29	30.3	0.000	0.000	0.000
Bathing						
Tubewell water	20.5	27.9	37.9	0.000	0.023	0.000
Supply water	0.4	0.2	0.4	0.000	0.220	0.000
Surface water	79.1	71.9	61.7	0.000	0.000	0.036
N	5759	5759	5759			

Table 2.3. Sources of water use for different purposes during dry season (%)

Use of water in different purposes	Baseline 2007	Midline 2009	End line 2011	p-value		
	(a)	(b)	(c)	(a vs. b)	(b vs. c)	(a vs. c)
Drinking						
Tubewell water	99.1	99.3	99.4	0.000	0.000	0.000
Supply water	0.3	0.2	0.3	0.599	0.009	0.002
Surface water	0.6	0.5	0.3	0.000	0.000	0.000
Cooking						
Tubewell water	64.2	72.1	75.7	0.000	0.000	0.000
Supply water	0.2	0.1	0.4	0.000	0.000	0.000
Surface water	35.6	27.8	23.9	0.000	0.000	0.000
Washing utensils						
Tubewell water	58.2	66.0	66.1	0.000	0.444	0.000
Supply water	0.3	0.2	0.4	0.000	0.528	0.000
Surface water	41.5	33.8	33.5	0.000	0.000	0.000
Cleaning after defecation						
Tubewell water	63.8	73.1	70.6	0.000	0.000	0.000
Supply water	0.7	0.3	0.5	0.000	0.012	0.000
Surface water	35.5	26.6	28.9	0.000	0.000	0.008
Bathing						
Tubewell water	25.7	35.7	40.4	0.000	0.000	0.000
Supply water	0.5	0.3	0.4	0.000	0.000	0.000
Surface water	73.8	64.0	59.2	0.000	0.000	0.000
N	5759	5759	5759			

Opinion on the availability of sufficient water at tubewell

Opinion on the availability of sufficient water at tubewell is described on Table 2.4. In the dry season, water availability from own tubewell significantly declined from baseline (80%) to midline (73%), thereafter it increased to 79% at end line. No significant differences between surveys were found in rainy season in this regards. Likewise, water availability in shared tubewell significantly declined from baseline (83%) to midline (74%), thereafter it increased to 80% at end line, But in rainy season, no significant differences between surveys were found in water availability at shared tubewells. However, water availability at public tubewell significantly increased from 62% at baseline to 72% at midline and to 73% at end line. But in rainy season, there was no significant differences in water availability at public tubewell (Table 2.4).

Table 2.4. Sufficient water availability at different tubewells by ownership status during dry and rainy seasons (%)

Season and ownership status	Baseline (2007) (a)	Midline (2009) (b)	End line (2011) (c)	p-value (a vs. b)	p-value (b vs. c)	p-value (a vs. c)
Dry season						
Own	80.1	73.2	79.1	0.000	0.000	0.405
n	2014	2204	2539			
Shared	82.6	74.0	80.2	0.000	0.000	0.027
n	3140	3517	1973			
Public	61.6	72.2	73.2	0.000	0.000	0.027
n	4945	4630	4310			
Rainy season						
Own	99.3	99.0	99.0	0.378	0.929	0.322
n	2014	2204	2539			
Shared	99.2	99.1	99.3	0.516	0.322	0.665
n	3140	3517	1973			
Public	99.4	99.3	99.4	0.696	0.523	0.790
n	4945	4630	4310			

Reasons of using tubewell water

The frequently cited reasons of using tubewell water were ‘better health’ and ‘convenience to use’ (Table 2.5). The proportion of respondents reporting ‘better health’ decreased from 39.7% at baseline to 27.4% at midline and 30% at end line. Besides, the proportion reporting ‘convenience to use’ increased to 45% at midline from 41% at baseline but decreased to 27% at end line.

Table 2.5. Major reasons of using tubewell water by the households (%) (multiple responses)

Reasons	Baseline (2007)	Midline (2009)	End line (2011)	p-value		
	(a)	(b)	(c)	(a vs. b)	(b vs. c)	(a vs. c)
Health	39.7	27.4	30.0	0.001	0.001	0.001
Convenient to use	41.0	45.2	26.5	0.093	0.001	0.001
No alternative	8.4	10.1	16.9	0.011	0.022	0.001
Reliable	9.1	14.3	15.0	0.001	0.001	0.112
Modern/contemporary	0.1	0.4	2.9	0.451	0.001	0.011
Others (Cheap, social status, nearby house, etc)	1.7	2.6	8.7	0.211	0.021	0.001
n	2014	2204	2539			

Reported status of arsenic in tubewell water

Reported status of arsenic in tubewell water is described in Table 2.6. Respondents who have got tested their tubewells for arsenic regardless of ownership status were asked about the test results. Most respondents of both types (own and shared) said that their tubewells were arsenic-free, but the proportion was higher for the shared group. Among the owner group, the proportion of arsenic-free tubewell increased from baseline to midline and end line. While among the shared group the proportion of arsenic free tubewell increased from baseline to midline but decreased at midline and end line from baseline (Table 2.6).

However, no significant difference was found in the use of arsenic contaminated tubewells at either survey among the ultra poor households (39.1% vs. 41% vs. 39.5%). Moreover, significant changes were found in case of poor (47% vs. 42% vs. 36%) and non-poor households (41% vs. 38% vs. 35%), respectively in all surveys (Fig. 2. 2). Lower proportion of the non-poor households used arsenic contaminated tubewells at end line.

Table 2.6. Status of responses on the results of tested tubewell water for arsenic contamination (%)

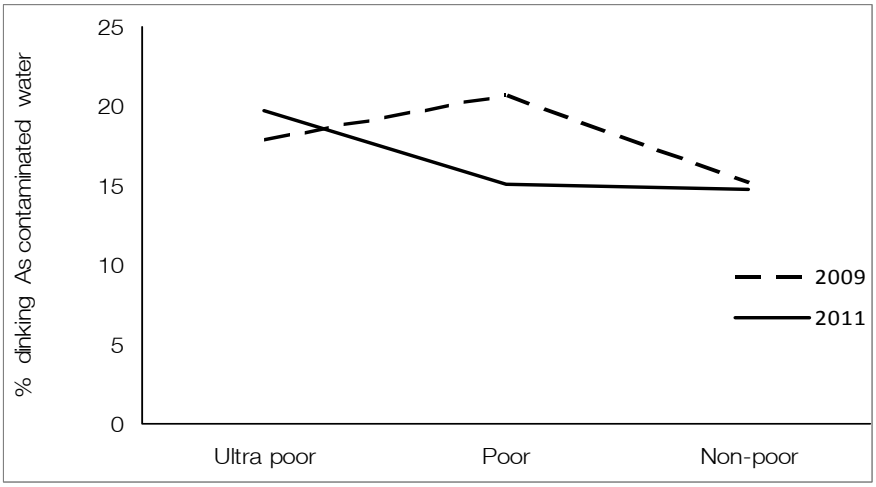
Status	Baseline (2007)	Midline (2009)	End line (2011)	p-value		
	(a)	(b)	(c)	(a vs. b)	(b vs. c)	(a vs. c)
Own tubewells						
Arsenic free	57.8	60.0	64.6	0.222	0.008	0.000
Arsenic contaminated	42.0	39.4	35.3	0.149	0.017	0.000
Don't know	0.2	0.6	0.1	0.086	0.022	0.562
n	1,513	1,528	1,701			
Shared tubewells						
Arsenic free	78.3	83.1	77.2	0.001	0.008	0.001
Arsenic contaminated	21.3	16.2	22.4	0.009	0.007	0.001
Don't know	0.4	0.7	0.4	0.096	0.012	0.862
n	2563	2809	1414			

Figure 2.2. Use of arsenic contaminated tubewell water by economic statuses

Use of arsenic contaminated tubewell water for drinking and cooking purposes

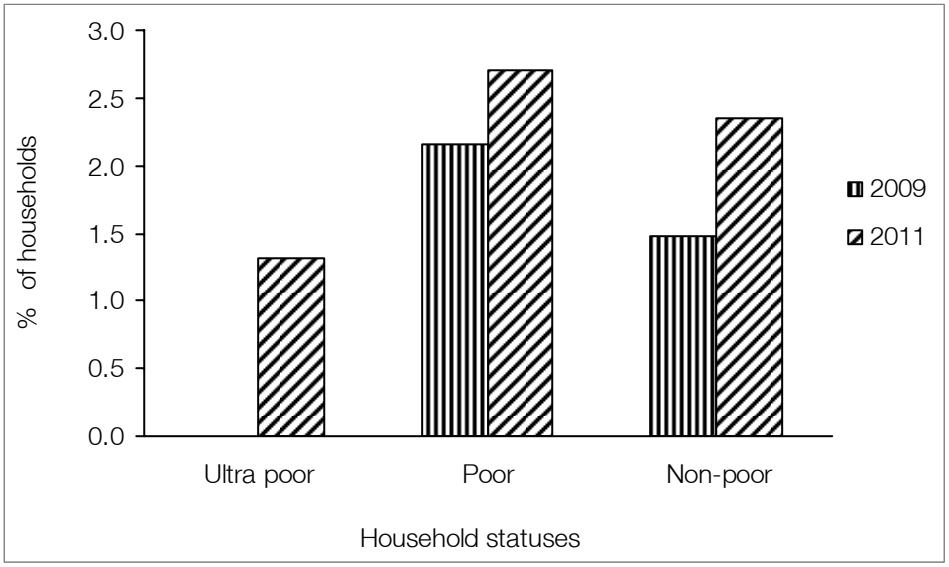
Issue of arsenic contaminated tubewell water use for drinking and cooking purposes was not addressed in baseline. However, in midline and end line, data were collected and analyzed comparing the surveys by economic statuses of households. Uses of arsenic contaminated tubewell water for drinking and cooking purposes among different economic groups of the households are presented in Figure 2.3 and 2.4, respectively. The analysis showed that the proportion of ultra poor households drinking arsenic contaminated water increased from midline to end line, while for poor and non-poor households, the proportion decreased (Fig. 2.3). Highest decrease was found among poor households at end line.

Figure 2.3 Changes in drinking arsenic contaminated tubewell water among households



Arsenic contaminated water use for cooking increased from 0 at midline to 1.4% at end line. In case of poor households, the use of arsenic contaminated water for cooking increased from 2.2% at midline to 2.7 at end line. However, for non-poor households, it increased to 2.3% at end line from 1.5% at midline (Fig. 2.4).

Figure 2.4. Changes in cooking with arsenic contaminated tubewell water among households



Water safety practices

Water safety practices at source and during collection, transportation and preservation including awareness of water treatment were presented in this section.

Water safety practices at source

Table 2.7 shows the changes of water safety practices at source of water collection.

Placement of tubewell

The proportion of tubewells installed at lower plane compared to latrine increased across the surveys. Besides, the proportion of tubewells installed within 10 meter of latrine increased significantly from 30% at baseline to 33% at midline and to 37% at end line (<0.001).

Status of concrete-built platform of tubewells

The proportion of concrete-built platform significantly increased across the surveys (63% at baseline to 69% at midline, and to 73% at end line) (<0.001).

Cleanliness of tubewell

The proportion of cleaned platform of tubewell increased significantly across surveys (31% at baseline to 40% at midline to 65% at end line).

Drainage system of tubewell

The proportion of earthen drain significantly decreased across surveys (64% at baseline to 58% at midline and to 51% at end line). Consequently, the proportion of concrete-built drainage system increased significantly across the surveys (15% at baseline to 19% at midline to 31% at end line).

Table 2.7. Safety characteristics of tubewells of the study areas (%)

Safety characteristics	Baseline (2007)	Midline (2009)	End line (2011)	p-value		
	(a)	(b)	(c)	(a vs b)	(b vs c)	(a vs c)
Functional/defected tubewells						
Functional	93.3	95.0	95.4	0.015	0.496	0.001
Needs minimum repair	5.2	3.5	3.7	0.006	0.589	0.020
Needs maximum repair	1.5	1.5	0.9	0.775	0.282	0.450
n	2014	2204	2539			
Placement of tubewell compared to latrine						
Tubewell at uphill than latrine	13.7	27.7	20.7	0.000	0.000	0.000
Tubewell at lower plane than latrine	41.1	44.5	43.1	0.015	0.263	0.142
n	2259	2746	3,306			
Mean distance of tubewell from latrine						
Distance <10m	29.8	33.2	37.0	0.000	0.000	0.000
n	4277	4765	5311			
Condition of tubewell platform						
Concrete built	63.1	69.1	73.4	0.000	0.000	0.000
Broken	6.7	6.9	3.8	0.815	0.000	0.000
n	3410	3456	4374			
Cleanliness of tubewell platform						
Clean	31.2	39.9	65.1	0.000	0.000	0.000
n	3406	3453	4374			
Drainage system of tubewell						
Concrete drain	14.5	18.5	31.2	0.000	0.000	0.000
Earthen drain	63.6	57.5	51.4	0.000	0.000	0.000
Pipe	12.8	15.1	13.3	0.005	0.022	0.500
n	3410	3453	4,374			

Water safety during transporting and storing

Putting cover on water jar during carrying and storing water for drinking and cooking increased significantly across the surveys (Table 2.8). The proportion of respondents who put cover on water jar during transport of water for drinking, significantly increased from 54% at baseline to 72% at midline, to 77% at end line (<0.001). Besides, the proportion of respondents who reported to put cover on water jar during storing water increased across surveys (60% at baseline to 65% at midline to 77% at end line) (<0.001). Respondents who reported to put cover on water jar while carrying water for cooking substantially increased across the surveys (50% at baseline to 63% at midline to 65% at end line) (<0.001).

Table 2.8. Covering of water jar during transporting and storing water for drinking and cooking purposes (%)

Indicators	Baseline (2007)	Midline (2009)	End line (2011)	p-value		
	(a)	(b)	(c)	(a vs. b)	(b vs. c)	(a vs. c)
Drinking purpose (in %)						
During transporting	54.0	72.3	76.5	0.000	0.000	0.000
During storing	60.1	64.7	77.2	0.000	0.000	0.000
N	5759	5759	5759			
Cooking purpose (in %)						
During transporting	50.3	63.4	64.8	0.000	0.111	0.000
N	5759	5759	5759			

Awareness on water treatment (purification) and prevention of waterborne diseases

Most frequently mentioned about boiling as means for water purification. The proportion significantly increased at midline than at baseline and again declined at end line but still it is higher than the baseline (Table 2.9). Majority reported that drinking pure water could prevent water borne diseases; the increase was significant from baseline (52%), at midline (57%), and at end line (56%). Drinking tubewell water also could prevent waterborne diseases that 20% respondents reported at baseline, 37% at midline and 23% at end line (<0.001).

Table 2.9. Awareness on water treatment (purification) and prevention of waterborne diseases (%)*

Opinions on water treatment	Baseline (2007)	Midline (2009)	End line (2011)	p-value		
	(a)	(b)	(c)	(a vs. b)	(b vs. c)	(a vs. c)
Opinions regarding cleaning/purifying water						
By boiling	64.0	79.5	76.9	0.000	0.016	0.000
With medicine	7.8	17.0	8.4	0.000	0.000	0.305
By filtering	2.1	4.7	3.6	0.000	0.003	0.000
Don't know	19.3	8.5	1.3	0.000	0.000	0.000

(Table 2.9 continued...)

(...continued Table 2.9)

Others (using salt, sodium striates, lime, etc.)	20.7	18.2	16.4	0.001	0.000	0.000
N	5759	5759	5759			
Opinions regarding prevention of waterborne diseases						
Drinking pure water	51.8	57.4	56.0	0.000	0.000	0.000
Drinking tubewell water	19.5	37.3	22.8	0.000	0.000	0.000
Others (keeping cleanliness, construction of concrete built platform, etc.)	5.4	1.9	12.3	0.000	0.000	0.000
Don't know	28.2	12.3	3.8	0.000	0.000	0.000
N	5759	5759	5759			

*Multiple response

Determinants of water safety practices at household level

Two separate models considering safety indicators, such as, concrete built platform (model I) and cleanliness of tubewell platform (model II) were used to discover the determinants of the water safety practices at household level. The estimated parameters of the model are shown in Table 2.10. Judging from the asymptotic z-values of the estimated parameters for both model I and II, it appeared that water safety practice increases with the increase in programme implementation period. Analysis revealed that ownership of television appeared to be the most significant factors influencing water safety practices followed by better economic status and higher level of education of household heads. Besides, service and ownership of radio at both the models (I & II) showed a positive association with the safety practices. Farming and day labourer as occupations of household heads had reverse association with water safety practices while business had no influence. Extreme poverty showed no association with water safety practices.

Table 2.10. Determinants of water safety practices at household level: Estimates of binary logistic regression model

Factors	Water safety practices at household level			
	Model I		Model II	
	Concrete-built platform		Cleanliness of TW platform	
	ß	*z-value*	ß	*z-value*
Education				
Women's education (1 if yes)	0.113 ***	10.682	0.125***	10.631
Occupation of household head				
Service (1 if yes)	0.141***	4.594	0.131***	3.513
Farming (1 if yes)	-0.119***	8.222	-0.193***	17.436
Business (1 if yes)	0.062	1.105	0.035	0.296
Day labourer (1 if yes)	-0.460***	82.454	-0.439***	57.511

(Table 2.10 continued...)

(...continued Table 2.10)

Perceived economic status				
Deficit (1 if yes)	-0.062**	2.798	0.056	1.869
Surplus (1 if yes)	0.345***	28.378	0.511***	52.058
Household economic status				
Ultra poor (1 if yes)	-0.235	21.095	0.002	0.001
Poor (1 if yes)	-0.771	10.577	-0.012	0.246
Household assets				
Radio (1 if yes)	0.191***	19.836	0.134***	8.094
Television (1 if yes)	0.489***	192.152	0.300***	60.995
Survey periods				
Midline (2009) (1 if yes)	0.195***	24.210	0.352***	56.151
End line (2011) (1 if yes)	0.748***	344.581	1.491***	1089.5
N	17,277		17,277	
Constant	-0.644***	84.630	-1.778 ***	494.035
R^2		0.10	0.147	

*** 1% level of significance, ** 5% level of significance

Satisfaction of existing water sources, interest in and preference to install new water sources

The level of satisfaction with existing water source increased from 50% at baseline to 52% at midline, and to 57% at end line ($p<0.001$). It was highest among the ultra poor (<0.01). Besides, respondents were asked whether they were interested to install new water sources. At baseline, 60% of the respondents were interested to install new water sources, while at midline it increased to 67% but at end line, the numbers significantly decreased to 53%. Moreover, in the case of installing new water sources, we asked which types of water sources they usually would prefer. At baseline, 93% respondents opined that they would prefer tubewell as water source, while at end line, the number was significantly decreased to only 85% (<0.01) (Table 2.11).

Preferred amount of monthly instalment for loan repayment

The respondents were asked if a new tubewell would be installed through loan from government or any organization, then how much money they could repay per month. Analysis revealed that significant increase was found at end line on the most of the cases of willingness to repay the preferred monthly instalment (Table 2.12). The respondents who agreed to repay by monthly instalment as more than Tk. 150-400 at baseline, significantly increased over the years (15% at baseline; 19% at midline, and 23% at end line). Besides, in baseline, only 3% respondents agreed to repay as more than Tk. 400 per month, while at end line, the numbers increased to 4%. Moreover, 40% respondents both at baseline and end line were interested to repay monthly instalment of Tk. 75-150, but higher tendency to repay was found at midline.

Table 2.11. Status of satisfaction with existing water sources, interest to install new water sources and preference of tubewell as water source in term of percentage (%)

Subject	Baseline 2007	Midline 2009	End line 2011	p-value		
	(a)	(b)	(c)	(a vs. b)	(b vs. c)	(a vs. c)
Satisfied with existing water sources	50.3	51.5	56.6	0.219	0.000	0.000
N	5759	5759	5759			
Interested to install new water source	59.6	67.7	53.4	0.000	0.000	0.000
N	5759	5759	5759			
Preference of tubewell as water sources	93.1	98.7	85.1	0.000	0.000	0.000
n	3433	3899	3073			

Table 2.12. Distribution of respondents according to willingness to pay for tubewells in term of percentage (%)

Preferred instalment	Baseline (2007)	Midline (2009)	End line (2011)	p-value		
	(a)	(b)	(c)	(a vs. b)	(a vs. b)	(a vs. b)
>400	2.8	3.4	3.6	0.047	0.006	0.000
300-400	0.4	0.3	0.1	0.033	0.052	0.000
250-300	1.8	2.1	2.1	0.075	0.012	0.000
200-250	1.5	1.4	1.8	0.004	0.349	0.000
150-200	11.6	12.3	14.7	0.000	0.000	0.000
75-150	39.6	44.9	39.5	0.000	0.000	0.000
50-75	2.1	1.8	1.5	0.000	0.002	0.000
25-50	11.7	13.2	6.6	0.000	0.000	0.000
<25	28.5	20.6	30.1	0.000	0.178	0.000
n	3432	3640	2331			

DISCUSSION

The purpose of this was to assess the effect of WASH I interventions in different indicators relative to water use and safety systems in the programme areas over the years. Analysis revealed that the improvement of tubewell water uses for different purposes at household level both at midline and at end line. However, decrease in the availability of tubewell water in dry season which might have happened due to the decline of groundwater level. In the dry season, generally groundwater table falls beyond the suction lift of tubewells most likely due to lifting of much more groundwater for irrigation and domestic purposes. Thus, most tubewells fail to lift sufficient water in the dry season (Dey *et al*. 2010). Besides, short rainfall also causes less recharge of groundwater. It is worth mentioning that before two decades there were abundant surface water for irrigating the field crops, but due to climate change

and uneven distribution of rainfall this resource has become scarce, mainly in the dry season (Dey *et al* 2011). In most cases farmers do not know about the actual requirement of water for producing a particular crop, resulting in over lifting of underground water. This has three fold effects. i.e. wastage of the scarce water resource, increased irrigation cost, and uplifting excess underground water causing environmental degradation (Alam *et al*. 2009; Dey *et al.* 2013). Although, the share of groundwater to total irrigated area was 77% in 2007-08 (BBS 2009), its sustainability is becoming a risk in terms of quantity and quality in many parts of Bangladesh. Groundwater level in some locations under WASH programme falls between 5-10m in dry season (Dey *et al*. 2011). Different studies have noted that change in groundwater level may also lead to alter mineral composition moving to deeper groundwater may tap into aquifers with high mineral content or high levels of specific constituents of concern for health. In order to provide adequate water in the event of these changes and extremes, natural supplies may need to be augmented in some areas, together with use of more climate-resilient technologies and processes (WHO 2011).

Arsenic contamination related comparative analysis between own and shared tubewells, revealed that own tubewells were more arsenic contaminated than shared tubewells. The reason is that, in most cases own tubewells are shallow tubewell (STW) and shared tubewells are deep tubewell (DTW) (Dey and Ali 2010). Many studies reported that water from DTW is mostly free from arsenic contamination (Roy *et al*., 2008). The prime reasons for using tubewell water was their health concern (in case of own tubewells) and no alternative (to shared tubewell use), though some households drank arsenic contaminated tubewell water. Analysis revealed that the proportion of people drinking arsenic contaminated water decreased in end line (16.6%), where as ultra poor (19.7%) were more exposed than poor (15.1%) and non-poor (14.8%) households. Our previous study supports these findings (Dey *et al*., 2010). This study found that 82% households drank arsenic-free tubewell water in rural areas of Bangladesh. The GoB and UNICEF study (2010) supports this findings that overall 85.5% (83.8% in rural and 93.3% in urban) population of Bangladesh drink improved drinking water containing arsenic within Bangladesh national standard (0.05 mg/litre). Furthermore, a UNICEF study (2010) also indicated that, on an average, nearly 87% population of Bangladesh drink arsenic-free water.

Non-availability of arsenic-free tubewell water, unmarked tubewell (whether contaminated by arsenic or not), were identified as the major reasons for dinking arsenic contaminated tubewell water by the households. Most common source of drinking water in rural areas are shallow tubewells (63%), which are the main source of arsenic contamination and the intensity of arsenic in higher in shallow than deep tubewell. Besides, long distance had to cross over for the arrangement of arsenic-free deep tubewell water. Therefore, some households were bound to drink arsenic contaminated water knowing its presence. On the other hand, previously arsenic identified tubewells (red marked) are no longer differentiable from the arsenic-free (green marked) tubewells because of disappearance of its colour marking. This might be because of lack of proper monitoring as well as negligence to the safe supply of drinking water by the government and other stakeholders associated with it. It is

noteworthy that wide-spread information plays important role in refraining people from drinking arsenic contaminated water. Some earlier studies indicate that drinking arsenic contaminated water causes various arsenic-related diseases, where at least 6,500 people may die from cancer every year and 2.5 million people will develop some kind of arsenicosis in the next 50 years (Mitra *et al*. 2002; Roy, *et al*. 2008). It is a matter of great concern that the prevalence of arsenic in drinking water increased the mortality rate in Bangladesh (Tan *et al*. 2010).

Water safety practices

Analysis revealed that improvement status of water safety practices at source, during transporting and storing including awareness on the treatment of water. The improvement statuses of some sanitary indicators i.e. constructed concrete-built tubewell platforms and their cleanliness and drainage system at households that might be the impact of BRAC WASH I programme in water safety measures. Thus, the loan support to the households and motivation to build tubewell platforms with concrete seems to be beneficial. Besides, analysis revealed that putting cover on water buckets during carrying and storing water for drinking and cooking increased significantly over the years. This can be attributed to the BRAC interventions for raising awareness on safe water use and its safety issues at the households/community levels. It is worth mentioning that proper hygiene education makes the community members aware of the correct use, storage and disposal of water and general hygiene (Duncker 2000).

Analysis revealed that ownership of television appeared to be the most significant factors influencing water safety practices followed by better economic status and higher level of education of household heads. Television as well as radio as awareness raising media at household level showed better water safety practices. Besides, other influencing factors, such as service, appeared positive association with the safety practices at household level. Jalan *et al.* (2004) explained that better informed households' with education and media exposure, and higher economic status showed more willingness in adoption of water safety practices. Farming and day labourer as occupations of household heads had reverse association with water safety practices while business had no influence. Extreme poverty showed no association with water safety practices.

The important limitation of the study is that tubewell water was not tested for knowing the level of arsenic because arsenic concentration was higher in the sampled area. However, reduced use of arsenic contaminated tubewell water compared to baseline as well as availability of alternative source of drinking water may bring positive benefit for health. Simple filtration and chlorination can be employed to reduce such kinds of contamination. Previous study identified the improvement status of water safety measures including improvement of awareness of cleaning/purifying water and hygienic management of water for drinking and cooking (Dey and Ali 2010). This can be attributed to the BRAC interventions for raising awareness on safe water use and its hygienic management at the households/community level which may also help prevent dirrhoeal diseases

especially among children. A study found that 94% of the dirrhoeal diseases are preventable through modifications to the environment, including access to safe water (WHO 2007). Studies of BRAC WASH programme also found that the combined effect of safe water use, sanitation and hygiene practices, prevalence of waterborne diseases reduced from 9.4% to 2.3% over the years in rural Bangladesh (Karim and Dey 2011). Considering lower level of microbial water quality to the sampled population, health benefit of further improvement of water quality is an unanswered question that would be appropriate for future research to address.

CONCLUSIONS

Despite substantive progress in tubewell water use for drinking, cooking and other household uses, some challenges to achieving 100% safe water use continues to exist in the intervention areas. The key impediments were identified as arsenic contamination in tubewell water and unmarked tubewells for arsenic or non-arsenic, no treatment to water before drinking, etc. Study revealed that water safety practice increases with the increase in programme implementation period. Significant improvement in water safety practices (at source, during transporting, and preservation) was found in the study area.

RECOMMENDATIONS

1. Emphasis should be given on testing of tubewell water for arsenic as well as microbial contamination and to inform the households/community about the results. More emphasis should be given on hygiene education for raising awareness on the safety practices including not using arsenic contaminated water for cooking at household level.

2. Proper guideline for installation of tubewell considering surrounding point sources of pollution including latrine, ditch/pond having contaminated stagnant water, waste dumping point etc. should be followed. Each tubewell must be provided with a concrete platform.

3. Special attention should be given in the dry season when groundwater table usually falls beyond the suction lift of tubewell. Thus, deep tubewell and piped water supply systems can be installed for getting sufficient water for different purposes including drinking, cooking, etc. Besides, arsenic removal filter and pond sand filter can be provided for purifying water.

4. Existing surface water reservoir should be excavated deeply for water conservation in the areas where groundwater declines in the dry season, or water is highly saline, or contaminated by arsenic or iron, etc.

5. Microbial study of the water should be the future study.

6. Drinking water should be treated /boiled before drinking.

7. Drinking water should be treated at household level for removing microbial contamination and chemical loadings. Thus, BRAC WASH programme as well as government of Bangladesh needs to pay more attention to these impediments at the household level to further improve existing situation.

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Chapter 3

Sanitation status at household level in BRAC's WASH I programme areas: changes from baseline to end line survey

Tahera Akter and Nepal C Dey

ABSTRACT

Poverty and physical environment often pose barriers towards improving sanitary latrine coverage at household level. To overcome such barriers, BRAC WASH I Programme has been working in 150 *upazilas* in three phases since 2006. The BRAC Research and Evaluation Division conducted baseline, midline and end line surveys in 50 *upazilas* of the first phase. This study evaluated the impact of the programme on households' sanitation status in intervention areas. Thirty thousand households from 50 *upazilas* were selected in two steps: i) 30 villages were selected from each sub-district by cluster sampling, and ii) 20 households were chosen systematically from each village. Data were collected from households through interview using pre-tested questionnaire. The matched households in all the three surveys were included in the analysis. Chi-square and t-tests compared the differences between indicator values. Households using sanitary latrines increased significantly at midline (41.5%) and end line (57.4%) from baseline (31.7%). Proportion of physically verified clean latrines increased significantly from baseline (33.4%) to midline (50.8%) to end line (53.3%). Hygienic use of latrines increased significantly across the surveys in terms of availability of water (baseline 32.7%, midline 37.8%, and end line 38.7%) and slipper (baseline 4.4%, midline 8.2%, and end line 13.5%) inside or nearby the latrine. Transition of latrine-use in the households showed that 73% of those using sanitary latrines in baseline continued to do so in end line, while the rest shifted to unsanitary practices. The challenges, encountered towards sanitary latrine use were breaking the water seal and financial inability to buy facility. Effective measures need to be taken towards solution.

BACKGROUND

The global condition for drinking water appears better than that for sanitation. It is often reported that in the world, the proportion of households with access to safe drinking water is on track towards MDG, but not for sanitation (Bartram and Cairncross 2010). The report also extends that while the development on providing drinking water from improved water source is heading in the right direction, fewer people have water supply at home than have basic sanitation. Though, progress in sanitation is often mentioned as "lagging behind water supply." Currently 2.6 billion people lack access to improved sanitation worldwide, two-thirds of whom live in Asia

and sub-Saharan Africa (Mara *et al.* 2010). The same report reveals that 99% people in developed countries have access to improved sanitation, while in developing countries only 53% have such access. Within the developing countries, urban and rural sanitation coverage shows wide gap representing 71% and 39%, respectively. At present, the majority of people lacking sanitation live in rural areas. Globally eight out of ten users of unimproved sanitation facilities and six out of seven people, who defecate in the open places, live in rural areas (Bartram and Cairncross 2010).

The government of Bangladesh has set national target of 100% sanitation coverage by 2013 to attain MDG target. As an effort of improving sanitation coverage in the country, National Sanitation Campaign was launched in 2003 involving people at all levels of society. The results of this campaign brought huge changes in the rate of latrine use. The official estimate by the National Sanitation Secretariat of the Government of Bangladesh reported that hygienic latrine coverage in rural areas was improved from 33.2% in 2003 to 88.2% in 2008 (GoB 2010). According to BBS-UNICEF Joint report, the proportions of people using improved latrine and hygienic latrine in rural areas were 54.3% and 49.9% respectively in 2009 (BBS and UNICEF 2010).

The variations in reporting sanitation progress data between the organizations are considered as the difference in operational definition of sanitation facilities and weakness of the monitoring system such as lack of capacity (Rahman 2009). In spite of some differences, all reports revealed improvement in sanitation coverage and reduction in open defecation. However, the improvement of national sanitation situation was reported to be off track towards attaining MDGs (WHO and UNICEF 2010). If the current trend of progress continues, the sanitation coverage will reach 61% in 2015 as reported in MICS (BBS-UNICEF 2010). In that case, government's goal of 100% sanitation coverage by 2013 will not be achieved. Some major factors responsible for poor sanitation situation are unaffordability, lack of awareness and environmental difficulties such as water scarcity (Quazi 2003).

To improve the sanitation situation and to reach the goal by the specified time, NGOs and private sectors joined with the government and been implementing programmes to reach the goal (LGD 2008). BRAC initiated a comprehensive intervention on water, sanitation, and hygiene (WASH) in 2006. It has been offering interventions in 150 *upazilas* (*upazilas*) throughout the country. The programme aimed to improve the health situation of the rural poor. The major interventions include: i) provision of access to sanitation services for 17.6 million people, ii) promotion of safe hygiene behavior through an education campaign for 37.5 million people, and iii) provision of safe drinking water for 8.5 million people (1 million through new supplies and 7.5 million through repair of existing facilities) (Kabir *et al.* 2010). The intervention is being offered in the community, religious and educational institutions. Village WASH Committees are formed based on community participatory process to improve overall WASH situation in their respective villages through different activities such as organizing meeting for problem identification, and their possible solutions, as well as organizing popular theatre, film shows, and folk songs for community awareness development. The major activities include installation of sanitary latrines and tubewells as well as imparting health education.

The Research and Evaluation Division (RED) of BRAC conducted a baseline survey from November 2006 to June 2007 to understand the pre-programme status vis-à-vis the impact evaluation of the programme in the selected WASH programme areas. Subsequently, a midline survey was done during April-June 2009, after two years of the baseline survey to assess the changes and improvements in the motivation, knowledge and practices in various intervention components to the households/community, educational and religious institutions. This was followed by an end line evaluation of impact of the BRAC WASH programme on different aspects of water, sanitation and hygiene, conducted during December 2010 to March 2011.

OBJECTIVES

The general objective of this study was to measure the impact of BRAC WASH I Programme in sanitation coverage and practice at households under the the programme areas compared to baseline status.

The specific objectives were to:

- Assess the extent of changes in sanitation indicators from baseline to end line, and
- Identify issues for further consideration of BRAC WASH programme towards improving sanitation situation.

METHODS

Study design

The study embraced a cross-sectional comparative design between baseline (2007), midline (2009) and end line (2011) statuses. The surveys were implemented in 50 *upazilas* where WASH I programme of BRAC has been offering its interventions since middle of 2006. These *upazilas* are known as low performing areas in terms of water, sanitation and hygiene coverage compared to the national averages. Details of study methodology is given in chapter 1.

Sample size

The sample comprised of 30,000 households, 600 from each study sub-district for each of baseline, midline and end line surveys. The significance level was set at 5% with admissible error of 5% and design effect of 1.5. Considering the maximum possible ratio of 50% the sample size estimated for the survey was 576 for each *upazila* (sub-district), which was rounded to 600 for distributive convenience (Seraj 2008).

Sampling procedures

A multi-stage sampling design was followed in drawing the samples (Pl see methodology chapter). A total of 29,885 households were interviewed at midline while at baseline corresponding figure was 29,985, 7% lost. The end line survey could visit 26,404 households, 11.6% lost from the midline survey. Reasons of lost to follow-ups were unavailability of the respondents during the time of data collection, river bank erosion, etc.

Data management and analysis

The filled in questionnaires were edited for completeness and consistency at BRAC Head Office by a group of trained field interviewers. These were entered in computer, and cleaned using the SPSS software version 14 under the supervision of the senior researchers. The analysis was performed on the matched households in all the three surveys (26,404 in each survey, giving a total of 79,212 households). Statistical techniques such as chi-square and t-tests were used to compare the differences between indicator values. Binary logistic regression was performed to identify the determinants of outcome variables.

A sanitary/hygienic latrine was characterized as (i) confinement of feces away from the environment, (ii) sealing of the passage between the squat hole and the pit to effectively block the pathways for flies and other insect vectors thereby breaking the cycle of disease transmission, and (iii) keep the latrine odor free and encourage continual use of hygienic latrine (LGD 2005). Analysis determined latrine coverage by operational definitions of sanitation facilities used by different organizations (Table 3.1). It is necessary to mention that BRAC WASH programme followed government definition of hygienic latrines, but not limiting the number of shared households in using a latrine. Furthermore, the sanitation technologies mentioned in operational definitions used by the government and JMP were matched with BRAC WASH programme to measure latrine coverage across the surveys (Table 3.5).

Dependent variables

Use of sanitary and unsanitary latrines was considered as the dependent variable in this study.

Independent variables

Independent variables were education of household head categorized as never schooling and ever schooling, their economic status classified as non-poor, poor and hardcore poor. Other independent variables considered were NGO membership and access to media at home with ownership of radio and/or TV.

Table 3.1. Different definitions of sanitation facility as used by different organizations

Definition of sanitation facility	Name of organization
a. Facilities that are owned or shared by a maximum two households of following type: - latrine with slab and water seal - latrine with water seal and septic tank	Hygienic latrine defined by the Government of Bangladesh National Sanitation Strategy, 2005
b. Own facilities of the following technology type: - latrine with slab and water seal - latrine with slab but no water seal - latrine with water seal and septic tank	Improved latrine defined by UNICEF-WHO Joint Monitoring Programme (JMP)
c. Facilities that are owned or shared of following type: - latrine with slab and water seal - latrine with water seal and septic tank	BRAC WASH Programme considered hygienic latrine defined by the government, but not limiting the number of households sharing a latrine

Source: (BBS-UNICEF, 2010)

RESULTS

Background characteristics of the study samples

Household composition of sampled populations in study area revealed equal proportion of male and female members (50.4% vs. 49.6%). In end line, the background characteristics showed that majority of household heads were non-poor (59%) and 55.3% ever attended schools (Table 3.2). About one-third of the household heads were involved in agricultural work, 31% in day labour and 14.5% in business. Over half of the households (56.1%) had no NGO membership except the rest. About 37.5% respondents reported to have access to media at home as they owned radio and/or TV, while majority of them had no ownership of any of them (62.5%).

Types of latrines used in households

Sanitary latrines use by the households significantly increased over the years (baseline 31.7%, midline 41.5%, end line 57.4%) (Table 3.3). The proportion of households using ring slab latrines without water seal decreased to 25.5% at midline and 26.7% at end line from 37.4% at baseline. The proportion of pit latrine users increased in midline (11.9%) and declined in end line (2.4%) compared to baseline (7%). Proportion of open defecation significantly reduced from baseline (23.9%) to midline (21.1%) and to end line (13.5%).

Table 3.2. Socioeconomic profile of samples in baseline (2007), midline and end line

Indicators	Baseline %	N	Midline %	N	End line %	N
Education of household head						
Ever schooling	55.4	14629	54.6	14410	55.3	14591
Never schooling	44.6	11994	45.4	11994	44.7	11813
NGO membership of household						
Yes	45.6	12016	47.5	12489	43.9	11477
No	54.4	14327	52.5	13800	56.1	14684
Main occupation of household head						
Agriculture	33.2	8778	32.7	8622	33.4	8827
Labour	32.6	8598	30.5	8047	30.9	8150
Service	6.5	1707	5.8	1571	6.2	1623
Business	16.9	4474	15.8	4168	14.5	3821
Household work	7	1846	10.4	2735	9.5	2505
Disable	2.2	578	3	781	3.8	1015
Others	1.6	423	1.8	480	1.7	462
Economic status of household head						
Ultra poor	18.8	4959	18.8	4959	16.8	3361
poor	26.9	7115	26.9	7115	24.2	4964
Non-poor	54.3	14330	54.3	14330	59	18079
Access to media at home						
Yes	37.4	9884	37.9	9994	37.5	9903
No	62.6	16520	62.1	16410	62.5	16501

Table 3.3. Households by types of latrine use (%)

Types of latrines		BL	ML	EL	p-value BL vs ML	p-value ML vs EL	p-value BL vs EL
Sanitary latrine							
	Sanitary	31.7	41.5	57.4	0.001	0.001	0.001
Unsanitary latrine	Ring slab without water seal	37.4	25.5	26.7	0.001	0.001	0.001
	Pit	7	11.9	2.4	0.001	0.001	0.001
	Open defecation	23.9	21.1	13.5	0.001	0.001	0.001
	N		26404				

BL=Baseline, ML=Midline, EL=End line

Households' ownership status of sanitary latrines in intervention areas shows significant changes across the surveys. The proportion of own latrines increased significantly from baseline (72.8%) to midline (75.6%) and to end line (81.2%). Similarly, the proportion of shared latrines decreased from baseline (27.2%) to 24.4% at midline and 18.8% at end line (Table 3.4).

Table 3.5 shows latrine coverage in BRAC intervention area in relation to the operational definitions of sanitation facilities used by different organizations as of Table 1. If government definition was applied, hygienic latrines use among the households increased from 26.1% at baseline to 34.3% at midline and 49.8% at end

line. According to JMP definition, use of improved latrine increased across the surveys (baseline 48%, midline 49.1%, end line 67.2%). According to BRAC WASH programme, hygienic latrines use increased in 57.4% at end line and 41.5% at midline from 31.7% at baseline.

Table 3.4. Ownership of sanitary latrines used by the households (%)

Ownership status	BL	ML	EL	p-value		
				BL vs ML	ML vs EL	EL vs BL
Own	72.8	75.6	81.2	0.001	0.001	0.001
Shared	27.2	24.4	18.8	0.001	0.001	0.001
n	8346	10956	15011			

BL=Baseline, ML=Midline, EL=End line

Table 3.5. Latrine coverage by different definitions as used by different organizations (%)*

Name of organizations	Coverage (%)		
	BL	ML	EL
The Government of Bangladesh (National Sanitation Strategy, 2005)	26.1	34.3	49.8
UNICEF-WHO (Joint Monitoring Programme)	48	49.1	67.2
BRAC WASH programme	31.7	41.5	57.4
N	26404		

Source: (BBS-UNICEF, 2010)

*If 16.9% shared latrines in end line (10.7% sanitary latrine, 6.2% ring slab without water seal) were included with JMP definition, the total coverage would be 84.1%.

Based on the end line data, status of ring slab latrines was shown in Table 4.6. While the number of rings in a latrine was considered, three and six rings were found to be predominantly installed in both ring slab with water seal (20.3% and 23.3%) and ring slab without water seal (23.5% and 13%), respectively.

Self contribution was the main source of money for latrine installation showing declining tendency over the surveys (baseline 90%, midline 89.7% and end line 82.6%, respectively). NGO contribution, however, in latrine installation significantly increased from baseline (2.2%) to midline (4.3%) and to end line (13.4%). Conversely, government support for latrine installation decreased significantly in end line (Table 3.7).

Opinion on using own or shared latrines

The respondents were asked about their opinion on using own or shared latrine. In addition, households who defecated in the open place were also asked about the reasons for not owning latrines. The reasons varied according to their ownership status. The main considerations of using own latrines were health and environmental consciousness (baseline 52.3%, midline 52.1%, end line 55.9%), and convenience in using safe latrines (baseline 33.7%, midline 31.4%, end line 34.4%) (Table 3.8).

Table 3.6. Ring slab latrines by number of ring and status of water seal (with or without) (%) (Only in end line survey)

Number of ring	Ring slab with water seal (%)	Ring slab without water seal (%)
1	2.7	6.7
2	3.8	9.2
3	20.3	23.5
4	8.4	11.2
5	11.4	10.6
6	23.3	13
7	4.7	3.4
8	3.9	3.3
9	2.2	1.5
10	4.2	3.1
11-20	10.9	11.1
>=21	4.2	3.4
n	11466	6945

Table 3.7. Source of money for latrine installation (%)*

Source of money				p-value		
	BL	ML	EL	BL vs ML	ML vs EL	BL vs EL
NGO	2.2	4.3	13.4	0.001	0.001	0.001
Government	6.6	5.1	1.8	0.001	0.001	0.001
Relative	0.6	0.6	0.4	0.962	0.02	0.027
Self	90	89.7	82.6	0.348	0.001	0.001
Others	0.6	0.3	1.8	0.001	0.001	0.001
n	14595	16938	18595			

BL=Baseline, ML=Midline, EL=End line
*Multiple responses considered

Table 3.8. Opinion of respondents on the reasons of using own latrine (%)*

Opinions				p-value		
	BL	ML	EL	BL vs ML	ML vs EL	BL vs EL
Convenience	33.7	31.4	34.4	0.001	0.006	0.051
Health and environment	52.3	52.1	55.9	0.694	0.597	0.363
Social status	3.9	3.5	2.5	0.167	0.001	0.001
Economic	10.3	13.3	10	0.001	0.001	0.016
Others	0	0	4	0.036	0.001	0.001
n	14623	16971	18637			

BL=Baseline, ML=Midline, EL=End line
*Multiple responses considered

Table 3.9 presents perceptions of respondents from the corresponding households who did not own latrine. Most of respondents across the surveys (baseline 64.6%, midline 57.8%, end line 58.7%) reported that financial inability was the main reason of not owning a latrine. Besides, 22% of respondents in baseline, 37.7% in midline

and 29.4% in end line replied that they had already been using other's latrine, and thus they did not install own latrine. About 1.1% of respondents in baseline, 0.8% in midline and 10.1% in end line found their latrines unsuitable to use mainly because of breakage and filling up the latrine.

Table 3.9. Opinion of respondents on the reasons of no ownership of /not using own latrines (%)*

				p-value		
Opinions	BL	ML	EL	BL vs ML	ML vs EL	BL vs EL
Financial inability	64.6	57.8	58.7	0.001	0.966	0.001
Use others' latrine	22	37.7	29.4	0.001	0.001	0.001
Lack of space	7	5.6	4.9	0.041	0.001	0.001
Unsuitable for use	1.1	0.8	10.1	0.043	0.001	0.001
Others	9.1	3.3	10.2	0.001	0.001	0.319
n	7451	5848	5010			

BL=Baseline, ML=Midline, EL=End line
*Multiple responses considered

In case of shared latrine users, about half of the respondents in end line (48.8%) pointed out that financial inability increasingly became the main problem and compelled them to share latrines with others. Due to joint family, 22.3% respondents did not think it necessary to build a separate latrine. Few shared latrine users had different perceptions regarding this such as 'for saving money' even if they had ability to install own latrine (Table 3.10).

Table 3.10. Opinion of respondents on using of shared latrine (%)*

				p-value		
Opinions	BL	ML	EL	BL vs ML	ML vs EL	BL vs EL
Convenience	15.8	16	3.1	0.794	0.001	0.001
Financial inability	38.7	43.6	48.8	0.001	0.001	0.001
Joint family	30.9	31.3	22.3	0.155	0.001	0.001
Saving money	12.3	8.7	3.3	0.001	0.001	0.001
Others	2.5	0.6	26.5	0.001	0.001	0.001
n	4627	3768	2919			

BL=Baseline, ML=Midline, EL=End line; *Multiple responses considered

While the latrines were filled up (Table 3.11), the households mainly cleaned and reused the filled-in ring slab latrines. And this action was increasingly followed by households from baseline (29.9%) to midline (39.3%) and to end line (40%). More than half of the respondents across the surveys (baseline 63.8%, midline 55%, end line 55.2%) reported that their latrines were not filled up. Few households, however, tended to install new latrine when the latrines were filled up. The proportion of such households, however, decreased from baseline (5.3%) to midline (4.7%) and to end line (2.9%).

Table 3.11. Actions taken by households while latrine filled up (%)*

Responses on actions				p-value		
	BL	ML	EL	BL vs ML	ML vs EL	BL vs EL
Clean and reuse	29.9	39.3	40	0.001	0.497	0.001
Install new latrine	5.3	4.7	2.9	0.025	0.001	0.001
No action as not filled-up	63.8	55	55.2	0.001	0.864	0.001
Others	1.1	1	2.5	0.441	0.001	0.001
n	14623	16971	18637			

BL=Baseline, ML=Midline, EL=End line
*Multiple responses considered

Respondents who were not satisfied with their present defecation practices were asked about their opinions on why they needed a safe latrine. Households' health and wellbeing became the main concern among the most respondents over the years (baseline 66.5%, midline 78.2%, end line 53.2%). The other factors which got priority among the respondents were no latrine ownership (end line 20.8%, midline 0.1%, baseline 0.1%) and convenience of using safe latrines (baseline 18.5%, midline 8.1%, end line 15%). The respondents also intended to get safe latrines because of households' social status and the proportions varied across the surveys (baseline 15.3%, midline 14.1%, end line 10%) (Table 3.12).

Quality of sanitary latrines used

Quality of sanitary latrines was measured in terms of some physically verified indicators such as latrine cleanliness, absence of unpleasant odor, invisibility of fecal matter, fence around the latrine, availability of water and sandal in or near the latrine. These indicators imply hygienic use of latrines. Quality of sanitary latrines increased significantly from baseline to end line in terms of latrine cleanliness (baseline 33.4%, midline 50.8%, end line 53.3%), availability of water (baseline 32.7%, midline 37.8%, end line 38.7%) and sandal in or near the latrine (baseline 4.4%, midline 8.2%, end line 13.5%), respectively. Unpleasant odor coming from the latrine reduced in 48% at midline and 50.1% at end line compared to 62.9% at baseline. Furthermore, the indicator for instance fecal matter left in the latrine showed similar tendency of change as unpleasant odor present in the latrine (Table 3.13).

Table 3.12. Opinions of respondents on the necessity of safe latrine (%)*

Opinions				p-value		
	BL	ML	EL	BL vs ML	ML vs EL	BL vs EL
Convenience	18.5	8.1	15	0.001	0.001	0.001
Social status	15.3	14.1	10	0.003	0.001	0.001
Health concern	66.5	78.2	53.2	0.001	0.001	0.001
No latrine ownership	0.1	0.1	20.8	0.738	0.001	0.001
Others	0.4	0.2	8.6	0.001	0.001	0.001
n	15806	14957	13830			

BL=Baseline, ML=Midline, EL=End line
*Multiple responses considered

Table 3.13. Indicators describing quality of sanitary latrines (%)

				p-value		
	BL	ML	EL	BL vs ML	ML vs EL	BL vs EL
Is the latrine clean?						
YES (%)	33.4	50.8	53.3	0.001	0.001	0.001
n	16822	18101	21519			
Is there any unpleasant odor coming from the latrine?						
YES (%)	62.9	48	50.1	0.001	0.001	0.001
n	16822	18101	21519			
Is there any fecal matter left in the latrine?						
YES (%)	48.2	35.2	37.9	0.001	0.001	0.001
n	16822	18101	21519			
Fence around the latrine						
YES (%)	98.9	98.1	99.1	0.001	0.001	0.065
n	16822	18101	21519			
Is there water available in and/or near the latrine?						
YES (%)	32.7	37.8	38.7	0.001	0.054	0.001
n	16822	18101	21399			
Is there sandal in and/or near the latrine?						
YES (%)	4.4	8.2	13.5	0.001	0.001	0.001
n	16822	18101	21519			

BL=Baseline, ML=Midline, EL=End line

If hygienic maintenance of household latrines was considered, over 81% female members (baseline 88.3%, midline 90%, end line 81%) was found to be involved in cleaning the latrines, while male participation was much lower (baseline 4.2%, midline 2.8% and end line 3.2%) (Table 3.14). But proportion of respondents reporting involvement of both members in cleaning household latrines increased significantly in end line (14.4%) compared to baseline (6.9%) and midline (6.6%).

Table 3.14. Persons who usually cleaned the latrine

				p-value		
Persons cleaned the latrine	BL	ML	EL	BL vs ML	ML vs EL	BL vs EL
Male member	4.2	2.8	3.2	0.001	0.034	0.001
Female member	88.3	90	81	0.001	0.001	0.001
Both	6.9	6.6	14.4	0.308	0.001	0.001
Sweeper	0.3	0.4	1.2	0.621	0.001	0.001
Others	0.3	0.2	0.2	0.004	0.022	0.43
n	12506	15166	17150			

BL=Baseline, ML=Midline, EL=End line

Transition in and probability of latrine use

Transition matrix (Table 3.15) shows the proportion of households who shifted their sanitation practices from baseline to end line. Out of 31.7% households using sanitary latrines in baseline, 73.3% continued to do the same practice in end line, but

few of them shifted to unsanitary practices such as ring slab latrine without water seal (19.6%) and open defecation (5.7%), respectively. Besides, among 37.4% households who used ring slab latrines without water seal in baseline, majority of them (52.4%) shifted to sanitary practices in end line, while 37.2% of them carried on the same practice and 7.4% shifted to open defecation. Among the pit latrine users, 46.6% shifted to sanitary practices, while 33.5% adopted ring slab latrine without water seal and 8.8% switched to open defecation in end line. On the other hand, out of 23.9% households who used to defecate in the open places during baseline, 46.4% of them shifted to sanitary practices in end line, while 33.8% households kept on following the same defecation practice.

Table 3.15. Transition matrix of latrine use in the household (%)

BL		ML				EL			
Types of latrines		Sanitary	Ring slab (no WS)	Pit	Open place	Sanitary	Ring slab (no WS)	Pit	Open place
Sanitary	31.7	66.5	18.1	8.3	7.1	73.3	19.6	1.4	5.7
Ring slab (no WS)	37.4	35.1	36.6	14.7	13.6	52.4	37.2	3	7.4
Pit	7	25.4	26.7	27.7	20.1	46.6	33.5	11.1	8.8
Open defecation	23.9	23.7	17.4	7.7	51.2	46.4	17.8	2	33.8
Total (%)	100	41.5	25.5	11.9	21.1	57.4	26.7	2.3	13.5

BL=Baseline, ML=Midline, EL=End line, WS= water seal

Probability of not using sanitary latrines among the socioeconomically poor groups had been tested compared to the better-off by logistic regression. Poor and hardcore poor households were 1.02 times more prone to use unsanitary latrines than the non-poor in end line, reducing the gap between the economic groups over the years. The difference between the groups in terms of access to sanitary latrines was found significant in baseline and midline, but the difference became insignificant in end line. Similarly, NGO membership of household did not show significant difference in end line in using sanitary latrine. Households having radio and/or TV at homes were supposed to have better access to information. Households with no ownership of radio or TV at homes had 1.66 times higher probability of not using sanitary latrines in end line. Households who ever attended in the schools had higher probability of using sanitary latrines than those who never attended (Table 3.16).

In regression analysis, the survey years were taken into account to measure odds ratio (OR) indicating change in sanitary latrine use from baseline to midline and to end line (Table 3.17). While the five-year WASH programme approached towards the end, the probability of using sanitary latrines significantly increased by 0.33 times in end line compared to midline (0.62 times).

Table 3.16. Odds ratio of selected variables indicating probability of not using sanitary latrine

	BL			ML			EL		
	OR	95% CI	p-value	OR	95% CI	p-value	OR	95% CI	p-value
Education of household head									
Ever schooling	1			1			1		
Never schooling	1.79	1.69-1.90	0.001	1.53	1.45-1.62	0.001	1.36	1.29-1.43	0.001
Poverty of household head									
Non poor	1			1			1		
Poor	1.36	1.27-1.46	0.001	1.3	1.22-1.39	0.001	1.02	0.95-1.09	0.648
Ultra poor	1.43	1.31-1.56	0.001	1.39	1.29-1.50	0.001	1.02	0.94-1.10	0.676
NGO membership of household									
Yes	1			1			1		
No	0.83	0.79-0.88	0.001	0.83	0.79-0.88	0.001	0.99	0.94-1.04	0.646
Access to media at home									
Yes	1			1			1		
No	1.78	1.68-1.89	0.001	1.8	1.70-1.90	0.001	1.66	1.57-1.76	0.001

BL=Baseline, ML=Midline, EL=End line, WS= water seal

Table 3.17. The success of WASH programme in reducing odds ratio

Survey year	OR	95% CI	p-value
Baseline (2007)	1		
Midline (2009)	0.62	0.60-0.64	0.001
End line (2011)	0.33	0.32-0.35	0.001

Children's sanitation practices

Sanitary latrine use among the under-five children was increased in end line (35%) from baseline (19.9%), but decreased from midline (39.5%). (Table 3.18).

Table 3.18. Children's defecation practices (%)*

Types of defecation practice				p-value		
	BL	ML	EL	BL vs ML	ML vs EL	BL vs EL
Sanitary	19.9	39.5	35	0.001	0.001	0.001
Unsanitary	81.3	60.5	65.3	0.001	0.001	0.001
N	11360	13982	9007			

BL=Baseline, ML=Midline, EL=End line
*Multiple responses considered

Disposal of children's faeces at fixed place such as latrine or open hole increased significantly over the years (baseline 34.5%, midline 41.5% and end line 50%). (Table 3.19).

Table 3.19. Disposal of children faeces (%)*

				p-value		
Disposal at	BL	ML	EL	BL vs ML	ML vs EL	BL vs EL
Fixed place	34.5	41.5	50	0.001	0.001	0.001
No fixed place	66	58.7	51.2	0.001	0.001	0.001
n	9231	8458	5885			

BL=Baseline, ML=Midline, EL=End line
*Multiple responses considered

DISCUSSION

Poverty and physical environment often pose barriers to using sanitary latrine and its hygienic maintenance. A tendency of breaking the water seal has been found among few households mainly because of water shortage or lack of consciousness. This is a challenge to increase sanitation coverage. If effectively motivated, these households with water seal broken latrines could be converted into active water seal, hence increase the overall coverage. According to some users water seal latrines are inconvenient in terms of use and maintenance (Quazi 2002). A large amount of water is required to wash out the latrine after use. But carrying water from water source is often difficult. Thus people sometimes break the water seal to use less water in flushing. These people are not aware about the effects of broken water seal latrine as insects are still enter into the pit (UNICEF 2008).

Households shifting into sanitary practices are higher than shifting into unsanitary practices implying that people are increasingly adopting sanitary practices except the few. Shared latrine users who do not have own latrine may have possibility to defecate in the open space. Households whose latrines became unsuitable to use in end line and did not make it reusable or install a new one, may also tend to defecate in the open place. Hanchett *et al.* (2011) explain that rural households slip back to the old habit very quickly if new latrines become blocked, broken or bad smells, and if nobody is behind to guide and encourage them timely. Their report also reveals that shared latrine users and households without latrines are most likely to practice open defecation.

The difference in reporting the sanitation progress data is assumed due to difference in operational definition for monitoring the situation. According to government definitions, hygienic latrine confines feces, has water seal or other pit closure and is shared by maximum two households. JMP considers improved latrines which confine feces, but do not necessarily have water seal or tight pit closure (Hanchett *et al.* 2011). Besides, JMP definition remains strict about sharing aspects (BBS and UNICEF 2010). BRAC WASH programme considers latrine as hygienic if it has slab; water seal and/or septic tank. Broken water seal in latrine is not considered as hygienic (Akter and Neelim 2008). The difference in sanitation coverage between the organizations appears due to the variation in types of sanitation technologies. Rural sanitation coverage measured by BBS-UNICEF and BRAC-WASH shows nearly

similar, while GoB's definition is applied. But considerable variation appears while JMP definition is applied. In spite of the difference, both reports depict improvement in sanitation coverage over the years. Study conducted by Independent Monitoring and Evaluation Cell (IMEC) in 2009 explained possible reasons contributing to varied sanitation coverage reported by different organizations. Their report identified gap in data collection system, and lack of understanding about the role of water seal as the factors responsible for variation in sanitation coverage.

Households have installed latrines mainly from their own source of money. But self-contribution decreased in end line probably because of increased NGO financial support in terms of loan to the poor and subsidy for the ultra poor. The poor often show lack of interest in getting latrine on loan as they wanted to own latrine at free of cost (Akter and Ali 2011). Ghosh *et al.* (2011) explains that NGO support helps to increase latrine ownership among the households in intervention areas. Households are more prone to own and use sanitary latrines in NGO-led WASH intervention areas than comparison areas. Unmet need for safe sanitation of the poor can be met by NGO-led development programmes. Appropriate measures taken by NGOs such as credit programmes can play a significant, positive role in improving sanitation situation in rural Bangladesh (Hadi 2000).

Though sanitary latrine use by the children under-five improved compared to the baseline, about half of the households not using sanitary latrines for children's defecation do not always dispose children feces at fixed places probably because of lack of consciousness about risk factors. Most of the people are not much aware about the route of disease transmission which increases health risk (Rana 2009). Gunther and Fink, 2010 explain that people cannot only rely on investment in sanitation infrastructure, as disposal of feces in public areas are seen as natural alternative to sanitation facilities. The problem becomes worse when the understanding about health benefits of safe sanitation involving effect of invisible bacteria are poor particularly for those with little or no formal education.

Quality of sanitary latrines improved from baseline to end line, but all the sanitary latrines are not used hygienically. Ghosh *et al.* (2010) finds improvement in hygienic latrine use in WASH intervention areas where households are strongly motivated through training and door to door visits by village WASH committees. The committee also monitors the sanitary latrines at household level and educated mothers who are usually in charge of household hygiene. Hanchett *et al.* (2011) emphasizes households' behavior change to improve quality of sanitary latrines. The author also mentioned the fact that high rate of latrines on site does not ensure improved public health if those latrines are not hygienically maintained and used.

Findings reveal that female members in WASH intervention areas are mainly responsible for hygienic maintenance of household latrines. Women are not only main managers and users of water (Gender and Development Group 2007) and sanitation facilities (WaterAid Uganda and UWASNET 2002) in households, but also the supervisor of household hygiene.

Households with poor socioeconomic status such as never schooling, poverty, no access to media at home show higher probability of not using sanitary latrines. Study conducted by Yusuf and Hussain (1996) reported that people do not always use sanitary latrines provided to them, since socioeconomic condition and education influence use of sanitary latrines. However in our study, NGO membership of household members does not show any variation in using sanitary latrines among the sampled populations. One possible reason is higher proportions of non-poor households existing among the sampled populations who might have no NGO membership. Hadi and Nath (1996), however, explain that NGO support with a package of services such as loan support, group formation, and training help in changing sanitation behavior by raising awareness and financial capacity.

CONCLUSION AND RECOMMENDATION

Research findings show improvement in ownership and use of sanitary latrines at household level in BRAC WASH intervention areas. However, some challenges are encountered towards the growth of sanitation coverage. A number of households shifting from sanitary to unsanitary practices over the years become matter of concern towards the success of the programme. It has been made explicit through the research that some households who used sanitary latrines (i.e., latrine with water seal) converted to other unsanitary practices from baseline to midline and to end line by removing water seal from the latrine or moving back to open defecation. A number of factors such as poverty, lack of awareness, and water shortage induce households to adopt such unsanitary practices. Manifestations of these factors are breaking the water seal and occasional or regular defecation in the open places. Even though, there are challenges, the sanitation situation is improving. Inspiring finding is that BRAC WASH programme has been able to reduce the gap between better-off and poor socioeconomic groups in terms of access to sanitary latrine.

Following areas can be considered for further improvement of sanitation situation:

- Water availability is one of the key factors of breaking the water seal. Analysis of some region specific issues such as water availability is essential to understand the tendency of breaking the water seal. Regional or sub-regional water availability can be analyzed to have an insight of tackling the challenges of switching from sanitary to unsanitary practices.
- Households whose latrines became unsuitable for use in end line, but did not take any action to reuse or install a new one are subject to increased motivation for future progress. Therefore, increased home visits by WASH staff for monitoring the facilities and continued hygienic education are necessary to improve the sanitation situation.
- The maintenance of water seal latrines requires large amount of water. Thus the users often break the water seal to use less water which is unhygienic. Innovation of user friendly sanitation technology could be a solution of sustainable use of sanitary latrines.

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Chapter 4

Impact of BRAC WASH-I programme on hygiene knowledge and practice in rural areas

Sifat-E-Rabbi and Nepal C Dey

ABSTRACT

This study assessed the impact of BRAC WASH-I programme on hygiene knowledge and practices in the intervention areas. The Research and Evaluation Division of BRAC conducted baseline, midline and end line surveys in 50 *upazilas* of the first phase of the programme. Thirty thousand households from 50 *upazilas* were selected in two steps: i) 30 villages were selected from each *upazila* by cluster sampling, and ii) 20 household were chosen systematically from each village. Data were collected from households through face-to-face interview using a pre-tested questionnaire and analyzed using the SPSS software. The matched households were considered (26,404 in each survey) for analysis. Chi-square test compared the differences between indicator values and general linear method (GLM) regression identified the determinants of outcome variable. Analysis found that the tendency of not storing drinking water increased by 20% during repeated study period among the households due to availability of water sources. More than half of the respondents (54.1%) in end line reported that both child and adult stools are harmful which increased to 25% from baseline. Self-reported hand washing practice with soap at critical times significantly increased from baseline to end line ($p<0.01$). In end line, 97% of the respondents had knowledge about hand washing before taking food and after defecation, whereas 22 and 88% reported washing one/both hands with soap at that particular time. Self-reported hand washing practice with soap after cleaning child's bottom significantly improved from baseline to end line (18% vs.30%). In multivariate analysis, education, soap and water availability at household were positively associated with hand washing practices. Gap between knowledge and practice still exists in hand washing practices. The WASH programme needs to pay more attention to follow-up and reinforce hygiene practices.

INTRODUCTION

Better hygiene practice and access to safe drinking water and sanitation are greater challenges towards improved health and development in most developing countries. Bangladesh is the 10th among the countries in the world where the largest number of death occurs due to diarrhoea accounting for 50,800 under-five deaths every year (UNICEF 2010). Lack of access to safe drinking water, inadequate sanitation and poor hygiene, e.g. washing hands after defecation and before eating or feeding babies have shown a positive effect in reducing the occurrence of diarrhoea, trachoma and skin infections (Ejemot *et al.* 2008).

Globally, diarrhoeal disease is the most deadly one among the various diseases caused by poor hygiene practice especially for children (Pruss *et al* 2008). Several studies have documented significant positive effect of water, sanitation and hygiene on reducing child diarrhoea (Esrey *et al.* 1991, Fewtrell *et al.* 2005, Waddington *et al.* 2009, Cairncross *et al.* 2010). Around 2.4 million deaths (4.2% of all deaths) could be prevented by proper hygiene practice and access to safe sanitation and drinking water (Bartram *et al.* 2010). Thus, lack of safe drinking water, sanitation and hygiene practice have profound impact in transmission of waterborne or diarrhoeal diseases, especially on children over the world.

Hygienic behaviour plays an important role in the prevention of diseases related to water and sanitation. Evidence showed that an average of 65% of death caused by diarrhoeal diseases could be reduced if good hygiene practice accompanies the provision of water and sanitation (WaterAid 2009). In Bangladesh, people have limited understanding of linkage between poor hygiene and diseases (WaterAid 2003), requiring effective education. However, in comparison to water and sanitation, hygiene education received less attention in any intervention, resulting to poor health benefit. Hygiene education focusing on the issues like washing hands with soap can reduce the risk of diarrhoeal diseases and respiratory tract infection (Bartram *et al.* 2010). Hygiene education also promotes unsafe hygiene practice with safe alternatives (WaterAid 2009). Good hygiene practice (e.g. hand washing with soap, store safe drinking water) is indispensable to get the most health benefit of safe water sources and sanitation facilities (WaterAid 2009). Lack of awareness, knowledge and hygiene practices may be a barrier towards safe water use and improved sanitation, resulting to high morbidity and mortality.

Hygiene refers to some acts which guide to lead good health and cleanliness. It is important to clear the term hygiene used in this report. The term hygiene refers behaviour and measures used to break the chain of diseases contamination in the household and community level. Whereas most people understand that hygiene is only related to hand washing, there is some confusion as to what else is also related to it. Practically, there are some measures to reduce or break the cycle of diseases contamination in the household and community level. The practice of water collection and storing hygienically, safe sanitation practices, safe disposal of feces, hand washing with soap at critical times are essential for preventing diarrhoeal diseases and other problems related to water and sanitation. But, emphasis is given mainly to hand washing as earlier studies indicate that washing hands with soap reduces risk of diarrhoea significantly.

The government of Bangladesh (GoB) in collaboration with UNICEF has initiated a programme named SHEWA-B (Sanitation, Hygiene Education and Water supply–Bangladesh) that is among the largest intensive sanitation, hygiene education and water supply programme ever attempted in developing countries. This programme targeted 30 million underserved people. BRAC initiated water, sanitation and hygiene (WASH) intervention in 150 *upazilas* in 2006 in co-operation with GoB to increase the sanitation coverage to attain the relevant targets (Goal 4 and 7) of UN Millennium Development Goals (MDG) (reducing child mortality and halving the number of

people without sustainable access to safe drinking water and basic sanitation by the year 2015). The programme was financially supported by the government of the Netherlands for five years (2006-2010).

The WASH intervention offered education on good hygiene practice to 37.5 million people in 150 *upazilas* (BRAC 2008). The intervention includes promotional activities for installation of sanitary latrines and tubewells and facilitation of sanitation and hygienic practices through intensive health education. The health education component consists of awareness building on: i) washing hands with soap after defecation; ii) washing hands with soap before eating and before serving food; iii) using safe water for drinking and cooking; iv) keeping surroundings of the households, kitchen, tubewells and latrines tidy; v) construct tubewell platform with solid materials; vi) disposal of domestic waste in a fixed place and disposal of children's faeces in sanitary latrine; and vii) preservation of foods with appropriate cover.

Before launching the WASH programme, a baseline survey was conducted in 2006-2007 to understand the pre-programme status vis-à-vis the impact evaluation of the programme. Subsequently, a midline survey was done during April-July 2009 to assess the extent of changes occurred in different indicators including knowledge and practices in various intervention components. The aim of the end line survey (December 2009-March 2010) was to identify the impact of BRAC WASH programme on water, sanitation and hygiene practice after five years of intervention.

OBJECTIVES

The overall objective of the study was to evaluate the impact of BRAC WASH programme on knowledge and practice of hygiene, compared to benchmark status. The specific objectives were to:

- Assess knowledge and hygienic practice of water collection and storing,
- Understand knowledge and practice of sanitation hygiene, and
- Delineate the knowledge and self-reported practice of hand washing at critical times and waste disposal.

MATERIALS AND METHODS

This study comprised of a cross-sectional comparative design between baseline (BL), Midline (ML) and end line (End Line) status. The sample composed of 30,000 households – 600 from each study *upazila* (sub-district) from each BL, ML and EL. Please use details method. Detail of methodology can be found in chapter 7.

Index for hand washing at critical time - Generalized Linear Model (GLM) was used to analyze factors associated with hand washing practice. We detailed out the specific indicators used to construct the index. We assigned a value of '1'for highest

score of self-reported hand washing practice of both hands with soap at critical times whereas '0' for lowest score when none washed hands at all. Then the values were summed up and divided by total number of indicators used that is the value of the index lies between '0 to 1'. This index was used as dependent variable for the regression analysis to see what or which factors influence hygienic hand washing practices at critical times. Thus, we created a variable namely 'Wash score' for multivariate analysis. Six critical times for hand washing are considered, e.g. before taking meal, before serving foods, before cooking foods, after defecation, before feeding babies, and after cleaning bottom of babies.

Variables

In this study self-reported practices related to water, sanitation and hygiene (e.g. water collection and storage, safe latrines use, hand washing and domestic cleanliness) were considered as dependent variables whereas age, sex, household head's/respondent's education and major occupation, perceived economic condition of household, NGO membership, access to media and respondent's knowledge were considered as independent variables.

RESULTS

Socio-demographic profile

Almost all the respondents (99%) were female in all the survey (baseline, midline and end line) with mean age varies between 34-38 years (Table 4.1). Over 42.9% of the respondents never went to school, 28.4% attended at primary level, followed by 26.4% at secondary level across the surveys. Most of the respondents were married and their main occupation was housewife (92.2%). About 68.5% of the households were found non-poor and the rest were poor (18.8 %) and ultra poor (12.7%) in end line. The proportion of ultra poor and poor decreased from baseline to end line. Almost all the respondents (>99%) collected drinking water from own and shared tubewell across the surveys. But, 76% of the respondents owned or shared household latrines in baseline which increased in end line (87%).

Statuses of drinking water collection container

In baseline 46% of the respondents reported jug as water collection container which significantly increased to 47% in midline and to 48% in end line (Table 4.2). Use of pitcher and bucket as water collection containers decreased across the surveys.

Table 4.1. Socio-demographic profile of the respondents during the (repeated) study period

Indicators	2007	2009	2011
Mean age(Years)	34.61	34.18	37.66
Literacy (%)			
Never schooling	43.8	44.5	42.9
Primary level	28.9	28.0	28.4
Secondary level	24.9	25.2	26.4
Higher Secondary	1.2	1.4	1.6
Above higher secondary	0.5	0.5	0.5
Others	0.7	0.4	0.2
Main occupation (%)			
Housewife	91.9	92.4	92.2
Others	8.1	7.6	7.8
Marital status (%)			
Unmarried	1.1	1.7	2.0
Married	93.5	91.9	91.3
Widowed	4.5	5.6	6.0
Separated/Divorced	0.9	0.8	0.7
Economic status (%)			
Ultra poor	18.8	14.2	12.7
Poor	26.9	22.9	18.8
Non-poor	54.3	62.9	68.5
Drinking water source (Tubewell)			
Ultra-poor	99.2	99.6	99.7
Poor	99.2	99.5	99.6
Non-poor	99.1	99.6	99.7
Ownership of latrines			
Individual	64.6	73.1	79.4
Shared	20.2	16.2	12.4
No ownership	15.2	10.7	8.2
Place of defecation			
Household latrines	76.5	79.2	86.9
Open place	23.5	20.8	13.1
N	26404	26404	26404

Table 4.2. Respondents by types of drinking water collection containers (%)

	Survey Year			Relative change and p-value		
Types of containers	2007	2009	2011	2007-2009	2009-2011	2007-2011
Pitcher	29.3	28.4	28	-3.0 (ns)	-0.5 (ns)	-3.4 (ns)
Bucket	24.3	24	23.5	-1.5 (ns)	-1.1 (ns)	-2.6 (ns)
Jug	46.2	47.5	48	3.1 (p<0.01)	0.9 (p<0.01)	4.0 (p<0.01)
Others	1.2	0.1	0.5	-24.3 (ns)	-0.24.7 (ns)	-43.0 (ns)
N		26404				

Covering water container during transportation and storage

In baseline, 18% of the respondents reported that they covered water containers during transportation which significantly increased to 27% in midline and 30% in end line (Table 4.3). Besides, during observation of water storage container, 38% of them were found to be covered in end line compared to 31% in baseline, while at midline, it was highest (38.7%). The percentage regarding "Don't store" considerably decreased from baseline to midline to end line (56 vs.44 vs. 45%) (p< 0.01).

Table 4.3. Respondents by status of covering water container during transportation and storage (%)

Verified status	Survey year			Relative change and p-value		
	2007	2009	2011	2007-2009	2009-2011	2007-2011
Covered while transportation (Reported)						
Yes	18.2	27	30.4	49.4 (p<0.01)	12.6 (p<0.01)	68.3 (p<0.01)
No	81.8	77	69.6			
N		26404				
Covered while storage (Observed)						
Yes	31.0	38.7	38	24.8 (p<0.01)	-8.3 (p<0.01)	14.5 (p<0.01)
No	13.0	17.1	18.1			
Don't store	56.0	44.2	44.9	-21.1 (p<0.01)	3.8 (p<0.01)	-18.0 (p<0.01)
N		26404				

Perceived norms for using latrines

The norms of entering latrines with slipper increased from 81% at baseline to 91% at midline, but decreased to 89% at end line from midline. The respondents also mentioned washing hands after defecation as a norm which also increased from baseline to midline and end line (70 vs. 78 vs. 80%). Besides, taking pot in right hands during commuting to and from latrine also increased from baseline to midline and end line (9 vs.15 vs.16%) (Table 4.4).

Table 4.4. Respondent by status of perceived norm of using latrines (%)

Norms	Survey Year			Relative change and p-value		
	2007	2009	2011	2007-2009	2009-2011	2007-2011
Wear slippers	81.4	91.2	89.4	12.0 (p<0.01)	-2.0 (p<0.01)	9.8 (p<0.01)
Take pot in right hands	8.9	15.0	16.0	68.5 (p<0.01)	6.7 (ns)	79.8 (p<0.01)
Wash hands after defecation	70.0	77.9	79.6	11.3 (p<0.01)	2.2 (p<0.01)	13.7 (p<0.01)
Others	30.4	19.0	27.4			
Don't know	5.3	2.4	1.8			
N		26404				

'*Multiple responses considered'

Perceived knowledge about child stool and sanitation practice

Above 40% of the respondents reported both children's and adult's stool as harmful in baseline, which increased significantly to 42% in midline and to 54% in end line. Besides, they were also asked about the appropriate age to train children about latrine use; 2-3 years was the suitable that 54% reported at baseline which significantly increased to 58% at midline and 62% at end line (Table 4.5).

Table 4.5. Respondents by status of knowledge about harmfulness of stool and child's sanitation (%)

Knowledge	Survey Year			Relative difference and p-value		
	2007	2009	2011	2007-2009	2009-2011	2007-2011
Who's stool is dangerous						
Children's	23.7	31.2	25.8	31.6 (p<0.01)	-17.3 (p<0.01)	8.86 (p<0.01)
Adult's	33	21.2	16.7	-35.8 (p<0.01)	-21.2 (p<0.01)	-49.3 (p<0.01)
Both	40.8	42	54.1	3.2 (p<0.01)	28.5 (p<0.01)	32.6 (p<0.01)
Don't know	2.5	5.6	3.4			
N		26404				
Child should trained for going latrine						
Yes	98.0	98.3	99.6			
No	2.0	1.7	.4			
N		26404				
In which age						
2-3 Years	53.9	58.2	62.3	8.0 (P<0.01)	7.0 (P<0.01)	15.58 (P<0.01)
4-5 Years	33.2	31.6	30.4			
Others	12.9	10.2	7.3			
N		26404				

Practice of children's stool disposal

Analysis revealed that the respondents who disposed child stool in a fixed place significantly increased from baseline to end line (48.4% vs. 57%) while highest increase was at midline (61%). At the same time, the percentage of those disposing child's stool in an open place decreased from baseline to midline and to end line (48 vs. 30 vs. 38%) (Table 4.6).

Knowledge about critical times of hand washing

Hand washing knowledge before taking meal and after defecation also significantly increased in midline and end line from baseline (Table 4.7). Compared to baseline, knowledge on hand-washing before cooking and after cleaning child's stool significantly increased in end line (30 vs. 40%) and (11 vs. 17%) respectively. But in midline, hand-washing knowledge before feeding babies (5.8 vs. 5.2%) and after cleaning bottom of babies (10.8 vs.9.3%) decreased a bit from baseline.

Table 4.6. Respondents by status of practice of child stool disposal (%)

Practice	Survey year			Relative change and p-value		
	2007	2009	2011	2007-2009	2009-2011	2007-2011
Disposal of children's stool						
Fixed place	48.4	60.9	57	26.08 (P<0.01)	-6.57 (P<0.01)	17.8 (P<0.01)
Open places	48.3	29.8	38.4	-38.3 (P<0.01)	-28.86 (P<0.01)	-20.5 (P<0.01)
Don't dispose	3.3	9.3	4.6	175.75 (P<0.01)	-49.45 (P<0.01)	39.4 (P<0.01)
N	8573	7558	5234			

Table 4.7. Respondent by status of knowledge about the critical time of hand washing (%)

Critical times	Survey year						Relative change and p-value		
	2007		2009		2011		2007-2009	2009-2011	2007-2011
	Yes	No	Yes	No	Yes	No			
Before taking meal	92.2	7.8	97.0	3.0	97.3	2.7	5.21 (P<0.01)	0.31 (ns)	5.1 (P<0.01)
Before serving food	10.8	89.2	11.3	88.7	13.6	86.4	4.63 (ns)	20.35 (P<0.01)	2.8 (P<0.01)
Before cooking	30.4	69.6	44.3	55.7	40.0	60.0	45.72 (P<0.01)	-9.71 (P<0.01)	10.4 (P<0.01)
After defecation	90.8	9.2	95.8	4.2	96.9	3.1	5.51 (P<0.01)	1.15 (P<0.01)	6.1 (P<0.01)
Before feeding babies	5.8	94.2	5.2	94.8	7.2	92.8	-10.34 (ns)	38.46 (P<0.01)	1.4 (P<0.01)
After cleaning child's stool	10.8	89.2	9.3	90.7	16.7	83.3	-13.89 (P<0.01)	79.57 (P<0.01)	6.0 (P<0.01)
N	26404								

Practice of hand-washing at critical times

Self-reported hand-washing practice with soap significantly increased from baseline to end line for all critical times, i.e. before taking, serving and cooking food and after defecation (p<0.01) (Table 4.8). The respondents who reported of washing hands with soap before taking food increased from 8% in baseline to 20% in midline and to 22% in end line. Analysis also revealed that hand washing practice with soap after defecation increased from baseline to midline and end line (72 vs. 86 vs. 88%). Besides, hand washing practice with soap increased significantly from baseline to midline and end line before serving food (1 vs. 1.9 vs. 3.6%) and cooking (3.3 vs. 7.7 vs. 9.1%) (Table 4.8).

Table 4.8. Respondents by status of hand washing (one/both hands) practice with soap (%)

Wash hands	Survey year			Relative difference and p-value		
	2007	2009	2011	2007-2009	2009-2011	2007-2011
Before taking food						
Soap/ash	7.9	20.0	21.8	153.16 (P<0.01)	1.8 (P<0.01)	13.8 (P<0.01)
Water	84.3	77.0	75.5	-8.66 (P<0.01)	-1.5 (P<0.01)	-8.8 (P<0.01)
Don't wash	7.8	3.0	2.7			
Before serving food						
Soap/ash	1.0	1.9	3.6	90.0 (P<0.01)	89.47 (ns)	260 (P<0.01)
Water	9.8	9.4	10.0	-4.08 (ns)	6.38 (ns)	2.04 (ns)
Don't wash	89.2	88.7	86.4			
Before cooking						
Soap/ash	3.3	7.2	9.2	115.15 (P<0.01)	28.17 (P<0.01)	175.76 (P<0.01)
Water	27.1	37.1	30.8	36.90 (P<0.01)	-17 (P<0.01)	13.65 (P<0.01)
Don't wash	69.6	55.7	60.0			
After defecation						
Soap/ash	71.6	86.2	88.1	20.39 (P<0.01)	2.04 (P<0.01)	23.04 (P<0.01)
Water	19.2	9.6	8.8	-50.0 (P<0.01)	-8.33 (P<0.01)	-54.17 (P<0.01)
Don't wash	9.2	4.2	3.1			
N		26404				

Hand washing practice while handling babies

Self-reported hand-washing practice with soap while handling babies significantly ($p<0.01$) increased in midline and end line from baseline. The respondents reported in the baseline 1.5% that they washed hands with soap before providing food to babies while it increased to 2.4% at midline and 3.3 at end line (Table 4.9). Besides, results also showed that in baseline 18% of the respondents reported that they washed their hands with soap after cleaning child's stool which decreased to 15% in midline and again increased to 29.7% in end line.

Table 4.9. Respondents by status of hand washing (one/both hands) practice with soap while handling babies (%)

Wash hands	Survey Year			Relative change and p-value		
	2007	2009	2011	2007-2009	2009-2011	2007-2011
Before feeding babies						
Soap	1.5	2.4	3.3	60 (P<0.01)	33.33 (P<0.01)	113.33 (P<0.01)
Water	8.2	5.8	7.9	-30.48 (P<0.01)	38.60 (P<0.01)	-3.66 (ns)
Don't wash	90.3	91.8	88.8			
After cleaning child's stool						
Soap	18	15	29.7	-16.11 (P<0.01)	96.69 (P<0.01)	12 (P<0.01)
Water	8.6	4.4	7.6	-48.83 (P<0.01)	72.73 (P<0.01)	-11.63 (P<0.01)
Don't wash	73.4	80.4	62.7			
N	9108	11345	7473			

Factors associated hand-washing practice

The hand-washing practice significantly increased from baseline to midline and end line ($p<0.01$) (Table 4.10). Among the independent variables education have strong association with hand-washing practices. Both household head's education (Co-efficient 0.001; CI= 0.001-0.002) and spouse's education (Co-efficient 0.003; CI= 0.002-0.003) have significant relation with this issue ($p<0.01$). Access to media (television) is significantly ($p<0.01$) associated with hand-washing practices whereas electricity have no significant impact on hand-washing. Hand-washing practice highly significantly ($p<0.01$) associated with tubewell (0.018, CI=0.016-0.020) and latrine ownership (0.015, CI=0.014-0.017). Besides, hand-washing materials (e.g. soap, ash) and water availability near latrines also have significant positive association with hygienic hand-washing practices. NGO-membership including BRAC has strong association with hand-washing practices.

Physically verified practice of some hygiene indicators

Some sanitation practices such as, availability of water and soap near latrine and separate soap were physically verified for hygienic practice of hand-washing (Table 4.11). Availability of water near latrine increased in midline (38 vs. 33%) and end line (39 vs.33%) from baseline. Soap availability near latrine also increased in midline (19 vs.14%) and end line (25 vs.14%) from baseline. But use of separate soap for washing clothes and hands also increased significantly in end line compared to baseline (53 vs. 39%), but it decreased in midline from baseline (39 vs. 26%).

Table 4.10. Results of GLM estimates for the factors influencing hand washing practices

Indicators	Dependent value: Hand washing Co-efficient	Z value	95% conf. Interval
Survey year			
Year 2009 (1 if year 2009,0 if year 2006 and 2011)	0.060	59.47***	0.0577-0.061
Year 2011 (1 if year 2011, 0 if year 2006 and 2009)	0.075	67.22***	0.0726-0.077
Education			
Education of household heads (years)	0.002	15.56***	0.001-0.002
Education of spouse (years)	0.003	21.03***	0.002-0.003
Occupation			
Occupation of HH (1=service, 0=others)	0.004	1.93*	-0.000-0.007
Occupation of HH (1=business, 0=others)	0.001	1	-0.001-0.003
Occupation of HH (1=farming, 0=others)	0.000	0.61	-0.001-0.002
Household assets			
Electricity (1 if Yes,0 if No)	0.000	0.85	-0.001-0.002
Television (1 if Yes,0 if No)	0.013	11.49***	0.010-0.015
Roof material (1if concrete, 0 if others)	0.002	0.82	-0.003-0.008
Floor material(1if concrete, 0 if others)	0.008	4.49***	0.004-0.117
Wall material (1if concrete, 0 if others)	-0.000	-0.12	-0.002-0.002
Economic status			
Perceived economic status (1 if deficit and 0 if surplus)	-0.008	-9.09***	-0.009-(-0.006)
Others			
Tubewell ownership (1if yes, 0 if No)	0.0186	16.13***	0.016-0.021
Latrine ownership (1 if yes, 0 if No)	0.016	17.29***	0.014-0.018
Water availability near latrine (1 if Yes, 0 if No)	0.003	2.62**	0.000-0.004
Soap/ash near latrine (1 if Yes, 0 if No)	0.022	16.13***	0.019-0.025
Slipper near latrine (1 if Yes, 0 if No)	0.028	15.2***	0.024-0.032
Membership			
BRAC member (1 if BRAC members , 0 if others)	0.008	6.49***	0.006-0.011
Other NGO member (1 if other NGO Member, 0 if BRAC member)	0.005	6.75***	0.004-0.007
Constant	0.177	115.19***	0.174-0.180

Note: ***, ** and * denote significant at 1%, 5% and 10% level, respectively.

Domestic hygiene practice

Analysis shows that the status of different types of waste disposal in fixed place decreased gradually from baseline to midline and end line, such as, kitchen waste (97 vs. 96 vs. 94%), household waste (98 vs. 96 vs. 94%), hen/duck waste (98 vs. 96 vs. 94%) and domestic animal waste (99 vs. 98 vs. 97%) (Table 4.12).

Information gathered from Village Wash Committee (VWC) meeting

The respondents were asked what kind of information they gathered after participating in Village Wash Committee (VWC) meeting. Analysis revealed that >80% of the respondents knew about safe sanitation and hygiene practices in end line which was significantly higher than midline (75%) (Table 4.13).

Table 4.11. Households by status of physical verification of own and shared latrines (%)

Verified status	Survey years			Relative change and p-value		
	2007	2009	2011	2007-2009	2009-2011	2007-2011
Availability of water near latrine						
Yes	33	38	39.1	15.15 (p<0.01)	1.32 (ns)	16.67 (p<0.01)
No	67	62	60.9			
Separate soap						
Yes	39.3	26.3	53.3	-33.08 (p<0.01)	102.66 (p<0.01)	35.62 (p<0.01)
No	60.7	73.7	46.7			
Soap near latrine						
Yes	14	19.8	25.3	37.14 (p<0.01)	30.21 (p<0.01)	78.57 (p<0.01)
No	86	80.2	74.7			

Table 4.12. Respondents by status of household waste disposal in a fixed place (%)*

Waste dispose	Survey Year			Relative change and p-value		
	2007	2009	2011	2007-2009	2009-2011	2007-2011
Kitchen waste	97	96	94	-0.83 (P<0.01)	-1.98 (P<0.01)	-2.79 (P<0.01)
Household waste	98	96	94	-1.43 (P<0.01)	-2.08 (P<0.01)	-3.48 (P<0.01)
N		26404				
Hen/duck waste	97	96	95	-0.82 (P<0.01)	-0.83 (P<0.01)	-1.64 (P<0.01)
n	23167	21077	21684			
Domestic animal waste	99	98	97	-0.82 (P<0.01)	-0.83 (P<0.01)	-1.64 (P<0.01)
n	18085	18365	18001			

*Multiple responses considered'

Table 4.13. Information gathered from the participation in VWC meeting (%)*

Information	Survey Years		Relative change and p-value
	2009	2011	2009-2011
About safe water	18.7	15.4	-17.64 (P<0.01)
About safe sanitation	75.0	80.2	7.0 (P<0.01)
About hygiene	75.0	80.2	7.0 (P<0.01)
Others	8.7	4.4	-49.42 (P<0.01)
n	3674	3761	

*Multiple responses considered'

DISCUSSION

The purpose of the end line survey is to track the changes made by BRAC WASH programme intervention in improving knowledge and practice of water, sanitation and hygienic behaviour among household members.

Knowledge and hygienic practice of water collection and storage

In terms of safe household water, factors included the practice of water collection and storage containers covered during transportation and storage and cleaning regularly. Studies in Bangladesh have documented inadequate storage conditions and vulnerable water storage container as major factors contributing to increase microbial contamination (Spira *et al* 1980, Shears *et al* 1995). Study result reveals that most of the respondents used jug and pitcher for water collection and storage. Storage containers having wider opening (e.g. buckets, pots) are associated with high level of microbial contamination (WHO 2002). This study also revealed that the tendency of not storing drinking water has been increased by 20% during repeated study period at household level due to availability of water sources. It indicates that household members collect water instantly and consumed without storage. Analysis further implied that during water storage, more than one-third households used cover on their storage container. Besides, improving status (46%) on washing water storage containers every day might be due to change in their knowledge. Dune *et al.* showed that increased storage time is a factor contributing to greater risks of microbial contamination of stored water (Dunne *et al.* 2001). It implies that their hygienic consciousness is increasing over time.

Knowledge and hygienic practice of sanitation

In terms of safe sanitation knowledge, norms for using latrines, perceived harmfulness of stool and necessity for child's sanitation practice are considered. Most of the respondents reported that wearing slippers and properly washing hands are the effective norms for using latrines hygienically, which implies improvement of

knowledge about safe sanitation behaviour. Studies documented that diarrhoeal disease pathogens are usually transmitted by fecal-oral route (Curtis 2000, Gerald *et al.* 2006). However, hand-washing after defecation can reduce the risk of diarrhoea (Ejmot *et al.* 2008). Analysis further showed that more than half of the respondents disposed child's feces in a fixed place. Besides, 62% of the respondents mentioned that child should be trained for using latrine at their early age. Many epidemiological studies showed strong association between stool disposal and child diarrhoea (Stanton and Clemens 1987; Han and Moe 1990; Baltazar and Solon 1989). Besides, studies documented that households without facilities for proper disposal of child's faces may increase risk of excreta handling by mothers, caregivers and children themselves (Curtis *et al.* 1995). In addition, children's feces are considered as harmless in some cultures and mothers are not habituated to wash their hands after handling them (Traore *et al.* 1994). However, the present study revealed that more than half of respondents in end line reported that both children's and adult's stool is harmful, which increased by 25% from baseline. It indicates that knowledge towards safe sanitation practice has been improved among the respondents from the baseline. Analysis further implied from observational evidence that most of the households did not have hand-washing facilities available near latrines. Epidemiological studies show that behaviours are the most important risk factors that promote human contact with fecal matter, including improper disposal of feces (including child's feces), lack of hand-washing after defecation, and before handling foods (Lanata *et al.* 1998, Curtis 1995, Traore 1994, LeBaron *et al.* 1990).

Knowledge and practice of hand washing

In this study hand washing at critical times e.g. before eating, after defecation, after cleaning child's stool, before feeding babies and serving foods are considered because different studies showed that hand washing can decontaminate hands and prevent cross-transmission (Kaltenthaler *et al.* 1991, Larson 1995, Rotter 1999). The effectiveness of hand washing with soap can reduce diarrhoeal risk up to 47% (Curtis Cairncroos 2003). Studies carried out in Bangladesh suggested that hand washing is one of the factors which decreases the incidence of diarrhoea in intervention (Stanton and clemens 1987, Alam *et al.* 1989). Another study revealed that after six years of water, sanitation and hygiene intervention in Bangladesh diarrhoeal prevalence associated with lower number of fecal-colony forming bacteria on hands reduced (Hoque *et al.* 1996). The majority of the respondents had knowledge about hand washing with soap and ash before eating and after defecation, but 21% and 88% of the respondents reported to do so, respectively. This finding shows the knowledge-behaviour gap in hand washing. A recent Kenyan study found that 71% of the respondents understood the importance of hand washing after defecation, but 31% did so (Yolande and Jacquelire 2010). It is important to note that reported hand washing practice with soap or ash before eating is much lower than that of after defecation. Shabnam's recent study conducted in Jamalpur district of Bangladesh shows similar findings regarding hand washing. Reported hand washing practice with soap or ash after defecation is very high than actual practice in Bangladesh (ICDDR,B 2008, Shabnam 2010). The

findings show that verbal response about hand washing behaviour does not provide a real scenario of practices.

The respondents having under-5 children reported hand washing with soap or ash twice e.g. before feeding and after cleaning child's stool. Responses' regarding hand washing before feeding babies indicate that this practice is not common; thus needs more emphasis in future. Another study also indicates similar findings (Halder *et al.* 2010).The knowledge and practice regarding hand washing with soap after cleaning the bottom of babies increased significantly from baseline to end line.

In the multivariate analysis, hand washing practice is strongly influenced by some important indicators such as education, media access, better economic condition, etc. The education of household head and spouse has greater emphasis on hygienic hand washing practice. Hygiene practice regarding hand washing increases if the level of education increases. Besides, access to television has strong association with hand washing rather than access to electricity. In addition, being financially better-off has positive influence on hand washing practices. Moreover, issues related to hand washing such as, ownership of latrine and tubewell, availability of water/soap/slipper near latrine are also associated. It is assumed that if water, soap and slippers are available near latrines then people would be more conscious about hygienic hand washing practice. In addition, NGO membership has strong association with hand washing practices.

Practice of domestic waste disposal

In this study, domestic waste includes kitchen waste, household waste, hen/duck's waste and domestic animal's waste. Majority of the respondents reported that they have a fixed place for waste disposal. But the percentage has been decreasing from baseline to end line. Improvement of waste disposal at fixed place was found in midline than baseline. However, it was decreased at end line, which might be due to less attention given in waste disposal during the survey period.

It is evident from our study that in BRAC WASH intervention areas, people are remaining conscious about water, sanitation and hygiene practice. Door to door visit of BRAC WASH programme staff to disseminate knowledge and monitor practice related to sanitation and hygiene might have impact on these positive behavioural changes. Besides, the respondents who attended VWC meeting were asked about what they had learnt from VWC meetings. Most of them reported that the sanitation and hygiene practices learned from these meetings increased in end line than baseline which might have positive impact in hygiene knowledge and practice. But, these positive changes do not reflect the long-term sustainability of behaviour changes. In some cases, negative changes in their practice (e.g. covered while storing, domestic waste disposal) also found from midline to end line. Moreover, gap between knowledge and practice still persists in hand washing. It indicates that knowledge dissemination through different sources enhances their knowledge, but proper monitoring is absent to make them practice their retained knowledge.

This study endures a methodological weakness because of the absence of control group. This is a constraint to evaluate the impact of BRAC WASH programme. However, availability of baseline data and randomness of the study sample allow to make a general conclusion that the observed changes are the impact of the intervention. Nevertheless, hand washing practice with soap at different critical times and waste disposal at fixed place were not physically verified, which is also a limitation of this study. Structured observation is imperative to assess the real scenario of hygiene practices. However, responses on the learning of hand washing practices from increased participation in the VWC meeting might put evidence of direct impact of the BRAC WASH programme. The separate teams of field investigators for data collection during baseline, midline and end line, and analysis of data of the same households across the surveys might help avert information bias.

CONCLUSIONS

After five years of intervention of BRAC WASH programme significant improvement in hygiene knowledge and practice has been achieved. However, gap between knowledge and practice still persist in hand washing practice. Long-term motivation is needed to improve hand washing practice with soap.

RECOMMENDATIONS

- Accelerated and sustained inputs as well as proper monitoring of programme may need to narrow down the gap between knowledge and practice.
- To achieve further success the WASH programme should pay more attention on knowledge dissemination on how to change hygiene behaviours. This might help scaling up and sustainability of the programme in near future.

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Chapter 5

Women in water-hygiene and sanitation management at households in rural Bangladesh: changes from baseline to end line survey

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ABSTRACT

Unhygienic conditions at household water supply and sanitation cause sufferings to women the most. To improve the situation, BRAC has been implementing water, sanitation and hygiene (WASH I) programme in 150 *upazilas* of Bangladesh since middle of 2006 in three phases. The BRAC Research and Evaluation Division (RED) conducted baseline (BL), midline (ML) and end line (EL) surveys in 50 *upazila* in the first phase. Each survey was conducted on 30,000 households of which, 600 from each study *upazila*. These were drawn in two steps using the cluster sampling method. In first step 30 villages were selected from each *upazila*. Then in second step, 20 households were chosen systematically from these selected villages. Data were collected through face-to-face interview using pre-tested questionnaire. The matched households in all three surveys (26404 in each survey) were considered for the analysis. Chi-square and t-tests compared the difference between indicator values, and binary regression identified the determinants of outcome variables. Respondents were the women of households who were given special attention on their participation and raise their voices in decision-making process. The findings revealed that the majority of the women (over 82%) were responsible for water collection from all types of tubewells, while involvement of other members significantly increased over the years. Moreover, the tendency of cleaning tubewell platform and household latrines is higher among women than men. The ultra-poor increasingly tended to cover water vessels of drinking water during transportation (BL 15.3%, ML 24.6%, and EL 30.7%) and storage (BL 31.3%, ML 37.7%, and EL 38.6%). Besides, water safety practices including construction of concrete platform and its cleanliness among the poor and ultra poor were found statistically insignificant. On the other hand, the non-poor were 1.46 and 1.19 times more likely to build and clean concrete platform respectively compared to the ultra poor. The participation of women in WASH meeting was found rather low representing only 14% in EL. To increase women's participation in productive activities, other family members should come forward to take part in management of household hygiene in water and sanitation.

INTRODUCTION

Unhygienic conditions cause sufferings to the women most, as illness of family members brings extra work for them over daily household tasks. In many cultures, only female household members usually collect water for their family (Muylwijk 2006). Most of the female members normally collect water for cooking, bathing, cleaning, and also maintain health and hygiene-related activities of the household members. It is estimated that on average 40-60 liters of water is consumed daily by an average household in developing countries for drinking, cooking, cleaning, and personal hygiene. To meet this requirement, women often involve themselves for long time in water collection (Rathgeber 1997). Many of them walk long distances to fetch water spending four to five hours per day carrying heavy containers which cause them physical problems and sufferings. Each female water carrier keeps a considerable amount of time per day (e.g., 1.3 hours during monsoon season and 2-3 hours during dry season) to meet daily water requirements for their household (ADB 2000). In some regions of Africa, women use up to 27% of their caloric intake in collecting water (Lewis 1994).

In urban context, women and girls have to wait for hours in queue for collecting water. As a result, they often miss opportunities for education, income generation or leisure time (UNICEF and WHO 2008). Consequently, many of them lack basic education on strategies of efficient use and pollution prevention of water (Muylwijk 2006). Rural water is being supplied basically from privately owned tubewell, shared tubewell, and publicly owned tubewell, whereas urban water supply adopts piped/tape water from deep tubewell. A tubewell is called privately owned when only one household used to collect water from the tubewell. When a tubewell was used by a group of households, such as neighbours and relatives, who may or may not follow any particular time to collect water are called shared tubewell, and public tubewell was open for all and had no time restriction for collecting water.

Women mostly suffer, if water and sanitation systems remain out of work. When access to water is restricted, women often have no options but to collect low quality water, thereby, risking safety of entire family (MNRE 2007). Women play significant role for the use and management of water sources, health, and sanitation facilities at household level. But their involvement in decision making process is often ignored (Kasmi and Segond 2008). If water sources are made easily accessible for them, a minimum of 30% of the total time could be saved and used for productive activities. Moreover, insufficient water supplies nearby may have adverse impact on sanitation (Devkota 2007). To overcome the problem and improve the situation, many NGO-led development programmes are involving women in water, sanitation and hygiene issues.

BRAC, one of the largest non-government development organizations in the world, has been working on improving the quality of life and empowering the poor through a holistic approach of development. BRAC initiated the water, sanitation and hygiene (WASH) programme in order to achieve MDGs of (i) reducing child mortality, and (ii) halving the number of people who are without access to safe drinking water and

basic sanitation by 2015. The programme aims to ensure (i) access to sanitation services to 17.6 million people, (ii) safe water supply to 8.5 million people, and (iii) hygiene education to 37.5 million people. With the support of the Government of Royal Neherlands, BRAC WASH programme has been working in 150 *upazilas* in three phases since 2006. A unique feature of the programme is to provide hygiene education to different groups such as women, men and children. By recognizing women's crucial contributions in households' water and sanitation management, the programme is designed in such a way that women can easily participate and raise their voice in decision making process (Akter 2008).

The intervention package includes installation of sanitary latrines and tubewells. Health education is being provided through cluster meetings of men, women and children, and home visits to facilitate safe water, sanitation and hygiene practices. To ensure participation of community people, Village WASH Committees (VWCs) have been formed in the intervention areas. VWCs are the focal points for involving rural people at all levels which function through problem identification, resource mobilization and adoption of actions in terms of providing sanitary latrines, repairing and maintenance of existing water facilities and installing new water supply options.
The Research and Evaluation Division (RED) of BRAC conducted a baseline (BL) survey from November 2006 to June 2007 for better understanding of the pre-programme status vis-à-vis the impact evaluation of the programme in the selected WASH programme areas. Subsequently, a midline (ML) survey was conducted during mid-2009 (April-June) after two years of the BL survey to assess the changes and improvements in the motivation, knowledge and practices in various intervention components to the households, communities, and educational and religious institutions. This was followed by an end line (EL) survey on different aspects of water, sanitation and hygiene in programme areas in 2011. Although there are several reports published on water and sanitation status at household level. However, women's role in managing household water-hygiene and sanitation has not been assessed systematically. The term water-hygiene in this study has been described following key hygiene indicators of BRAC WASH programme. To this end, water-hygiene indicators includes use of safe water sources for drinking and cooking, safe water storage including covering water vessels during transportation and storage, and maintenance of water sources including concrete-built platform and its cleanliness.

OBJECTIVES

The overall objective of this study was to examine women's role in managing household water-hygiene and sanitation. The specific objectives were to assess:

- hygienic management and use of water at household,
- the responsibility of cleaning latrine and tubewell platform,
- awareness regarding the use of safe water and sanitation and prevention of waterborne diseases,
- the status of households' water safety practices regarding tubewell, and

- the status of women's opinion in decision making for community-based NGO activities.

MATERIALS AND METHODS

The study embarrassed a cross-sectional cooperation design between baseline (BL) 2007, midline (ML) 2009, and end line (EL) 2011 status. The sample comprised of 30,000 households- 600 from each study *upazila* (sub-district) for each of BL, ML and EL. Please see details in chapter 1.

Dependent variables

Water safety practices such as concrete-built platform of tubewell and its cleanliness were considered as dependent variable in this study.

Independent variables

Education, economic status, occupation, household assets i.e. ownership of radio and/or television, intervention period were considered as independent variable. Economic status of households was classified as ultra poor, poor and non-poor. Ultra poor were those who were landless or homeless and who did not have fixed source of income. Households who had up to 50 decimal of land (agricultural and homestead) and any adult household member sells 100 days of manual labour per year for living, were called poor. On the other hand, the households that did not fall in any of the above categories were defined as non-poor. Respondent's self-rated economic status was also taken into account of measuring households' probability of practicing water safety measures at household level. In addition to households' socioeconomic characteristics, year of surveys e.g. BL, ML and EL was considered as variable for regression analysis to see the impact of time on water safety practices. A description of dependent and independent variables is given in Table 5.1.

Table 5.1. Classification of dependent and independent variables

Variable	Classification
Dependent	
Concrete-built platform	Yes, no
Cleanliness of tubewell platform	Yes, no
Independent	
Education	Never schooling, ever schooling
Household's economic status	Non poor, poor and ultra poor
Perceived economic status	Surplus, equilibrium, deficit
Access to media at home	Yes, no
Survey period	Baseline (BL), midline (ML), end line (EL)
Occupation of household head	Farming, non farming

RESULTS

Background characteristics of the study samples

Household composition of sampled populations in study area revealed equal proportion of male and female members is almost equal (50.4% vs. 49.6%). In EL, the background characteristics showed that majority (59%) of household heads were non-poor and about 55.3% ever attended schools (Table 5.2). About one-third of the household heads were involved in agricultural activities, 31% in day labour and 14.5% in business. Over half of the households (56%) had no NGO membership. About 37.5% respondents reported to have access to media at home as they owned radio and/or TV, while majority of them had no ownership of any of them (62.5%).

Table 5.2. Socioeconomic profile of samples in BL (2006), ML (2009) and EL (2011) (%)

Indicators	BL	N	ML	N	EL	N	p-value
Education of household head							
Ever schooling	55.4	14629	54.6	14410	55.3	14591	0.123
Never schooling	44.6	11994	45.4	11994	44.7	11813	
NGO membership of household							
Yes	45.6	12016	47.5	12489	43.9	11477	0.000
No	54.4	14327	52.5	13800	56.1	14684	
Main occupation of household head							
Agriculture	33.2	8778	32.7	8622	33.4	8827	0.000
Labour	32.6	8598	30.5	8047	30.9	8150	
Service	6.5	1707	5.9	1571	6.1	1623	
Business	16.9	4474	15.8	4168	14.5	3821	
Household work	7.0	1846	10.4	2735	9.5	2505	
Disable	2.2	578	3.0	781	3.8	1015	
Others	1.6	423	1.8	480	1.7	462	
Economic status of household head							
Hardcore poor	18.8	4959	18.0	4959	16.8	3361	0.000
poor	26.9	7115	25.8	7115	24.2	4964	
Non-poor	54.3	14330	56.2	14330	59.0	18079	
Access to media at home							
Yes	37.4	9884	37.9	9994	37.5	9903	0.572
No	62.6	16520	62.1	16410	62.5	16501	

BL= Baseline, ML= Midline, EL= End line

Women's involvement in collecting water

Women's water collection from private and shared tubewell decreased in ML (private: 97% vs. 95.3%; and shared: 96.1% vs 95.5%) and EL (private: 97% vs 94.2%; and shared: 96.1% vs 93.4%) from BL. But the fact was different in case of users collecting water from public tubewell. The proportion of women who collected water from public tubewell increased from BL to ML (80.6% vs 88.4%) and to EL (80.6% vs 81.8%). The contribution of other family members in water collection significantly increased across the surveys among all types of tubewell users (Table 5.3).

Table 5.3. Women's involvement in collecting water by types of water sources (%)

Responsible persons	Types of water sources								
	Private tubewell			Shared tubewell			Public tubewell		
	BL	ML	EL	BL	ML	EL	BL	ML	EL
Women	97.0	95.3	94.2	96.1	95.5	93.4	80.6	88.4	81.8
Others	3.0	4.7	5.8	3.9	4.5	6.6	19.4	11.6	18.2
n	12868	13865	15371	11986	12350	8838	6898	5985	6224

BL=Baseline, ML=Midline, EL=End line

Cleanliness of tubewell platform

Women's responsibility of cleaning tubewell platform decreased in EL for households of all economic groups. The changes in the proportion of women involved in cleaning tubewell platform from BL to ML remained approximately similar in all economic groups. But the change from baseline to end line was significant showing a declining tendency in all economic groups (ultra-poor: 97% vs 94.4%; poor: 95.5% vs 93.8%; and non-poor: 93.5% vs 89.1%). On the other hand, the involvement of other members in cleaning tubewell platform increased in EL for all economic groups (Table 5.4).

Table 5.4. Women's responsibility regarding cleaning of tubewell platform (%)

Status	Economic status								
	Ultra poor			poor			Non-poor		
	BL	ML	EL	BL	ML	EL	BL	ML	EL
Women	97	97.2	94.4	95.5	95.5	93.8	93.5	93.9	89.1
Other members	3	2.8	5.6	4.5	4.5	6.2	6.5	6.1	10.9
n	1419	1599	1237	2628	2826	1739	7324	7608	9876

BL=Baseline, ML=Midline, EL=End line

Determinants of water safety practices at household level

Two separate models considering safety indicators, such as, concrete-built platform (model I) and cleanliness of tubewell platform (model II) were used to discover the determinants of the water safety practices at household level. A number of independent factors potentially associated with these two models were examined. Probability of practicing water safety measures among the socioeconomically poor groups had been tested compared to the better-off by logistic regression. Women who ever attended in schools had higher probability of having concrete-built and cleaned platform (OR = 1.54, CI_{95} = 1.49-1.59; OR = 1.4, CI_{95} = 1.36-1.46) than those who never attended. The difference between the poor and ultra poor in terms of practicing water safety measures was found statistically insignificant. On the other hand, the non-poor were more likely to build concrete platform and to clean the platform respectively (OR = 1.46, CI_{95} = 1.39-1.54; OR = 1.19, CI_{95} = 11.13-1.26) compared to the ultra poor. The households with ownership of radio and/or TV at

homes had higher probability of having concrete-built and cleaned platform (OR = 2.5, CI_{95} = 2.08-2.22; OR = 1.53, CI_{95} = 1.47-1.58). Non-farming households were more tended to build concrete platform and to clean the platform (OR = 1.4, CI_{95} = 1.37-1.48; OR = 1.17, CI_{95} = 1.13-1.22) than the farming households. Moreover, the survey years were taken into account to measure odds ratio (OR) indicating change in water safety practices from BL to ML and to EL. While the five-year WASH programme approached towards the end, the probability of building concrete platform increased at EL (OR = 2.36, CI_{95} = 12.26-2.45) compared to ML (OR = 1.31, CI_{95} = 1.26-1.36). Similarly, probability of cleaning tubewell platforms improved at EL (OR = 4.70, CI_{95} = 4.51-4.90) compared to ML (OR = 1.67, CI_{95} = 1.60-1.74) (Table 5.5).

The adjusted linear regression model shows similar results (Table 5.6). Judging from the Wald values of the estimated parameters for both model I and II, it appeared that water safety practice increases with the increase in programme implementation period followed by better economic status, access to media (radio and/or television) and higher level of education of women. Besides, service of household head at both the models (I & II) showed a positive association with the safety practices. Farming and poor economic statuses had reverse association with water safety practices.

Table 5.5. Logistic regression model showing associated factors of practicing water safety measures

	Water safety practices by the women at household level							
	Model I				Model II			
	Concrete-built platform				Platform cleanliness			
	Adjusted OR	$CI_{95\%}$	p-value	Wald	Adjusted OR	$CI_{95\%}$	p-value	Wald
Education of women								
Never schooling	1				1			
Ever schooling	1.54	1.49-1.59	0.000	24.53	1.40	1.36-1.46	0.000	18.77
Households' economic status								
Ultra poor	1				1			
Poor	0.99	0.94-1.05	0.867	-0.17	0.98	0.92-1.03	0.416	-0.81
Non poor	1.46	1.39-1.54	0.000	14.32	1.19	1.13-1.26	0.000	6.53
Access to media at home								
No	1				1			
Yes	2.15	2.08-2.22	0.000	43.41	1.53	1.47-1.58	0.000	23.41
Occupation of household head								
Farming	1				1			
Non-farming	1.4	1.37-1.48	0.000	18.54	1.17	1.13-1.22	0.000	8.30
Survey period								
Baseline (BL)	1				1			
Midline (ML)	1.31	1.26-1.36	0.000	12.72	1.67	1.60-1.74	0.000	23.45
End line (EL)	2.36	2.26-2.45	0.000	41.97	4.70	4.51-4.90	0.000	72.83

Table 5.6. Linear regression model examining associated factors of water safety practices at household level

Factors	Women's water safety practices at household level			
	Model I		Model II	
	Concrete-built platform		Cleanliness of TW platform	
	ß	Wald	ß	Wald
Education				
Education of women (yes=1, no=0)	0.126 ***	10.748	0.187***	27.466
Perceived economic status				
Deficit (yes=1, no=0)	-0.242***	15.063	0.008	0.020
Surplus (yes=1, no=0)	0.437***	98.338	0.069	2.472
Household economic status				
Ultra poor (yes=1, no=0)	-0.038	0.479	-0.161***	9.942
Poor (yes=1, no=0)	-0.162	12.420	-0.000	0.000
Occupation of household head				
Service (yes=1, no=0)	0.168**	6.118	0.233***	10.945
Farming (yes=1, no=0)	-0.144***	11.201	-0.038	0.856
Access to media at home				
Radio (yes=1, no=0)	0.136***	8.259	0.249***	29.739
Television (yes=1, no=0)	0.319***	69.579	-0.087**	5.358
Survey periods				
Midline (2009) (yes=1, BL=0)	0.361***	59.375	0.832***	429.932
End line (2011) (yes=1, BL=0)	1.480***	1086.717	1.069***	643.087
N	17,277		17,277	
Constant	-1.727***	989.341	0.032	0.446
R^2		0.10	0.147	

***, ** indicate 5% and 10% level of significance

Hygienic management of drinking and cooking water

Covering water vessels during transportation

Across the surveys, it was found that the ultra-poor increasingly tended to cover water vessels during transportation for both drinking (BL 15.3%, ML 24.6%, EL 30.7%) and cooking water (BL 12.8%, ML 18.3%, EL 20.7%) (Table 7). In case of the poor and non-poor, the similar tendency of covering water vessels was observed across the surveys as the proportion increased from BL to ML and to EL.

Covering water vessels during storage

In case of covering stored water both for drinking and cooking purposes, the ultra-poor showed growing tendency of covering water vessels over the years (drinking water: BL 31.3%, ML 37.7%, EL 38.6%; and cooking water: BL 20.5%, ML 25.8%, EL 28.2%). But the condition was different for the poor, as the behavior of covering water vessels did not always show increasing trend across the surveys (Table 6.7).

Table 5.7. Status of covering water vessels during transporting and storing water for drinking and cooking (%)

	Economic status								
	Ultra poor			Poor			Non poor		
Status	BL	ML	EL	BL	ML	EL	BL	ML	EL
Covered water vessels (for drinking)									
Transportation	15.3	24.6	30.7	17.8	26.5	26	19.1	28	31.5
Storage	31.3	37.7	38.6	31.2	38	32.3	30.8	39.4	35.8
Covered water vessels (for cooking)									
Transportation	12.8	18.3	20.7	15.8	22	18.9	14.3	19.9	21.1
Storage	20.5	25.8	28.2	24.5	30	23.9	22.8	28.4	25.2
n	4959	4959	3361	7115	7115	4964	14330	14330	18079

BL=Baseline, ML=Midline, EL=End line

Time spent in water collection

There was varying time spent in water collection from shared tubewells (Table 5.8). The result was shown based on EL data only as a matter of data availability. Most of the households (91%) could collect water at homes within 10 minutes. About 4.7% households spent 20 minutes in water collection. However, 3.6% households had tubewell within the premises of same households. Thus time spent in such case was not considered.

Table 5.8. Time spent in water collection from shared tubewells (only in EL survey)

Time spent (minute)	Households (%)
0 (within the same household)	3.6
10	91
20	4.7
60	0.7
n	8838

Perception on water purification and prevention of waterborne diseases

The respondents expressed varying opinions about the ways of water purification. Majority of respondents in all surveys (BL 67.9%, ML 77.6%, and EL 74.7%) reported water could be purified by boiling. The proportion of respondents replying water purification by applying medicine increased across the surveys (BL 11.2%, ML

16.8%, and EL 27%). The proportion of respondents answering water purification by filtering decreased from BL to ML (7.3% vs 6.9%), but increased 20.9% at EL compared to BL. On the other hand, the proportion of respondents who did not know about water purification declined significantly across the surveys (BL 20.9%, ML 13.8%, and EL 3.7%) (Table 5.9).

Table 5.9. Respondent's opinions regarding water purification (%)*

Opinions	BL	ML	EL	p-value		
				BL vs ML	ML vs EL	EL vs BL
Boiling	67.9	77.6	74.7	0.001	0.001	0.001
Applying medicine	11.2	16.8	27	0.001	0.001	0.001
Filtering	7.3	6.9	20.9	0.291	0.001	0.001
Don't know	20.9	13.8	3.7	0.001	0.001	0.001
N	26404					

BL=Baseline, ML=Midline, EL=End line (*multiple response considered)

Higher proportion of respondents across the surveys indicated that waterborne diseases could be prevented by drinking pure water (BL 45.3%, ML 51.9%, and EL 57.2%). A number of respondents however expressed different opinion, as drinking tubewell water could help prevent waterborne diseases (BL 31.2%, ML 32%, and EL 20.8%). The proportion of respondents who did not know about waterborne disease prevention reduced significantly over the years are BL 22.2%, ML 15.5%, and EL 8.3%) (Table 5.10).

Table 5.10. Respondent's opinions about prevention of waterborne diseases

Opinion	BL	ML	EL	p-value		
				BL vs ML	ML vs EL	EL vs BL
Drinking pure water	45.3	51.9	57.2	0.001	0.001	0.001
Drinking tubewell water	31.2	32	20.8	0.052	0.001	0.001
don't know	22.2	15.5	8.3	0.001	0.001	0.001
Others	1.3	0.6	13.7	0.001	0.001	0.001
N	26404					

BL=Baseline, ML=Midline, EL=End line

Hygienic management of household latrines

If participation of male and female members was considered separately in hygienic management of household latrines, over 81% female members in all surveys (BL 88.3%, ML 90%, and EL 81%) was found to be involved in cleaning the latrines, while male participation was much lower (BL 4.2%, ML 2.8% and EL 3.2%) (Table 5.11). By considering the participation of both members (male and female) in cleaning household latrines, the proportion was found to be decreased from BL to ML (6.9% vs 6.6%), but increased significantly in 14.4% at EL compared to BL.

Table 5.11. Persons who usually cleaned the latrine (%)

Responsible persons	BL	ML	EL	p-value		
				BL vs ML	ML vs EL	BL vs EL
Male member	4.2	2.8	3.2	0.001	0.034	0.001
Female member	88.3	90	81	0.001	0.001	0.001
Both	6.9	6.6	14.4	0.308	0.001	0.001
Sweeper	0.3	0.4	1.2	0.621	0.001	0.001
Others	0.3	0.2	0.2	0.004	0.022	0.43
n	12506	15166	17150			

BL=Baseline, ML=Midline, EL=End line

Knowledge on the use of safe latrine

BRAC WASH programme disseminated some key messages related with hygienic use of safe latrines in intervention area. Respondents' knowledge on those messages was tested during household survey. Majority of the respondents knew about putting on sandal while using safe latrine (BL 81.5%, ML 91.3%, and EL 89.7%) and washing hands after defecation (BL 70%, ML 77.9%, and EL 79.6%). But the message of using enough water in cleaning and using safe latrines by all received relatively lower responses decreasing across the surveys (BL 27.1%, ML 18.6%, and EL 16.7%). Knowledge about holding Badna (latrine water pot) in right hand was usually reported by less number of respondents, but the proportion increased across the surveys (BL 9%, ML 15.1%, and EL 16.1%) (Table 5.12).

Table 5.12. Respondents' knowledge on the messages about safe latrine use (%)*

Reported responses	BL	ML	EL	p-value		
				BL vs. ML	ML vs. EL	BL vs. EL
Wearing sandal	81.5	91.3	89.7	0.001	0.001	0.001
Washing hands	70	77.9	79.6	0.001	0.001	0.001
Cleaning and using safe latrine	27.1	18.6	16.7	0.001	0.001	0.001
Holding pot in right hand	9	15.1	16.1	0.001	0.002	0.001
Others	8.6	2.9	11.2	0.001	0.001	0.001
N		26404				

BL=Baseline, ML=Midline, EL=End line (*Multiple responses considered)

Participation in WASH activities

The women in programme area were asked about the participation in BRAC WASH meeting. The analysis was based on ML and EL data. Only 14% of the respondents in both surveys replied that she or her family members participated in BRAC WASH meeting. The opinions from participants were increasingly accepted from ML (29.7%) to EL (33.2%) (Table 5.13).

Table 5.13. Participation in meeting and acceptance of opinions (%)

Status	BRAC WASH		
	ML	EL	P value
Participation in meeting Yes (%)	13.9	14.2	0.308
N		26404	
Acceptance of opinion Yes (%)	29.7	33.2	0.001
n	3674	3761	

DISCUSSION

The findings reveal that in all economic groups of WASH I intervention areas, women involvement in cleaning water and sanitation facilities (e.g., tubewell platform, latrine) reduced. Increased involvement of other family members in household water collection results in reduction of work load imposed on women only. Study conducted by Dey and Rana (2010) found that women's participation in productive activities increased as involvement of other family members in water handling increased. This brings opportunity for women to be involved in other productive activities. Due to household's workload, many of the rural women had less interest in attending WASH meeting regularly, and thus, lack of awareness about hygiene and health-related issues became explicit through some of their statements (Akter and Ali 2011). Another study by Kasmi and Segond (2007) depicts that women and girls spend several hours in carrying water which keeps girls often away from schooling and women from more productive and income-producing activities. While in our study, most women spend less time in water collection indicating water availability in programme areas.

Respondents' increased knowledge on safe water and associated safety measures corroborate their practice. They increasingly tend to follow hygienic practice in terms of covering water vessels during transportation and storage, since majority of them knew that drinking pure water could prevent waterborne diseases. This improvement in knowledge and practice might be the result of health education provided by BRAC WASH programme. Proper hygiene education makes the community aware about the right use, storage and disposal of water (Duncker 2000). Study conducted by Clasen and Cairncross (2004) depicts water management as health issue. Their study examines effect of water management on diarrheal diseases. The process of storing and using household water may have risk for microbial contamination, even if the water comes from treated piped sources (Jensen *et al*. 2002). Another study by Roberts *et al*. (2001) represents that stored water for long time may cause microbial contamination, as hands and the outer surface of collecting water vessels may carry fecal pathogens.

Socioeconomic characteristics of households such as education of women and access to media at home i.e. ownership of radio and/or TV have strong association

with water safety issues such as building concrete platform of tubewell, and cleaning its platform. Jalan et al (2004) explained that better informed households' with education and media exposure, and higher economic status showed more willingness in adoption of water safety practices. In addition their study also mentioned that adoption of water safety practices did not fully dependent on household's poverty status. The current study has also the similar observation depicting insignificant association between ultra-poor and poor group, but has significant association with non-poor group in practicing water safety measures. This difference may be due to income, awareness and their hygiene behavior. Role of socioeconomic characteristics such as income, education, access to information, and type of occupation driving hygiene behavior was also reported by Nauges and Berg (2006). They found that wealthier and better educated households were more likely to invest water safety practices.

The study conducted by Arsenic Policy Support Unit (APSU) of the Government of Bangladesh reveals that after receiving training, cleanliness around the tubewell improved (APSU 2006). The report also mentions that most of the respondents are able to identify possible pathways of contamination at source as well as during handling. This finding shows likeness with our study. Increased period of programme's intervention results in increased water safety practices as respondents get more chance to come into contact with programme's support such as cluster meeting for awareness building, and loan support. Out study has also observed strong association between the survey period as intervention increased from baseline to midline and to end line.

Our study finds that women became proactive in participating, and sharing opinion in WASH meeting. Their opinions are increasingly accepted in WASH meeting for decision making. They get opportunity to exchange their views in social gatherings, such as cluster meeting, to improve the quality of life. Women who cannot attend in the meeting, motivational home visits by BRAC WASH Committee help them know about hygiene practice and interventions from BRAC. Consequently, women express their opinion about getting loan for ownership of sanitary latrines for the sake of children's health, and family status (Akter and Ali 2011). Dey and Rana (2010) explained that increased women role in decision making process might have been the manifestation of both men and women's participation in BRAC WASH I community-based development work. The 2001 Ministerial Declaration of the Bonn International Conference on Fresh water emphasizes role of women in water-related areas stressing their broadened participation. Besides, the participation of both male and female members has been focused in managing water sources and sharing the benefits (UNEP 1997).

CONCLUSION

Findings of this study demonstrate that hygienic management of water improved at household level with the increasing involvement of other family members than women. Such positive changes open up the opportunity for women to be involved in other productive activities. However, women still play significant role in water

collection and cleaning of tubewell platform and household latrine. Even though their participation in cluster meeting is less, but sharing and acceptance of their opinion has increased. It indicates their active participation in community based development programmes by BRAC. It is also evident that ultra poor being prompt in hygienic handling of water such as covering water during transportation and storage. Besides, water safety practices including construction of concrete platform and its cleanliness were found insignificant among the poor and ultra poor, while it was significant with the non-poor. This finding emerges with the essentials that hygiene behavior of the poor and ultra-poor need more programme's attention. BRAC has special initiative to improve water and sanitation situation for the ultra poor stressing women's participation at all levels. To ensure greater participation of women in awareness building cluster meeting and to achieve the programme's target, equal participation of men beside women at all levels may play a crucial role.

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Chapter 6

Impact of BRAC water, sanitation and hygiene programme on water, sanitation and hygiene practices in educational institutions of Bangladesh

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ABSTRACT

This study assessed the impact of BRAC WASH I programme in schools under the intervention areas. Three consecutive surveys were conducted for the periodic evaluation of impact of BRAC WASH I programme. These include baseline (BL) survey in 2007, midline (ML) survey in 2009 and end line (EL) survey in 2011. During baseline survey 2,395 educational institutes were surveyed using a pretested questionnaire. However, for operational convenience during midline and end line surveys, the number of institutes was reduced to 1,487 and 1,189, respectively, but the same questionnaire was used to collect relevant data. Data were analyzed using computer software SPSS version 11.5 and chi-square test was performed to determine the level of significance in differences and changes occurred. Tubewell was found to be the source of drinking water in 100% study institutions. Overall, availability of sanitary latrines in educational institutions increased to 98% in end line from 91% in baseline. It was also found that the use of sanitary latrine among the students and teachers increased significantly in end line survey compared to baseline. The number of educational institutions having had installed separate latrines for boy and girl students significantly increased from 46% in baseline to 60% in end line. The absenteeism of girl students during menstruation was reported to reduce from 44% in baseline to 33% in end line survey. Improved water, sanitation and hygiene situation was found in educational institutions at end line survey.

INTRODUCTION

In most parts of the world school enrolment shows a rising trend in recent years. According to UNESCO, 668 million children enroll in primary schools (EFA Global Monitoring Report 2008) and this is approximately 84% of the total school-age children in the world. But unfortunately more than half of the schools lack access to clean drinking water, toilets and hygiene education (Global Health Council 2009). Thus, it can be assumed that more than 300 million children are spending daily school hours without having access to safe water or clean toilet. Availability of proper sanitation facility in schools is imperative for child health, growth and development, since children spend their considerable hours in schools each year (Lidonde 2004). Poor availability of safe water, sanitary latrines and poor hygiene practices in the schools may aggravate the incidence of water-borne diseases and intestinal parasite

infections among children. For example, diarrhoea is responsible for 1.5 million under-five child deaths each year (UNICEF and WHO 2009). Even though there is no data on the number of school-going children being affected by diarrhoea, its prevalence is reasonably common among children of all age groups. Children bear the greatest burden of diarrhoea, and protection of children from water, sanitation and hygiene related diseases might not only reduce the disease burden, but also would curtail the transmission of the disease to their family members and others in the community (Deen *et al*. 2008). Nonetheless, it is reported that 400 million children are often unable to learn effectively due to physical and mental impairment caused by intestinal helminth/parasites infection (Deworm the World 2011).

The physical and mental suffering of children induced by poor sanitation facility causes absenteeism and dropout among the students (IRC 2005). School dropouts and low literacy rate of girl students in many instances are often attributed to lack of privacy and separate latrine facility within the school premises (Lidonde 2004). Increased attendance of girls and their reduced dropout from schools have been reported due to availability of proper sanitation facility and hygiene management at the educational institutes (WaterAid 2009). Providing health education to the adolescent girl students on proper management of episodes of menstruation also reduces loss of their valuable study time (Lee *et al.* 2006). Teaching girls about health and hygiene during their primary education is important, since many of them become mother at young age (Freeman *et al*. 2009).

Schools are identified as a centre for development including hygiene and sanitation in society primarily by UNICEF in the last decade, who piloted the school-based water, sanitation and hygiene education programmes (Shordt 2004). It has been reported that 19% schools in Bangladesh had no water source, 28% had non-functional water source and 53% had functional water source. With respect to sanitation facility 6% schools had no latrine at all, 13% had a non-functional latrine, 25% had one latrine, and 56% had two or more latrines. There were separate latrines for girls and boys in 46% schools (Nahar and Ahmed 2006). In the educational institutes of Bangladesh, over 150 students use one latrine as opposed to 20-30 students in developed countries (The New Nation 2009). Nevertheless, there were 81,508 primary schools with approximately 16.5 million students in Bangladesh, while 6.4 million students enrolled in 18,770 secondary schools in 2009. In addition, there were also 9,475 madrasas or religious schools in the country (BANBEIS 2011). Hence, significant interventions are required to improve the WASH scenario in the educational institutions. To improve sanitation and hygiene facilities in schools the government of Bangladesh, UNICEF, BRAC, NGO-forum and several other NGOs have been implementing school sanitation programme. Nearly 5,000 schools are being reached with children, teachers, and parents been involved in assessment, resource mobilization, school planning, facilities improvement, and hygiene education using the child-to-child approach (Shordt 2004).

BRAC WASH I programme at school level

BRAC WASH Programme launched interventions in 2007 in educational institutes with two intervention protocols: (i) providing partial monetary support for construction of sanitary latrine in selected secondary level girls' schools and in the institutes of co-education with higher proportion of girl students, and (ii) offering health education covering water, sanitation and hygiene to the students, teachers and staff of all the institutes selected in the intervention areas (Arif and Ahmed 2010). Since the adolescent girls in the secondary schools were found to stay at home during menstruation due to unavailability of separate latrines in the schools, BRAC decided to support such schools to establish sanitary latrines for girls with adequate facility for menstrual hygiene.

Three educational institutes from each *union* (the lowest administrative unit of the government) are usually selected for support from the BRAC WASH programme where separate sanitary latrines for girls are not available. Presently Tk. 45,000 is allocated for construction of a sanitary latrine at the premise of an educational institute (Arif and Ahmed 2010); it is managed by a tri-partite purchase committee formed locally by the respective BRAC *upazila* accountant, BRAC WASH programme organizer in the area, and one member (usually a school teacher) from the school. The allocated money is spent for procuring hardware materials for sanitary latrine, water source and arranging waste management facility (e.g., dumping of the used sanitary pads). The community and school authority provide a half of the construction costs (Arif and Ahmed 2010).

Hygiene education is a strong component of school sanitation. Two teachers from each school are given one-day orientation on WASH intervention, and in turn they conduct general and menstrual hygiene education sessions for students based on a pre-planned roaster. Students undergoing sessions are encouraged to take their knowledge to their households and communities. Apart from this, BRAC designated staff conduct education sessions for the students (Kabir *et al.* 2010).

Apart from all these interventions, after construction of latrines in the schools a School Student Brigade, consisting of 24 students enrolling from class six to class nine, is formed by teachers and BRAC WASH employees. The school brigade is responsible for proper use and maintenance of latrines as well as the total cleanliness of the school premises.

BRAC WASH I programme, through the school sanitation promotion intervention, has completed installation of sanitary latrines in 3,655 secondary schools until March, 2011. Additionally, 4,400 school management committees and 3,655 school teachers have been oriented with hygiene education. For the formation of a school brigade in every school students from 14,814 schools have been trained by the BRAC WASH programme. However, to assess the effects of the interventions over time, BRAC Research and Evaluation Division (RED) carried out a baseline survey in 2006, a midline survey in 2009 and an end line survey in 2011.

OBJECTIVE

The overall objective of this study was to assess the changes that the BRAC WASH I programme brought in water, sanitation and hygiene in educational institutions under the programme areas compared to baseline status.

MATERIALS AND METHODS

Since the inception of BRAC WASH I programme three surveys were conducted 2007, 2009 and 2011 termed as baseline, midline and end line surveys respectively to evaluate the programme impact on water, sanitation and hygiene both at households and educational institutes. During the baseline survey 2,395 educational institutes were surveyed with pre-tested questionnaires to collect data on water, sanitation and hygiene situation. The head of the institute or a senior teacher in his/her absence was interviewed. However, during the midline survey the number of institutes was reduced to 1,487 for administrative conveniences, but the same questionnaire was used to collect data. To reduce the number of institutions during midline, only one institution was included in the study area from each category wherever several similar schools were found in operation in the same village. In such situation, the school with highest number of students was chosen. During the end line survey 1,189 educational institutes were surveyed in the same areas as it was done during the baseline and midline surveys. The surveyed institutions of different types were divided into six broad categories, viz. primary, BRAC school, secondary, higher secondary, madrasa and others. Variables from all the three surveys were analyzed and compared to find the impact of BRAC WASH programme in terms of safe water use, availability of water from water source, use of sanitary latrine by teachers, students, workers, physically observed the quality of latrines, hygiene practices, availability of separate latrines for girls, menstrual hygiene facility, reported absenteeism of girls in the schools during menstruation, etc. SPSS version 11.5 was used for data analysis and chi-square test was performed for determining statistical significance of any differences. The relative changes (RC) in WASH situation in midline or end line from baseline was calculated using the following formula,

$$\textit{Relative change (RC \%)} = \frac{Midline/endline\,status - Baseline\,status}{Baseline\,status} \times 100$$

RESULTS

In all the three surveys, majority (>60%) of the educational institutions were of primary level, for instance, government and private primary schools, BRAC non-formal primary and pre-primary schools. The secondary and above level educational institutions together with the madrasas constituted the most other type of educational institutions surveyed for assessing water, sanitation and hygiene situation (Table 6.1). The other types of surveyed educational institutions were community schools, vocational training schools, ethnic group schools, etc.

Table 6.1. Type of educational institutions surveyed during baseline, midline and end line surveys

Types of educational institution	Baseline (BL)		Midline (ML)		End line (EL)	
	N	%	N	%	N	%
Primary	1080	45.1	767	51.6	660	55.5
BRAC	445	18.6	254	17.1	130	10.9
Secondary	335	14.0	224	15.1	195	16.4
Higher secondary	48	2.0	18	1.2	14	1.2
Madrasa	461	19.2	182	12.2	160	13.5
Others	26	1.1	42	2.8	30	2.5
N	2395	100	1487	100	1189	100

An overwhelming majority of study educational institutions had tubewell (deep or shallow) or supply water for drinking. The number of institutions having no water source reduced significantly ($p<0.005$) over time from baseline to midline and end line survey (Table 6.2).

Table 6.2. Source of drinking water in educational institutions (%)

Sources	BL	ML	EL	RC, BL vs. ML	RC, ML vs. EL	RC, BL vs. EL
Tubewell (deep or shallow)/supply water	97.7	98.6	99.5	0.9	0.9	1.8
No water source	2.3	1.4	0.5	-39.1	-64.3	-78.3
N	2395	1487	1189	-	-	-

Note: Baseline = BL, Midline = ML, End line = EL, Relative change = RC.

Majority of the educational institutions (>80%) had water source within 150 ft from the main physical structure. However, the proportion of institutes having drinking water sources within 150 ft increased to 87% in end line from baseline (83%) and midline (83%) (Table 6.3).

Table 6.3. Distance of water source in educational institutions (%)

Distance of water source	Baseline	Midline	End line	RC, BL vs. ML	RC, ML vs. EL	RC, BL vs. EL
Less than 150 ft	83.0	82.9	87.3	-0.1	-18.0	5.2
More than 150 ft	17.0	17.1	12.7	0.6	-61.6	-25.3
N	2354	1467	1184			

Note: Baseline = BL, Midline = ML, End line = EL. Relative change=RC.

Proportion of educational institutes with own latrines in their campuses significantly increased to 98% in end line from baseline (91%) and midline (94%) ($p<0.005$). Except the educational institutes in 'other' category, the ownership of sanitary latrines increased over time (Table 6.4). Regardless of the type of institutions there was 7.2% relative increase of institutions having own latrines from baseline to end

line. It is worthy to mention that the relative increase of latrine ownership of the educational institutions was higher during midline to end line (4.3%) compared to that of baseline to midline survey (2.8%).

Table 6.4. Type of institutions having own latrines (%)

School types	BL	ML	EL	RC		
				BL vs. ML	ML vs. EL	BL vs. EL
Primary	98.3	98.4	99.4	0.1	1.0	1.1
BRAC school	49.3	59.7	82.7	21.1	38.5	67.7
Secondary	97.8	99.6	99.7	1.8	0.1	1.9
Higher secondary	98.8	100	100	1.2	0	1.2
Madrasa	90.6	95.6	98.8	5.5	3.3	9.1
Others	88	62.9	80	-28.5	27.2	-9.1
Total	91.3	93.9	97.9	2.8	4.3	7.2

Note: Baseline = BL, Midline = ML, End line = EL, Relative difference = RC.

There was a significant increase in the number of institutions with separate latrines for boy and girl students from 46% in baseline to 60% in end line survey (Table 6.5). However, the relative change in the increase between baseline and end line was higher by 30% than the chnage in increase between baseline and midline as well as midline and end line (20% vs. 9%)

Table 6.5. The proportion of institutions (%) having separate latrines for girls and boys

Separate latrines	BL	ML	EL	RC		
				BL vs. ML	ML vs. EL	BL vs. EL
Yes	46.2	55.4	60.2	19.9	8.7	30.3
No	53.8	44.6	39.8	-17.1	-10.7	-26.0
n	1810	1170	1054	-	-	-

Note: Baseline = BL, Midline = ML, End line = EL, Relative change =RC.

Increasing trend of using sanitary latrines was found among both boy and girl students in the educational institutions from baseline to end line surveys (Table 7.6). Similarly the proportion of institutions where neither the boy nor girl students used sanitary latrine also reduced over time and it was minimum during the end line survey. The relative change of baseline and midline for both boys and girls using sanitary latrines was 12.2%, while the same for midline to end line was 5%. This is an indication that the improvement during the initial stage of the BRAC WASH programme was higher than the later stage. Nevertheless, the tendency of only either boy or girl students using sanitary latrine reduced significantly from baseline to end line. The diminishing tendency of boys or girls only using sanitary latrines during midline and end line surveys might be attributed to the less proportion of only boys or only girls' institutions present in the samples compared to baseline survey.

Table 6.6. Status of sanitary latrine use among students in the educational institutions (%)

Sanitary latrine use among students	BL	ML	EL	RC		
				BL vs. ML	ML vs. EL	BL vs. EL
Both boys and girls using sanitary latrine	71.4	80.1	84.1	12.2	5.0	17.8
Boys using sanitary latrine	3.8	1.2	1.4	-68.4	16.7	-63.2
Girls using sanitary latrine	5.1	3.4	2.9	-33.3	-14.7	-43.1
None of boys and girls using sanitary latrine	19.7	15.3	11.5	-22.3	-24.8	-41.6
N	2363	1474	1187	-	-	-

Note: Baseline = BL, Midline = ML, End line = EL, Relative change = RC.

Similar to the increased trend of using sanitary latrines among students significant increase of institutions were found in the end line survey where both male and female teachers used sanitary latrine compared to baseline and midline surveys ($p<0.005$). From baseline to end line there was considerable reduction in the number of institutions wherein either male or female teachers use sanitary latrines. Significant difference was found in the number of institutions where none of male and female teachers used sanitary latrines in all the three surveys (Table 6.7).

Table 6.7. Status of sanitary latrine use among teachers in the educational institutions (%).

Sanitary latrine use among teachers	BL	ML	EL	RC		
				BL vs. ML	ML vs. EL	BL vs. EL
Both male and female teachers using sanitary latrine	58.2	64.4	69.4	10.7	7.8	19.2
Male teachers using sanitary latrine	21.4	14.6	12.1	-31.8	-17.1	-43.5
Female teachers using sanitary latrine	16.0	17.6	14.4	10.0	-18.2	-10.0
None of male and female teachers using sanitary latrine	4.4	3.4	4.1	-22.7	20.6	-6.8
N	2118	1369	1129	-	-	-

Note: Baseline = BL, Midline = ML, End line = EL, Relative change = RC.

The sanitation and hygiene situation in the educational institutions surveyed shows improvement from baseline to midline and end line surveys in terms of increased number of institutions where latrines were reported to clean regularly, soap was used for hand washing, specific place was available for disposal of menstrual rags, teachers and students received hygiene education (Table 6.8). It is remarkable that from baseline to end line survey there was reduction in the number of institutions where girls reported to stay home during menstruation. However, the relative change from baseline to midline (-32.7%) in this regard shows reduction of absenteeism, while the same from midline to end line shows increase of absenteeism (12.6%).

Table 6.8. Reported indicator values for sanitation and hygiene situation (%)

Indicators reported	BL	ML	EL	RC		
				BL vs. ML	ML vs. EL	BL vs. EL
Cleaning latrines regularly	96.6	97.6	97.5	1.0	-0.1	0.9
Hand washing with soap after defecation	64.9	84.9	82.8	30.8	-2.5	27.6
Specific place available for disposal of menstrual rags for girl students	4.2	12.2	18.7	190.5	53.3	345.2
Girls stay at home during menstruation (responded by teachers)	43.7	29.4	33.1	-32.7	12.6	-24.3
Teachers received hygiene education	25.3	66.7	61.2	163.6	-8.2	141.9
Students received hygiene education	50.0	71.8	67.1	43.6	-6.5	34.2

Note: Baseline = BL, Midline = ML, End line = EL, Relative change = RC.

The latrines in the educational institutions were observed physically during all the three surveys and several indicators were used to study the quality of latrines from hygiene point of view. It was revealed that there was significant increase in the number of quality latrines since higher proportion of latrines were found clean, without odour and residual fecal, with water, soap and slipper available inside or nearby the latrines (Table 6.9).

Table 6.9. Physically verified indicators for cleanliness of latrines in the educational institutions (%)

Indicators observed and physically verified	BL	ML	EL	RC		
				BL vs. ML	ML vs. EL	BL vs. EL
Latrine was cleaned	29.7	53.5	68.1	80.1	27.3	129.3
No odour was found in the latrine	34.2	56.6	67.4	65.5	19.1	97.1
No residual fecal was found in the latrine	46.6	68.2	75.5	46.4	10.7	62.0
Sufficient water was kept nearby or inside the latrine	45.7	57.2	59.5	25.2	4.0	30.2
Soap was kept nearby or inside the latrine	11.7	29.3	43.7	150.4	49.1	273.5
Slipper was found available nearby or inside the latrine	1.6	4.7	9.2	193.8	95.7	475
Surrounding of the school premises was found clean	24.6	35.0	29.4	42.3	-16.0	19.5
N	2395	1487	1189	-	-	-

Note: Baseline = BL, Midline = ML, End line = EL, Relative change = RC.

During all the three surveys soap was found to be mostly used material for hand washing in the educational institutions (Table 6.10). Improvement was found in hand washing behavior since there was significant increase in the use of soap for hand washing from baseline to end line but decrease in the use of ash, soil and only water for hand washing.

Table 6.10. Materials used for hand washing after defecation in the educational institutes as reported (%)

Hand washing after defecation with	BL	ML	EL	RC		
				BL vs. ML	ML vs. EL	BL vs. EL
Soap	64	84.9	82.8	32.7	-2.5	29.4
Ash	6.2	4	2	-35.5	-50.0	-67.7
Soil	17.4	6.5	5	-62.6	-23.1	-71.3
Only water	17.6	6.3	11.9	-64.2	88.9	-32.4
Don't wash hands	1.5	0	0	-100.0	0	-100.0
N	2395	1487	1189	-	-	-

Note: Baseline = BL, Midline = ML, End line = EL, Relative change = RC.

The study respondents mostly (>95%) mentioned that the training on hygiene education was necessary for teachers and members of school managing committee (SMC) for the improvement of hygiene situation in the educational institutions during all the three surveys (Table 6.11).

Table 6.11. Felt need of training of teachers and school committee members on hygiene

Response to the necessity of training on hygiene	BL	ML	EL	RC		
				BL vs. ML	ML vs. EL	BL vs. EL
Yes	96.0	95.6	97.1	-0.4	1.6	1.1
No	4.0	4.4	2.9	10.0	-34.1	-27.5
N	2395	1487	1189	-	-	-

Note: Baseline = BL, Midline = ML, End line = EL, Relative change = RC.

During all the three surveys the respondents also gave opinion regarding the means of making the teachers and SMC members aware of hygiene practices in the educational institutions. Coordination and discussion between the SMC members and teachers about hygiene, training them on hygiene, regular meeting, seminar and workshop were the most frequently opined means for increasing hygiene awareness among teachers and SMC members (Table 6.12).

Table 6.12. Opinions regarding how the teachers and school committee members could be made aware of hygiene, multiple responses (%)

Opinions given	BL	ML	EL
Through coordination and discussion between school committee and teachers	38.8	51.8	21.8
Compulsory hygiene education for teachers and school committee members	38.2	18.3	23.4
Regular meetings	20.7	26.8	25.6
Seminar, workshop etc.	4.9	7.7	38.1
Others	5.8	9	8.3
N	2395	1487	1189

Note: Baseline = BL, Midline = ML, End line = EL

Data on opinions regarding the ways of making the students and their families aware of hygiene reveal that meeting and discussion about the benefits of hygiene practices with the students were frequently mentioned in all the surveys. Sensitizing the own family members by the students themselves has been stressed more during midline and end line surveys. The respondents also mentioned that training of the students about hygiene practices was necessary apart from seminar, drama and other interactive means of promoting hygiene (Table 6.13).

Table 6.13. Opinions regarding how the students and their family members could be made aware of hygiene, multiple responses (%)

Opinions given	BL	ML	EL
Meeting and discussion about the benefits of hygiene with students	46.2	45.4	41.5
Sensitizing the family members by students	39.8	58.9	50.2
Training students about hygiene and monitoring	32.6	30.9	35.1
Seminars, posters, drama, video etc.	10	6.5	19.2
Cannot mention	0.4	0.5	0.1
N	2395	1487	1189

Note: Baseline = BL, Midline = ML, End line = EL

DISCUSSION

The sample size of three surveys is quite representative of the educational institutions covering students of different age groups. The higher proportion of primary and secondary level schools is significant to study the hygiene practices. The study reveals that tubewell water has been used for drinking in all the educational institutions surveyed and in >80% of the cases the water source was situated within 150 ft of the schools. Nahar and Ahmed (2006) reported that 19% of the schools had no source of water in Bangladesh. Hence, the availability of water source in the educational institutions surveyed has been relatively promising.

It is remarkable that almost all the primary, secondary and higher secondary schools have their own sanitary latrines. There has been improvement of having own latrines in BRAC schools in the end line survey compared to baseline and midline surveys. But still more interventions are needed to reach 100% sanitary latrine coverage in BRAC schools. Nahar and Ahmed (2006) reported that 6% of the schools had no latrines in Bangladesh. The overall sanitary latrine scenario hence has been improved in terms of availability of latrines as well as their use among teachers and students. Besides, the significant increase of existence of separate latrines for girls and boys might be attributed to the impact of BRAC WASH programme interventions.

The BRAC WASH programme activities played important role in addressing the felt needs of adolescent girl students, since the teachers perceived that absenteeism of girls during their menstruation reduced significantly due to availability of facilities for disposal of sanitary rags. The direct impact of this improvement has been observed in the reduction of absenteeism of girl students. However, concern remains as

majority educational institutes have no specific place for disposal of menstruation rags. Girls who have reached menstrual age may be deterred from school by inadequate sanitation facilities in place. WaterAid Bangladesh found that a school sanitation project with separate facilities for boys and girls helped boost girls' school attendance 11% per year on average from 1992 to 1999 (Shordt 2004). Hence, focuses should be directed to improve these facilities as well as the provision of separate sanitation for girls and boys. This may also provide congenial environment for the girls against sexual harassment (IRC 2005). Other studies show that in Bangladesh the enrolment of girls has increased markedly and gender gaps eliminated (Schurmann 2009), and gender parity has achieved in literacy rate (BBS 2008). The improved sanitation facilities in the educational institutes supported by the BRAC WASH programme might promote an enabling environment for education.

The improvements of the reported and physically observed indicators for quality of latrines from baseline to end line survey in the institutions might be the impact of BRAC WASH interventions promoting hygiene among teachers and students through hygiene education and training. Another important feature of the intervention is that as students have an opportunity to learn and practice sanitation and hygiene-related skills at the institutes, which is likely to continue throughout life. The hand-washing behaviour of students and children with soap also increased significantly after implementing BRAC WASH programme in the educational institutes. Evidence shows that skill-based health education related to healthy lifestyles, which is offered at the school might sustain during schooling and throughout life (Burgers 2000). Changes in sanitation and hygiene practices might have impact in reducing burden of waterborne illness in the community. This needs to be studied in BRAC WASH programme areas. Research indicates that unsafe sanitation and hygiene practices increase burden of various diseases (Prüss-Üstün *et al.* 2004). Rosen *et al.* (2009) showed that hand washing intervention in pre-school changed educator beliefs, attitudes, knowledge and self-efficacy, which has positive effects on students. Nevertheless, environment surrounds the child and children's health is sensitive to the environment (Neira *et al.* 2008). Educational practices and methods which build knowledge and understanding while encouraging empowered participation of children and young people can significantly decrease severity of impacts, most notably in cases related to environmental health threats (Penrose and Takaki 2006).

Partial financial incentive offered by BRAC for procuring hardware devices encouraged school authorities to improve their sanitation facilities. In future monitoring for sustained use of sanitary latrines and keeping the hygiene practices continuing will be necessary as only establishing latrines and giving hygiene education might not be sufficient to make a real change in the hygiene behaviour. The lack of adequate infrastructural facilities for sanitation is primarily attributable to financial constraint. However, both infrastructural development and health education should be continued as more than quarter of the students and teachers did not receive health education advices.

CONCLUSION

The water, sanitation and hygiene situation in the educational institutions of BRAC WASH intervention areas have been improved at the end of the programme. Though the programme does not provide direct support for ensuring safe water supply in the institutions, however, the hygiene education given to the teachers and students evidently created awareness about the necessity of drinking safe water. Nevertheless, programme interventions for constructing sanitary latrines and giving hygiene education have been able to improve sanitation situation and hygiene behaviour of students and teachers.

RECOMMENDATIONS

The following recommendations might be considered for ensuring the sustainability of present achievements:

- Continuation of BRAC WASH intervention for another one year or more in the intervention areas might help reach 100% sanitation coverage in the educational institutions.
- Routine monitoring of proper use of sanitary latrine and practice of hygiene education is essentially needed to ensure sustained use of sanitary latrines and hygiene practice.
- Direct intervention by BRAC WASH programme ensuring arsenic-free water supply in educational institutions may help further improve water safety.

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Chapter 7

Impact of BRAC water, sanitation and hygiene programme on the prevalence of water-related diseases in Bangladesh

Fazlul Karim and Nepal C Dey

ABSTRACT

In Bangladesh, over 50% of acute illnesses are attributable to poor water supply, sanitation and hygiene practices. To improve the situation, BRAC has been implementing water, sanitation and hygiene programme in 150 *upazilas* of Bangladesh since mid-2006 in phases. The BRAC Research and Evaluation Division (RED) conducted baseline (2007), midline (2009) and end line (2011) surveys in 50 *upazilas* of the first phase. This study assessed the impact of the programme on water-related disease occurrence among study population. Each survey was conducted on 30,000 households - 600 from each study sub-district, samples being drawn in two steps using the 30-cluster sampling method: (i) 30 villages were selected from each *upazilas*, and (ii) from each village, 20 households were drawn systematically. Data were collected through face-to-face interview using pre-tested questionnaire, and were analyzed using SPSS software. The matched households in all the three surveys (26,404 in each survey) were included in the analysis. Chi-square and t-tests compared the differences between indicator values, and binary regression identified the determinants of outcome variable. The prevalence of water-related diseases significantly reduced from 9.4% in baseline to 7.1% in midline and to 2.3% in end line (p=.000). Under-five children were more likely to have inflicted with water-related diseases across the surveys. Users of safe water for bathing were less likely to have water-related diseases. Higher score on hand-washing by soap/ash at critical times was associated with reduced prevalence of water-related diseases at end line survey. Effective intervention on safe water, sanitation and hygiene practice has potential to reduce water-related disease burden in the community.

Keywords: Prevalence, Waterborne Disease, WASH

INTRODUCTION

Poor water supply profoundly impacts health by causing acute infectious and/or chronic diarrhea, and non-diarrhoeal diseases. Worldwide, about 2.4 million deaths (4.2% of all deaths) could be prevented each year if everybody practiced appropriate hygiene and had good, reliable sanitation and drinking water (PrÜss *et al.* 2008). Most of the excess disease burden in low-income countries (LIC) falls on young children—17% of all deaths in under-five children are attributed to diarrhoea (Clasen *et al.* 2007). Sufficient quantity and quality of water is also linked with good health of population, in turn, an insufficient water supply prevents good sanitation and hygiene. Consequently, improvements in various aspects of water supply represent important opportunities to enhance public health (Hunter *et al*. 2010), whereas millions of people in Bangladesh use hand pumps or tuberwells that provide water tied with arsenic (Khan *et al.* 2007). At household level, maintenance of water hygiene during collection, storage and drinking play a role in improved public health. Likewise, hand-washing with soap at critical times, and before and after meals reduces risk of endemic diarrhoea, respiratory and skin infections, while face-washing prevents trachoma and other eye infections.

Bangladesh, one of the most densely populated countries in the world, with nearly 158 million people (Indexmundi 2011), also faces enormous challenges in ensuring safe water, sanitation and hygiene. The incidences of waterborne and sanitation-related diseases are common due to contaminated drinking water sources, lower sanitation coverage and poor sanitation practice (WaterAid 2006, UNICEF 2008). Though Bangladesh has achieved considerable progress in safe water supply and sanitation, the challenges of gaining 100% access to safe water, sanitation and hygiene practice are particularly difficult, especially in the face of arsenic contamination of most underground water sources.

People have very limited understanding of linkage between poor hygiene and diseases (WaterAid 2003). To achieve the successful benefits of safe water and sanitation, people should know about the links between diseases and unsafe hygiene practices (WaterAid 2009). In comparison to water and sanitation, hygiene education received less attention from the inception, resulting in poor health benefit. Hygiene education focuses some issues like washing hands with soap can reduce the risk of diarrhoeal diseases and respiratory tract infection (Bartram *et al.* 2010). Lack of awareness and proper understanding about the problem and its possible consequences may be a barrier towards improved water, sanitation and hygiene practices, resulting in high morbidity and mortality. Effective behaviour change in different aspects of water, sanitation and hygiene (e.g., safe water collection, storage and use, hand-washing at critical times, reduced open defecation, safe disposal of child faeces, etc.) could be main concern for improved health status.

The study objective

The objective was to assess the impact of the WASH programme on the prevalence of water-related diseases among population in the programme catchment areas.

MATERIALS AND METHODS

The study embraced a cross-sectional comparative design between baseline (BL), midline (ML) and end line (EL) statuses. Please see details in chapter 1. The sample comprised of 30,000 households— 600 from each study *upazila* for each of BL, ML and EL.

Outcome variable

Self-reported (but not medically confirmed) water-related diseases such as diarrhoea, dysentery, jaundice, worm infections, polio, typhoid, and skin diseases were considered as marker of water-related diseases.

Independent variables

Age, sex, household head's education, household head's major occupation, perceived economic condition of households, place of defecation, sources of water used for different purposes, hand-washing with soap/ash at different critical times, status of tubewell platform construction, cleanliness of tubewell platform and latrines, preservation of slipper for wearing during commuting to and from latrines, preservation of sufficient water nearby latrines for use, preservation of soap/ash nearby latrines for hand-washing, domestic waste disposal in fixed place/hole, survey periods (2006/07, 2009 and 2010/11) were considered as independent variable. Age was categorized into two groups such as <5 and ≥5 years. Household heads who reported of never attending schools were considered as never schooling, who attended any grade at primary level defined as primary schooling, who attended any grade at high schools considered as high schooling, and who completed high schooling or more were considered as SSC and above schooling. Perceived economic status of a household was stratified as deficit, and non-deficit and/or surplus. Occupations of household heads considered were labour, agriculture, service and business.

Scoring for hand-washing at critical times— Use of ingredients/detergents (e.g., soap, ash, mud, etc. with water) for hand-washing at critical times varied between individuals. Likewise, health benefits of these ingredients/detergents are also variable. Thus, analysis requires scoring for the use of individual items for hand-washing depending on the relative significance for making a sense out of them (Bose *et al.* 2009). For this, we assigned '0' when none washed hands at all; '1' to those washed one hand by water and/or mud; '2' to those washed both hands by water and/or mud; '3' to those washed one hand by soap/ash; and '4' to those washed both hands by soap/ash.

We considered seven critical times for washing hands, which include before meals, after defecation, after cleaning a children's stool, before feeding a child, before cooking, after meals, and before serving food. There was a probability of a minimum score of '0', and a maximum of 28. Thus, we created a variable namely 'Score hand-washing with soap/ash at critical times' for the binary logistic regression.

RESULTS

Sample characteristics

Table 7.1 shows the sample characteristics by individual survey (BL, ML and EL). The proportion of male-female population was identical across the different surveys. Overwhelming majority of the population (85 to 92%) belonged to ≥5 years of age group, whilst the under-five population (children aged <5 years) was higher (15%) for ML compared to BL (11%) and EL (8%). The proportion of never schooling population was almost similar across the surveys, ranging from 32 to 35%. Over 45% of household heads across the surveys never went to school. Most (33%) household heads were engaged in agricultural activities, followed by labour ranging from 31 to 33% across the different surveys. Table 7.2 shows the economic condition of sample households by individual survey. The proportion of households with perceived deficits in annual income compared to needs was higher (43%) in ML than 39% in BL and 38% in EL. The proportion of ultra poor households was identical at 18.8% for BL and ML, and it was 12.7% for EL. Likewise, the proportion of poor households was lowest (18.8%) in EL compared to BL and ML (26.9% each).

Prevalence of water-related diseases

The reported prevalence of water-related diseases significantly reduced from 9.4% in BL to 7.1% in ML and 2.3% in EL (p=.000) (Table 7.3). The reduction in males and females across the different surveys was also pronounced. Table 7.4 shows the population by prevalence of specific water-related diseases under two broad categories such as waterborne and water-washed diseases. Reduction in the prevalence of specific diseases under the category of waterborne diseases was highly significant across the surveys, except for typhoid in the EL. Reduction of prevalence of specific diseases under water-washed category was also highly pronounced across the different surveys.

Table 7.5 shows the reported prevalence of water-related diseases by different background characteristics of study population and individual survey period. Though the prevalence of water-related diseases reduced significantly among both under-five and ≥5 years of age groups across the surveys, the prevalence continued to be highly pronounced among the under-five children in each surveys. Analysis by education of household heads showed a significant reduction of water-related diseases prevalence across the different surveys among population belonging to both ever and never schooling of household heads. The difference of prevalence between ever and never schooling of household heads within the individual survey was significant only for the BL.

Table 7.1. Sample characteristics by individual survey

Indicators	Surveys		
	BL (2007)	ML (2009)	EL (2011)
1	2	3	4
Households matched for three surveys	26404	26404	26404
Population by sex			
% Male (number)	49.9 (60515)	50.0 (60054)	50.4 (60871)
% Female (number)	50.1 (60641)	50.0 (60081)	49.6 (60001)
Total % (number)	100.0 (121156)	100.0 (120135)	100.0 (120872)
Population by broad age groups			
% <5 years (number)	11.1 (13427)	15.0 (18063)	8.1 (9753)
% ≥5 years (number)	88.9(107729)	85.0 (102072)	91.9 (111119)
Population ≥6 years or more by education	*n=105314*	*n=99645*	*n=109328*
% Never schooling (number)	34.8 (36664)	32.5 (32404)	32.3 (35362)
% Ever schooling (number)	65.2 (68650)	67.5 (67241)	67.7 (73966)
Household heads by education	*N=26404*	*N=26404*	*N=26404*
% Never schooling (number)	45.5 (12006)	45.9 (12108)	45.1 (11920)
% Ever schooling (number)	54.5 (14398)	54.1 (14296)	54.9 (14484)
Household heads by main occupation (number)	*N=26404*	*N=26404*	*N=26404*
% Agriculture	33.2 (8778)	32.7 (8622)	33.4 (8827)
% Labour (skilled/unskilled)	32.6 (8598)	30.5 (8047)	30.9 (8160)
Service	6.5 (1707)	5.9 (1571)	6.1 (1623)
% Business	16.9 (4474)	15.8 (4168)	14.5 (3821)
% Household work	7.0 (1846)	10,4 (2735)	9.5 (2505)
% Others	1.6 (423)	1.8 (480)	1.7 (462)
% Disabled	2.2 (578)	3.0 (781)	3.8 (1016)

Parentheses indicate cell frequency. BL=Baseline, ML=Midline and EL=End line

Table 7.2. Economic conditions of sample households by individual surveys

Indicators	Survey year		
	BL *(N=26404)*	ML *(N=26404)*	EL *(N=26404)*
1	2	3	4
Households by perceived annual economic condition			
% Deficit (number)	38.5 (10169)	43.3 (11442)	37.8 (9975)
% Non-deficit and/or surplus (number)	61.5 (16235)	56.7 (14962)	62.2 (16429)
Households by poverty status			
% Ultra poor (number)	18.8 (4959)	18.8 (4959)	12.7 (3361)
% Poor (number)	26.9 (7115)	26.9 (7115)	18.8 (4994)
% Non-poor (number)	54.3 (14330)	54.3 (14330)	68.5 (18079)

Figures in parentheses indicate cell frequency. BL=Baseline, ML=Midline and EL=End line

Reduction in the reported prevalence of water-related diseases occurred among population in each survey from BL through EL across the different occupation groups of household heads. Households of all economic strata in terms of ultra poor, poor and non-poor experienced significant reduction in the prevalence of water-related diseases across the different surveys. The proportion of ultra poor with prevalence of water-related diseases was significantly higher than the non-poor across the different surveys. Households' perceived economic status also reveals a significant reduction in the prevalence from BL through EL. Here also, the deficit households had a significantly higher prevalence than non-deficit and/or surplus households in each survey (Table 7.5).

The prevalence of water-related diseases significantly declined from BL to ML, ML to EL and BL to EL among population using safe water for different purposes (Table 6). When compared between safe and unsafe water users for different purposes within the individual surveys, the prevalence significantly declined among those drank safe water than those who drank unsafe water in BL and ML.

Table 7.3. Population by prevalence of water-related diseases, sex and survey (%)

Prevalence status	Survey year								
	BL			ML			EL		
	M (n= 60515)	F (n= 60641)	Total (n= 121156)	M (n= 60054)	F (n= 60081)	Total (n= 120135)	M (n= 60871)	F (n= 60001)	Total (N= 120872)
1	2	3	4	5	6	7	8	9	10
None	86.5 (52368)	85.7 (51978)	86.1 (104346)	92.6 (55597	92.6 (60054)	96.3 (115651)	97.5 (59353)	97.7 (58630)	97.6 (117983)
Water-related diseases	9.3 (5614)	9.6 (5822)	9.4 (11436)	7.1 (4287)	7.0 (4225)	7.1 (8512	2.4 (1448)	2.1 (1285)	2.3 (2733)
Other diseases	4.4 (2665)	4.9 (2946)	4.6 (5611)	0.3 (181)	0.4 (227)	0.3 (408)	0.1 (72)	0.1 (88)	0.1 (160)
p-value	0.054			0.0479			0.006		

Row p-values on male/female combined. Figures in parentheses indicate cell frequency. BL=Baseline, ML=Midline and EL=End line. All column p-values are <0.001

Similar decline was found among those cooked with safe water compared with those used unsafe water for cooking in ML. Safe water users for utensils washing in all the three surveys experienced a significant decrease in the prevalence compared to the unsafe water users. In BL and ML, significant decline in the prevalence occurred among those using safe water for bathing compared to those who did not. Safe water users for washing hands after defecation achieved a significant decline in the prevalence in ML only.

In BL and ML, both male-female safe latrine users were less likely than unsafe latrine users to suffer from water-related diseases (Table 7.7). The prevalence declined from BL to ML, ML to EL and BL to EL for all. Wearing of slipper during commuting to and

from latrines did not show any significant drop in water-related disease prevalence in either survey. The prevalence declined for both users and non-users of slipper across the surveys (Table 7.8). The prevalence of water-related diseases significantly declined in each survey among those used their own latrines compared to those who did not own a latrine (Table 7.9). But both the owner and non-owner groups had a decline in prevalence from the BL to ML, ML to EL, and BL to EL.

Table 7.4. Population by prevalence of specific water-related diseases, survey and category (%)

Categories	Surveys			p-value		
	BL (n=121156)	ML (n=120135)	EL (n=120872)	Col 2 vs. 3	Col 3 vs. 4	Col 2 vs. 4
1	2	3	4			
Waterborne diseases						
Diarrhoea	4.5 (5462)	4.2 (5066)	1.3 (1577)	0.000	0.000	0.000
Dysentery	2.6 (3202)	1.5 (1859)	0.4 (536)	0.000	0.000	0.000
Jaundice	0.2 (285)	0.4 (486)	0.2 (196)	0.000	0.000	0.000
Typhoid	0 (37)	0 (8)	0 (14)	0.000	0.206	0.001
Polio	0 (11)	0 (0)	0 (0)			
Sub-total	7.4 (8997)	6.2 (7419)	1.9(2323)			
Water-washed						
Skin diseases	1.5 (1826)	0.6 (729)	0.1 (124)	0.000	0.000	0.000
Worms	1.6 (1886)	0.8 (929)	0.3 (336)	0.000	0.000	0.000
Sub-total	3.1 (3712)	1.4 (1658)	0.4 (460)			
Total	10.5 (12709)	7.6 (9077)	2.3 (2783)	0.000	0.000	0.000

Multiple responses considered. Figures in parentheses indicate cell frequency. BL=Baseline, ML=Midline and EL=End line.

Table 7.5. Prevalence of water-related diseases by different background characteristics of study population and individual survey (%)

Characteristics	Surveys			p-value		
	BL	ML	EL	Col 2 vs. 3	Col 3 vs. 4	Col 2 vs. 4
1	2	3	4			
Age groups (years)	n=121156	n=121156	n=121156			
<5	21.2 (2848)	12.5 (2250)	6.6 (641)	0.000	0.000	0.000
n=	13427	18063	9753			
≥5	8.0 (8588)	6.1 (6262)	1.9 (2092)	0.000	0.000	0.000
n=	107729	102072	111119			
p-value	0.000	0.000	0.000			
Education of household heads	N=26404	N=26404	N=26404			
% Never schooling	9.4 (1123)	6.9 (840)	2.2 (260)	0.000	0.000	0.000
n=	12006	12108	11920			
% Ever schooling	7.6 (1090)	6.6 (945)	2.0 (296)	0.002	0.000	0.000
n=	14398	14296	14484			
p-value	0.000	0.302	0.439			
Main occupation of household heads (%)						
Agriculture	8.4 (739)	6.3 (546)	2.3 (205)			
Labour (skilled/unskilled)	9.0 (777)	7.3 (587)	2.0 (164)			
Service	6.3 (108)	5.7 (89)	1.6 (26)			
Business	7.2 (324)	6.2 (260)	1.8 (67)			
Household work	8.8 (162)	7.4 (203)	2.0 (51)			
Others	8.5 (36)	5.4 (26)	1.7 (8)			
Disabled	11.6 (67)	9.5 (74)	3.4 (35)			
Households' economic status						
% Ultra poor	10.6 (2150)	7.5 (1545)	2.5 (354)	0.000	0.000	0.000
n=	20261	20542	14058			
% Poor	10.2 (3195)	7.7 (2444)	2.4 (494)	0.000	0.000	0.000
n=	31322	31551	20790			
% Non-poor	8.8 (6091)	6.6 (2523)	2.2 (1885)	0.000	0.000	0.000
n=	69573	68042	86024			
p-value Ultra poor vs. poor	0.135	0.354	0.415			
Poor vs. Non-poor	0.000	0.000	0..109			
Ultra poor vs. Non-poor	0.000	0.000	0.016			
Households' perceived annual economic condition (%)						
Deficit	10.5 (4796)	7.8 (3999)	2.6 (1158)	0.000	0.000	0.000
n=	45592	51535	44347			
Non-deficit and or surplus	8.8 (6640)	6.6 (4513)	2.1 (1575)	0.000	0.000	0.000
n=	75564	68600	76525			
p-value	0.000	0.000	0.000			

Figures in parentheses indicate cell frequency. BL=Baseline, ML=Midline and EL=End line.

Table 7.6. Prevalence of water-related diseases by sources of water use for different purposes, household individual survey (%)

Purposes	Surveys						p-value					
	BL		ML		EL							
	Safe	Unsafe	Safe	Unsafe	Safe	Unsafe	Col 2 vs. 4	Col 4 vs. 6	Col 2 vs. 6	Col 2 vs. 3	Col 4 vs. 5	Col 6 vs. 7
1	*2*	*3*	*4*	*5*	*6*	*7*						
Drinking	9.4 (11326)	13.4 (82)	7.1 (8475)	9.9 (32)	2.3 (2725)	2.3 (7)	0.000	0.000	0.000	0.000	0.000	0.138
n=	*120545*	*611*	*119811*	*324*	*120563*	*309*						
Cooking	9.5 (10130)	8.8 (1278)	7.0 (7581)	8.1 (926)	2.3 (2536)	1.9 (196)	0.000	0.000	0.000	0.074	0.000	0.066
n=	*106699*	*14457*	*108744*	*11391*	*110677*	*10195*						
Utensils washing	9.6 (9623)	8.3 (1785)	7.0 (7097)	7.6 (1410)	2.3 (2402)	1.9 (330)	0.000	0.000	0.000	0.000	0.001	0.005
n=	*99724*	*21432*	*101476*	*18659*	*103735*	*17137*						
Bathing	9.3 (7476)	9.6 (3932)	6.7 (5662)	8.1 (2845)	2.2 (2041)	2.3 (691)	0..000	0.000	0.000	0.003	0.000	0.101
n=	*80055*	*41101*	*85019*	*35116*	*90897*	*29975*						
After defe-cation	9.5 (9741)	9.1 (1667)	7.0 (7334)	7.8 (1173)	2.3 (2442)	2.1 (290)	0.000	0.000	0.000	0.114	0.000	0.622
n=	*102073*	*18283*	*105150*	*14985*	*106803*	*14069*						

Safe water source= Any shallow/deep tubewell, and supply/tap water. Unsafe source= Sources other than safe ones. Multiple responses considered. Figures in parentheses indicate cell frequency. BL=Baseline, ML=Midline and EL=End line

Table 7.7. Prevalence of water-related diseases by place of defecation and individual survey (%)

Place	Surveys						p-value					
	BL		ML		EL							
	Male	Female	Male	Female	Male	Female	Col 2 vs. 4	Col 4 vs. 6	Col 2 vs. 6	Col 3 vs. 5	Col 5 vs. 7	Col 3 vs. 7
1	*2*	*3*	*4*	*5*	*6*	*7*						
Safe latrines	8.3 (1648)	8.5 (1726)	6.4 (1636)	6.1 (1587)	2.4 (828)	2.0 (696)	0.000	0.000	0.000	0.000	0.000	0.000
n=	*19916*	*25847*	*25466*	*34500*	*34798*	*20295*						
Unsafe latrines	9.8 (3941)	10.2 (4078)	7.7 (2634)	7.7 (2621)	2.4 (618)	2.3 (5838)						
n=	*40308*	*34038*	*34375*	*25356*	*25866*	*40124*						
p-value	0.000	0.000	0.000	0.000	0.112	0.096						

Safe latrine=Ring slab latrine with water seal or latrine with water seal and safety tank. Unsafe latrine=Sources other than safe latrine. Multiple responses considered. Figures in parentheses indicate cell frequency. BL=Baseline, ML=Midline and EL=End line

Table 7.8. Prevalence of water-related diseases among population using own latrines by status of wearing slipper during commuting to and from latrine (%)

Place	Surveys			p-value		
	BL	ML	EL			
1	2	3	4	Col 2 vs. 3	Col 3 vs. 4	Col 2 vs. 4
Yes	9.1 (6264)	7.0 (5446)	2.2 (1909)	0.000	0.000	0.000
n=	*69165*	*78116*	*86195*			
No	9.7 (291)	6.9 (220)	2.8 (59)			
n=	*2996*	*3190*	*2134*			
p-value	0.217	0.912	0.098			

Multiple responses considered. Figures in parentheses indicate cell frequency. BL=Baseline, ML=Midline and EL=End line

Table 7.9. Prevalence of water-related diseases among population using own latrines by status of cleaning latrines regularly (%)

Place	Surveys			p-value		
	BL	ML	EL			
1	2	3	4	Col 2 vs. 3	Col 3 vs. 4	Col 2 vs. 4
Yes	8.8 (5462)	6.9 (5020)	2.2 (1766)	0.000	0.000	0.000
n=	*62153*	*73220*	*81353*			
No	10.9 (1093)	8.0 (646)	2.9 (202)			
n=	*10008*	*8086*	*6976*			
p-value	0.000	0.000	0.000			

Multiple responses considered. Figures in parentheses indicate cell frequency. BL=Baseline, ML=Midline and EL=End line.

Table 7.10 shows the prevalence of water-related diseases by status of hand-washing at different critical times. Seven critical times were considered. Study people washing hands after cleaning a child's stool registered a significantly higher decline in the prevalence than those who did not wash in BL and ML. Those washing hands before meals in ML, after defecation in ML, after cleaning a child's stool in BL and ML, after meals in BL, before serving food in BL and EL had a lower prevalence compared to those who did not wash hands in these critical times.

In BL, the prevalence of water-related diseases was lower among those washed both hands with soap/ash before meals than those who did not wash with soap/ash (Table 7.11). Users of soap/ash for both hands washing after defecation had a significantly lower prevalence in all the three surveys. Those washing hands with soap/ash after cleaning a child's stool also had lower prevalence than those who did not wash both hands with soap/ash in BL. Those washing both hands with soap/ash before cooking had lower prevalence than those who did not do so in BL and EL. In BL, both hands washers with soap/ash before feeding a child and before serving food did not experience significant decline in the prevalence. But both hands washing with soap/ash in other critical times shows significant decline in the prevalence of water-related diseases across the survey.

Table 7.10. Prevalence of water-related diseases by status of hand-washing at critical times (%)

Times	Surveys						p-value		
	BL		ML		EL				
	Yes	No	Yes	No	Yes	No	Col 2	Col 4	Col 2
1	2	3	4	5	6	7	vs. 4	vs. 6	vs. 6
Before taking meals	9.4 (10566)	9.3 (870)	7.1 (8215)	8.1 (297)	2.3 (2661)	2.2 (72)	0.000	0.000	0.000
n=	*111822*	*9334*	*116472*	*3663*	*117583*	*3289*			
After defecation	9.5 (10417)	9.2 (1019)	7.0 (8118)	8.0 (394)	2.2 (2634)	2.7 (99)	0.000	0.000	0.000
n=	*110062*	*11094*	*115190*	*4945*	*117150*	*3722*			
After cleaning a kid's stool	11.4 (1574)	9.2 (9862)	7.9 (1010)	7.0 (7502)	2.2 (489)	2.3 (2244)	0.000	0.000	0.000
n=	*13840*	*107316*	*12743*	*107392*	*21995*	*98877*			
Before feeding kid	9.3 (703)	9.4 (10733)	7.7 (531)	7.0 (7981)	2.2 (202)	2.3 (2531)	0.001	0.000	0.000
n=	*7569*	*113587*	*6912*	*113223*	*9318*	*111554*			
Before cooking	9.4 (3461)	9.4 (7975)	7.2 (3850)	7.0 (4662)	2.1 (1040)	2.3 (1693)	0.000	0.000	0.000
n=	*36697*	*84459*	*53578*	*66557*	*48474*	*72398*			
After taking meals	9.0 (7303)	10.4 (4133)	7.0 (5650)	7.3 (2862)	2.3 (2733)	0 (0)	0.000	0.000	0.000
n=	*81431*	*39725*	*80698*	*39437*	*120872*	*0*			
Before serving foods	8.7 (1153)	9.5 (4991)	6.7 (944)	7.1 (7568)	2.0 (335)	2.3 (2398)	0.000	0.000	0.000
n=	*13209*	*107947*	*13999*	*106136*	*16605*	*104267*			

Multiple responses considered. * Zero (0) sample in the cell. Figures in parentheses indicate cell frequency. BL=Baseline, ML=Midline and EL=End line

Latrine owners who used to clean latrines regularly had significantly lower prevalence of water-related diseases in each survey than those who did not clean. The prevalence also significantly decreased from BL to ML, ML to EL and BL to EL for both cleaners and non-cleaners (Table 7.12). Those who preserved sufficient water nearby latrines for use had lower prevalence of water-related diseases than those who did not preserve. Both groups experienced decline in the prevalence from BL through EL (Table 7.13). Except in EL, the prevalence of water-related diseases was lower in BL and ML among those who preserved soap/ash nearby latrines for use (Table 7.14).

Table 7.11. Prevalence of water-related diseases among population washing both hands at critical times by status of using soap or ash (%)

Wash both hands with	Surveys						p-value		
	BL		ML		EL		Col 2 vs. 4	Col 4 vs. 6	Col 2 vs. 6
	Yes	No	Yes	No	Yes	No			
1	*2*	*3*	*4*	*5*	*6*	*7*			
Before taking meals	7.9 (636)	9.6 (9930)	7.0 (1551)	7.1 (6664)	2.1 (471)	2.3 (2190)	0.006	0.000	0.000
n=	*8005*	*103817*	*22112*	*94360*	*22003*	*95580*			
After defecation	8.8 (4038)	9.9 (6379)	6.6 (4912)	8.0 (3206)	2.1 (1547)	2.6 (1087)	0.000	0.000	0.000
n=	45711	64351	74879	40311	75328	41822			
After cleaning a kid's stool	10.3 (668)	12.3 (906)	7.9 (667)	8.0 (343)	2.1 (287)	2.4 (202)	0.000	0.000	0.000
n=	*6502*	*7338*	*8440*	*4303*	*13717*	*8278*			
Before feeding a kid	8.5 (76)	9.4 (627)	7.4 (132)	7.8 (399)	2.2 (47)	2.2 (155)	0.292	0.000	0.000
n=	*891*	*6678*	*1790*	*5122*	*2136*	*7182*			
Before cooking	8.6 (334)	9.5 (3127)	6.7 (551)	7.3 (3299)	2.5 (240)	2.1 (800)	0.000	0.000	0.000
n=	*3901*	*32796*	*8163*	*45415*	*4039*	*39005*			
After taking meals	7.8 (180)	9.0 (7123)	6.3 (255)	7.0 (5395)	2.2 (182)	2.3 (2551)	0.022	0.000	0.000
n=	*2300*	*79131*	*4039*	*76659*	*8285*	*112587*			
Before serving foods	8.2 (83)	8.8 (1070)	6.8 (152)	6.7 (792)	1.9 (67)	2.1 (268)	0.174	0.000	0.000
n=	*1017*	*12192*	*2226*	*11773*	*3606*	*12999*			

Figures in parentheses indicate cell frequency. BL=Baseline, ML=Midline and EL=End line.

Table 7.12. Prevalence of water-related diseases by status of latrine cleanliness (physically verified) (%)

Verified status	Surveys			p-value		
	BL	ML	EL	Col 2 vs. 3	Col 3 vs. 4	Col 2 vs. 4
1	2	3	4			
Clean	7.5 (1978)	6.3 (2682)	2.0 (1060)	0.000	0.000	0.000
n=	*26510*	*42762*	*53190*			
Unclean	9.6 (5128)	7.3 (3059)	2.5 (1169)			
n=	*53207*	*41932*	*46970*			
p-value	0.000	0.000	0.000			

Figures in parentheses indicate cell frequency. BL=Baseline, ML=Midline and EL=End line

Table 7.13. Prevalence of water-related diseases by status of sufficient water preservation nearby latrines for use (physically verified) (%)

Verified	Surveys			p-value		
status	BL	ML	EL	Col 2 vs. 3	Col 3 vs. 4	Col 2 vs. 4
1	2	3	4			
Yes	8.5 (2244)	6.4 (2056)	2.0 (788)	0.000	0.000	0.000
n=	*26258*	*32058*	*38781*			
No	9.1 (4862)	7.0 (3685)	2.4 (1430)			
n=	*53459*	*52636*	*60821*			
p-value	0.011	0.001	0.001			

Figures in parentheses indicate cell frequency. BL=Baseline, ML=Midline and EL=End line

Table 7.14. Prevalence of water-related diseases among population using own latrines by status of preservation of ash/soap for use nearby latrines (physically verified) (%)

Verified	Surveys			p-value		
status	BL	ML	EL			
1	2	3	4	Col 2 vs. 3	Col 3 vs. 4	Col 2 vs. 4
Yes	7.7 (849)	6.0 (1000)	2.2 (558)	0.000	0.000	0.000
n=	*11054*	*16536*	*25707*			
No	9.1 (6257)	7.0 (4741)	2.2 (1671)			
n=	*68663*	*68159*	*74453*			
p-value	0.000	0.000	0.507			

Figures in parentheses indicate cell frequency. BL=Baseline, ML=Midline and EL=End line

Latrine users preserving slippers nearby latrines for use had lower prevalence of water-related diseases than those who did not preserve slippers in all the three surveys. Both slipper preserver and non-preserver groups had a reduction in the prevalence from BL through EL (Table 7.15). In BL and ML, tubewell users having had concrete-built platforms had a lower prevalence of water-related diseases than those who had *kancha* or broken platforms of tubewells (Table 7.16). Those maintaining tubewell platforms clean had lower prevalence of water-related diseases than those who did not in any survey. The prevalence declined from BL through EL for both platform cleaner and non-cleaner groups (Table 7.17).

Table 7.15. Prevalence of water-related diseases among population using own latrines by status of preservation of slipper for use nearby latrines (physically verified) (%)

Verified status	Surveys			p-value		
	BL (n=79717)	ML (n=84694)	EL (n=100160)			
1	2	3	4	Col 2 vs. 3	Col 3 vs. 4	Col 2 vs. 4
Yes	6.7 (245)	5.5 (384)	1.9 (259)	0.011	0.000	0.000
n=	*3649*	*7002*	*13683*			
No	9.0 (6861)	6.9 (5357)	2.3 (1970)			
n=	*76068*	*77692*	*86477*			
p-value	0.000	0.000	0.004			

Figures in parentheses indicate cell frequency. BL=Baseline, ML=Midline and EL=End line.

Table 7.16. Prevalence of water-related diseases among population using own tubewells by status of tubewell platform construction (physically verified)

Verified status	Surveys			p-value		
	BL	ML	EL			
1	2	3	4	Col 2 vs. 3	Col 3 vs. 4	Col 2 vs. 4
Concrete built	8.6 (3252)	6.3 (2606)	2.2 (1426)	0.000	0.000	0.000
n=	*37663*	*41116*	*63698*			
Kuncha	10.0 (5113)	7.0 (3148)	2.3 (1008)			
n=	51232	44753	43213			
Broken	8.1 (549)	7.7 (422)	2.5 (73)			
n=	*6776*	*5490*	*2876*			
p-value row 2 vs. 4	0.000	0.000	0.316			
Row 4 vs.6	0.000	0.171	0.487			
Row 2 vs. 6	0.158	0.001	0.275			

Figures in parentheses indicate cell frequency. BL=Baseline, ML=Midline and ES=End line

Table 7.17. Prevalence of water-related diseases among population using own tubewells by status of tubewell platform cleanliness (physically verified) (%)

Verified status	Surveys			p-value		
	BL (n=93665)	ML (n=91266)	EL(n=109787)			
1	2	3	4	Col 2 vs. 3	Col 3 vs. 4	Col 2 vs. 4
Clean	8.2 (2201)	5.9 (2139)	2.1 (1460)	0.000	0.000	0.000
n=	*26973*	*36016*	*70457*			
Unclean	9.8 (57087)	7.3 (4030)	2.7 (1047)			
n=	*66692*	*55250*	*39330*			
p-value	0.000	0.000	0.000			

Figures in parentheses indicate cell frequency. BL=Baseline, ML=Midline and EL=End line

Those who had a fixed place/hole for disposing household wastes had lower prevalence of water-related diseases than those who did not have in BL and ML. The prevalence declined for both groups from BL through EL (Table 7.18).

Table 7.18. Prevalence of water-related diseases by status of having fixed place/hole for domestic waste disposal (physically verified) (%)

Verified status	Surveys			p-value		
	BL	ML	EL			
1	2	3	4	Col 2 vs. 3	Col 3 vs. 4	Col 2 vs. 4
Have	9.4 (10559)	7.0 (7793)	2.3 (2515)	0.000	0.000	0.000
n=	*112778*	*110757*	*110926*			
Have not	10.5(877)	7.6 (704)	2.2 (218)			
n=	*8378*	*9241*	*9946*			
p-value	0.001	0.024	0.645			

Figures in parentheses indicate cell frequency. BL=Baseline, ML=Midline and EL=End line

Determinants of the prevalence of water-related diseases

Table 7.19 shows the odds ratios derived through the binary logistic regression. Four models were used to discover the determinants of the prevalence of water-related diseases among the study population. The model-I represents baseline survey (BL), model-II midline survey (ML), model-III end line survey (EL), and model-IV combined all surveys. The same covariates were included in all the models. However, in model-IV, the additional covariates were the individual surveys (survey periods).

The analysis showed an association between the periods of survey (i.e., duration of programme implementation) and the prevalence of water-related diseases, the prevalence significantly decreased with the increase in the survey periods (model-II and model-III) from BL (model-I). Under-five children were more likely to have inflicted with water-related diseases across all models. The study population belonging to the households whose heads had a high school or more level of education was less likely to have occurrence of water-related diseases at model-I, but primary or high school level of education of household heads showed an inverse relation at model-II. Whilst at all surveys combined or model-IV, primary level of schooling of household heads showed an inverse association and SSC or above level of their education showed a positive association. At model-I, males had a lower prevalence but at model-III it reversed. Business as occupation of household heads at model-I and model-IV, agriculture at model-II and model-IV showed a positive association with reduced prevalence of water-related diseases. Households with non-deficit or surplus in annual income were less likely to have prevalence of water-related diseases across all the models.

Users of safe water for cooking were less likely to have prevalence of water-related diseases at model-II, but the users of safe water for utensils washing were more likely to have occurrences of water-related diseases across all the models. Besides, users of safe water for bathing were less likely to have occurrence of water-related

diseases at all the models. Safe water users after defecation had lower prevalence of water-related diseases at model-I only. Drinking safe water showed a positive association with reduced prevalence of water-related diseases at model-I and model-IV. Study population cleaning latrines on a regular basis were less likely to have occurrence of water-related diseases across all the models of analysis. Preservation of soap/ash nearby latrines for hand-washing showed a significant negative association at model-III. Besides, except at model-III, preservation of slippers nearby latrines for wearing during commuting to and from latrines showed a positive association with the reduced prevalence of water-related diseases at all the models. Study population with clean tubewell platforms was less likely to have occurrence of water-related diseases across all the models. Higher score on hand-washing by soap/ash at different critical times showed a positive relationship with reduced prevalence of water-related diseases at model-III and model-IV.

Table 7.19. Odds ratios of reported water-related diseases

Covariates	Model I Baseline (95% CI)	Model II Midline 95% CI)	Model III End line (95% CI)	Model IV All surveys (95% CI)
Surveys				
Baseline	-	-	-	1
Midline	-		-	0.73 (0.71, 0.75)***
End line	-	-		0.24 (0.23, 0.25)***
Age				
≥ 5 years	1	1	1	1
<5 years	2.16 (2.07, 2.26)***	1.72 (1.65, 1.79)***	1.59 (1.52, 1.66)***	1.81 (1.76, 1.85)***
Household head's education				
Never schooling	1	1	1	1
Primary level schooling	1.04 (0.98, 1.11)	1.14 (1.07,1.22)***	1.02 (0.91,1.15)	1.08 (1.03, 1.12)***
High level schooling	0.93 (0.89,0.980)***	1.07 (1.02, 1.134)***	0.92 (0.83, 1.01)	0.98 (0.95,1.02)
SSC and above	0.89 (0.83, 0.96)***	0.97 (0.88, 1.06)	0.99 (0.85, 1.14)	0.93 (0.88, 0.98)**
Sex				
Female	1	1	1	1
Male	0.95 (0.91,0.99)**	1.01 (0.96,1.05)	1.10 (1.02,1.19)***	0.99 (0.96,1.02)
Household head's occupation				
Labour	1	1	1	1
Agriculture	0.95 (0.91,1.00)	0.88 (0.84,0.93)***	1.04 (0.96, 1.14)	0.93 (0.90, 0.96)***
Service	0.95 (0.87,1.04)	1.00 (0.90,1.11)	0.93 (077, 1.12)	0.96 (0.90,1.02)
Business	0.91 (0.86,0.96)***	0.93 (0.87,1.00)	1.00 (0.88,1.12)	0.92 (089, 0.96)***

(Table 8.19 continued....)

(....Continued Table 8.19)

Perceived economic status				
Deficit	1	1	1	1
Non-deficit or surplus	0.88 (084,0.91)***	0.89 (0.85,0.93)***	0.82 (0.75, 0.89)***	0.87 (0.85, 0.90)***
Safe water use for different purposes				
Cooking	0.99 (0.92, 1.07)	0.88 (0.80,0.96)***	1.09 (0.91, 1.30)	0.96 (0.91,1.01)
Utensils washing	1.48 (1.35,1.62)***	1.212 (1.05,1.36)***	1.35 (1.10, 1.65)***	1.35 (1.26, 1.44)***
Bathing	0.87 (0.83,0.92)***	0.78 (0.74, 0.83)***	0.87 (0.77, 0.97)**	0.84 (0.81, 0.87)***
After defecation	0.89 (0.81,0.97)**	0.99 (0.89,1.10)	1.03 (0.85, 1.26)	0.95 (0.89,1.01)
Drinking	0.62 (0.48,0.79)***	0.84 (0.57, 1.22)	0.94 (0.43, 2.05)	0.71 (0.59, 0.87)***
Latrine clean	0.81 0.76,0.86)***	0.91 (0.86, 0.96)***	0.87 (0.79, 0.95)***	0.86 (0.83, 0.89)***
Preserved soap/ash nearby latrine	0.98 (0.91,1.07)	1.00 (0.92,1.09)	1.19 (1.06, 1.34)***	1.03 (0.97, 1.03)
Sufficient water preserved nearby latrine	1.03 (0.97,1.08)	0.99 (0.93,1.05)	0.91 (0.83,1.00)	0.99 (0.96,1.03)
Slipper preserved nearby latrine	0.86 (0.75, 0.99)**	0.87 (0.78,0.98)**	0.92 (0.79,1.06)	0.89 (0.82, 0.96)***
Tubewell platform pucca	1.01 (0.96, 1.06	0.97 (0.92, 1.03)	1.15 (1.05, 1.26)***	1.01 (0.98, 1.05)
Tubewell platform clean	0.91 (0.86, 0.96)***	0.86 (0.81, 0.91)***	0.80 (0.73, 0.88)***	0.87 (0.84, 0.90)***
Waste disposal in fixed place/hole	0.94 (0.87, 1.02)	0.99 (0.91, 1.07)	1.03 (0.89, 1.19)	0.97 (0.92, 1.02)
Score hand-washing with soap/ash at critical times	0.99 0.98, 1.00)	0.99 (0.99, 1.00)	0.97 0.96, 0.98)***	0.99 (0.99, 0.99)**

*** Significant at 1% level and ** Significant at 5% level. CI= Confidence interval.

DISCUSSION

The prevalence remarkably declined at midline and end line compared to baseline. Earlier studies in other settings confirm this finding (Fewtrell and Colford 2005, Fewtrell *et al*. 2005). This implies that prolonged interventions on any issue enable the implementers not only to provide hardware support (such as sanitary latrines, tubewell, etc.) but also to reinforce the software support (such as information, education, motivation, etc.) on safe water and sanitation supply, and hygiene practices towards positive behaviour change leading to reduction in related disease occurrence.

Diarrhoea still remained a major challenge. The key to control diarrhoea is hygiene, sanitation and water (Boschi-Pinto *et al*. 2008). In low-income countries (LIC), poor quality drinking water is an important risk factor for diarrhoea; and diarrhoeal diseases are the second most common contributor to disease burden (PrÜss *et al* 2001, Fewtrell *et al*. 2005). Though over 80% of the households have access to improved water sources (excluding arsenic contamination) in terms of hand

pump/deep tuebwells in the intervention areas, water may be contaminated at source point and user level. More specifically, people may not cover the water container during collection and storage of water. Besides, the cup or glass being used for drinking water may also be contaminated by germs due to lack of hygiene practice. On the other hand, *kancha* platform of a tubewell compounded with uncleanliness of the platform may help germs get in the ground water sources and contaminate, resulting in disease occurrences. Our analysis shows an association between tubewell platform cleanliness and reduced prevalence of water-related diseases across the surveys. But even occasional short-term failures in water supply or water treatment can seriously undermine many public health benefits associated with improved water supply (Hunter *et al*. 2009).

Much of the impact of water supply on health is mediated through increased use of water in hygiene. For instance, hand-washing with soap reduces the risk of endemic diarrhoea, respiratory and skin infections, while face-washing prevents trachoma and other eye diseases (Bartram and Cairncross 2010). Luby *et al*. (2004) reported 53% reduction in diarrhoea risk in a trial of hand-washing intervention in a poor setting in Pakistan. In our analysis, we gave score on hand-washing with soap/ash at different critical times and then included the variable in the binary logistic regression. Likewise, increased score was associated with decreased disease prevalence. Thus, this supports the above study evidence. But interestingly, prevalence of water-related diseases increased among the safe water users for utensils washing. This is a surprising result since self-report usually produces an over-estimate of good practices as respondents, consciously or not, try to please the interviewers and/or portray a good image of themselves (Cousens *et al*. 1996), which may be termed as a 'courtesy bias' (Biran *et al*. 2008).

A discernible finding was that the water-related disease burden reduced among both users and non-users of safe water for different purposes and latrines, and hand-washing with soap/ash particularly after faecal contact events. This result is unclear. However, this may be because respondents did not easily recall all safe water use or soap/ash use or probably they were more hesitant about spontaneously discussing on unsafe water use or faecal contact events with interviewers. Proper interviewers' training and repeatedly asking questions may help unfold the true practice. Schmidt *et al*. (2009) reported that out of 5,182 critical opportunities observed for hand-washing, 25% used soap. Hand-washing with soap often practiced after faecal contact (32%) than before food handling (15%).

Sex difference in the prevalence of water-related diseases reversed at end line, i.e., females had significantly lower prevalence than males. This can be explained by two factors: a) BRAC WASH programme is highly women-focused, and the reversal of sex disparity may be an outcome of this; and b) longer duration of programme contributes to ensure more motivation and benefits to females by overcoming the barriers to female-male equity in health development. However, removal of sex disparity has immense implications in a society where all forms of discriminations against women is pervasive, women-friendly healthcare is less likely, and they infrequently use health services during their illness (Young *et al*. 2006).

Disparity between perceived household economic status and water-related disease prevalence persist across the surveys. Socioeconomic disparity in diarrhoea prevalence was also reported by other studies (Emch 1999, Hasuizume *et al*. 2008). Appropriate measures are imperative to address the issues of health inequity.

Across all the surveys, under-five children were more likely to get water-related diseases. Clasen *et al. (*2007*)* reported that most of the excess disease burden in LICs felt on young children - 17% of all deaths in under-five children are attributed to diarrhoea and inadequate water supply is a contributor to deaths in children. This is likely that a substantial proportion of mothers/caregivers do not wash hands with soap/ash after faecal contact events and before feeding a child (Ahmed *et al.* 2008). Poor practice of personal and water-related hygiene, and environmental sanitation at household level are risk factors of water-related diseases (Aunger *et al*. 2010), especially for the children. Child defecation at safe latrine is also an important factor. Different levels of children's access to safe latrine provide varying health benefits. Use of improved latrines for child defecation will not bring health benefits unless the latrine provides an adequate barrier between the users and their excreta and is well managed.

The study suffers from some methodological limitations. Therefore, one should be careful in interpretation of the results:

- There was a seasonal variation in data collection during baseline between November and July, midline during April-July, and end line during December-March. This may have impact on the prevalence of water-related diseases as a study shows that incidence of water-related diseases varies between the seasons (Cilmate Change Cell 2009). As these medical conditions are common in Bangladesh round the year, the effect would be a minimum.
- There was no comparison group, posing constraints to a precise comparison of the effects. However, availability of baseline status and randomness of the study participants permit to attribute the changes to the interventions.
- Reporting bias especially about personal and household hygiene (e.g., hand-washing with soap/ash) may have resulted in under or over-estimates of practices, which may be termed as 'courtesy bias' (Biran *et al.* 2008). Structured observational study is imperative to assess the true hygiene practices. Furthermore, the prevalence was not confirmed by microbiological pathogen tests, rather based on reported medical conditions of persons in the households. This may bias the prevalence rate. However, the strengths of the study including separate teams of field investigators during baseline, midline and end line, and analysis of data of the same households for all the surveys might help avert information bias.

CONCLUSION

The study findings reveal a significant reduction in the prevalence of water-related diseases and removal of sex disparity over time. Thus, the evidence suggests that a reasonably well-implemented intervention on water, sanitation and hygiene where pre-existing conditions are poor, is likely to reduce water-related disease prevalence. But challenge remains to continue on improved and sustained hygiene practices.

RECOMMENDATIONS

To strengthen the interventions, some suggestions are put forward for consideration.

- Evidence and experience show that water, sanitation and hygiene-related diseases are still prevalent, suggesting a need for health sector interventions alongside WASH to secure the fullest health benefits. In other words, health sector should incorporate WASH activities in the health systems.
- Continued reinforcement and improvement in existing services/facilities are needed to ensure that everyone benefits from the interventions in a sustainable manner.
- Ensure exposure of everyone, especially the caregivers of young children, to well-conceived hygiene promotion through appropriate intervention.
- Appropriate measures are imperative to address the poverty issues by integrating WASH programme.

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APPENDIX

Surveyed *upazilas*

WASH I-1st Phase		WASH I-2nd Phase		WASH I-3rd Phase	
District	*Upazilas*	District	*Upazilas*	District	*Upazilas*
Bogra	1. Adamdighi	Bagerhat	51.Chitalmari	Chittagong	101.Patiya
	2. Bogra Sadar		52.Mollahat	Comilla	102.Barura
	3. Dhunat		53.Morrelganj		103.Brahmanpara
	4. Dupchanchia		54.Rampal		104.Burichang
	5. Gabtali	Chandpur	55.Chandpur Sadar		105.Chauddagram
	6. Kahaloo		56.Kachua		106.Comilla S.
	7. Nandigram		57.Matlab		107.Comilla Dakhin
	8. Sariakandi		58.Shahrasti		108.Nangalkot
	9. Sherpur	Chittagong	59.Anwara	Cox's Bazar	109.Pekua
	10. Shibganj		60.Boalkhali		110.Cox Bazar Sadar
	11. Sonatala		61.Chandanaish		111.Ramu
	12. Shajahanpur		62.Hathazari		112.Ukhia
Dinajpur	13. Biral		63.Lohagara	Dhaka	113.Dhamrai
	14. Birampur		64.Mirsharai		114.Dohar
	15. Birganj		65.Rangunia	Dinajpur	115.Dinajpur Sadar
	16. Bochaganj		66.Raozan	Gazipur	116.Kaliganj
	17. Ghoraghat		67.Satkania		117.Kapasia
	18. Hakimpur	Faridpur	68.Alfadanga	Habigonj	118.Bahubal
	19. Kaharole		69.Bhanga		119.Chunarughat
	20. Nawabganj		70.Boalmari		120.Habiganj S.
	21. Parbatipur		71.Faridpur Sadar	Jhenaidha	121.Harinakunda
	22. Phulbari		72.Madhukhali		122.Kaliganj
Feni	23. Chhagalnaiya		73.Nagarkanda		123.Kotchandpur
	24. Parshuram		74.Sadarpur	Kushtia	124.Bheramara
	25. Fulgazi	Gopalganj	75.Gopalganj Sadar		125.Khoksa
Jessore	26. Bagherpara		76.Kashiani		126.Kushtia Sadar
	27. Jhikargachha		77.Kotalipara		127.Mirpur
	28. Keshabpur		78.Muksudpur	Lalmonirhat	128.Aditmari
	29. Manirampur		79.Tungipara		129.Kaliganj
	30. Sharsha	Joypurhat	80.Joypurhat Sadar	Magura	130.Mohammadpur
Khulna	31. Batiaghata		81.Kalai		131.Shalikha
	32. Dighalia		82.Panchbibi		132.Sreepur
	33. Dumuria	Kishoregonj	83.Hossainpur	Manikgonj	133.Ghior
	34. Phultala		84.Kishoreganj Sadar		134.Shivalaya
	35. Rupsa		85.Pakundia		135.Singair
Mymensingh	36. Bhaluka	Maulovibazar	86.Kulaura	Meherpur	136.Mujibnagar
	37. Gaffargaon		87.Maulvibazar Sadar	Narayangonj	137.Bandar
	38. Gauripur		88.Sreemangal		138.Sonargaon
	39. Haluaghat	Natore	89.Baraigram	Pabna	139.Ishwardi
	40. Mymensingh Sadar		90.Lalpur	Rajbari	140.Baliakandi
	41. Trishal		91.Natore Sadar		141.Pangsha
Nilphamari	42. Domar	Netrakona	92.Barhatta		142.Rajbari S.
	43. Nilphahari Sadar		93.Durgapur	Shariatpur	143.Bhedarganj
	44. Saidpur		94.Kendua	Shatkhira	144.Kalaroa
Noakhali	45. Sonaimuri		95.Netrokona Sadar	Sherpur	145.Sherpur Sadar
	46. Senbagh	Tangail	96.Basail	Sunamgonj	146.Jagannathpur
Panchagar	47. Atwari		97.Ghatail	Sylhet	147.Balaganj
Thakurgaon	48. Haripur		98.Gopalpur		148.Beanibazar
	49. Pirganj		99.Madhupur		149.Fenchuganj
	50. Ranisankail		100.Sakhipur		150.Golabganj