APSU

Arsenic Policy Support Unit

Water Safety Plans in Bangladesh: Experiences from Pilot Projects

EXECUTIVE SUMMARY

The water sector in Bangladesh has made significant efforts to develop and implement water safety plans (WSPs) for rural and urban water supplies. The World Health Organization promotes the use of water safety plans in the 3^{rd} edition of the Guidelines for Drinking Water Quality as a key component of an overall water safety framework. All major rural water supply programmes in Bangladesh have now committed to implementing WSPs in their programmes.

'Model' WSPs have been developed for all the major water supply technologies used in rural areas of Bangladesh. These were developed through a consultative process facilitated by the Arsenic Policy Support Unit (APSU) drawing on the knowledge and experience of water supply experts from Government of Bangladesh, NGOs, donors and academia. To support WSP implementation at a community level a set of community monitoring tools was developed for use by caretakers and village committees.

APSU supported a series of pilot projects to test the WSPs and community monitoring tools to assess their feasibility in rural communities in Bangladesh. The pilot projects were implemented by NGO Forum for Drinking Water Supply and Sanitation; Environment and Population Research Centre; Dhaka Community Hospital; the Bangladesh Water Supply Program Project; and, the DPHE-UNICEF Arsenic Mitigation project.

The results of the pilot projects have been very positive and the success of a diverse range of organisations in implementing WSPs provides confidence that their use can be scaled up. The pilot projects showed consistent improvements in the sanitary condition of the water supplies and in microbial water quality. The pilots also highlighted the need for ongoing periodic support to communities through surveillance.

Community responses were encouraging towards the WSP approach. There was ready acceptance of the community monitoring tools and communities recognised the need for regular monitoring and action. The pictorial tools for community monitoring encouraged the caretakers to undertake preventive maintenance and to move sources of hazards, such as pit latrines, to safe distances from the water supply. These actions improved water safety. The existing village committees can play important roles in the implementation of WSP and in ensuring that caretakers continue to follow best practice.

The water safety plans have been well accepted by DPHE, NGOs and donors as an effective guide for understanding how water safety can be managed. The organisations implementing the pilot projects noted a number of improvements for the community monitoring tools to make them more effective. This process will be initiated through a further consultative process.

It is recommended that projects and programmes implementing WSPs should integrate training about WSPs with hygiene promotion, caretaker training and awareness-raising. The use of existing processes and approaches will be more cost-effective and are likely to be more sustainable than stand-alone activities.

A key challenge for scaling up WSPs will be the size of the problem given that there are so many tubewells in Bangladesh. It is likely that initially the focus should be on community water supplies, but strategies will need to be formulated for household supplies, such as rainwater harvesters and safe shallow tubewells.

WSPs are by their nature dynamic and require regular review and updating. Different water supply projects need to ensure that there is regular interaction and collaboration. The formation of a national WSP core group would assist in this process to develop expertise and provide technical support in collaboration with the Policy Support Unit of Local Government Division. Such a core group could work closely with DPHE, NGOs and donors to support widespread implementation of WSPs and the development of a water safety framework for Bangladesh.

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ABBREVIATIONS AND ACRONYMS

AIRP	Arsenic-Iron Removal Plant
APSU	Arsenic Policy Support Unit
BWSPP	Bangladesh Water Supply Program Project
DCH	Dhaka Community Hospital
DPHE	Department of Public Health Engineering
DTW	Deep tubewell
DW	Dug well
EPRC	Environment and Population Research Centre
ITN-BUET	International Training Network, Bangladesh University of Engineering and Technology
PSF	Pond Sand Filter
OMC	Option Maintenance Committee
PW	Piped water supply
RWH	Rainwater harvesters
STW	Shallow tubewell
VDC	Village Development Committee
TTC	Thermotolerant coliforms
WHO	World Health Organisation
WSP	Water Safety Plan

1.0 INTRODUCTION

This report describes the process of implementation of Water Safety Plans in Bangladesh since 2004. The focus of attention has been on rural water supplies, although there has also been some experience with Pourshava piped water supplies. The World Health Organization (WHO) issued the 3rd edition of their Guidelines for Drinking Water Quality in 2004 recommending that Water Safety Plans (WSPs) should be introduced in all water supplies as a key component of water safety management. The water supply sector in Bangladesh has taken this up and the major rural and small town water supply programmes have made commitments to implement water safety plans in their future programmes. In order for WSPs to be utilised effectively in Bangladesh, the general guidance available from WHO (WHO, 2004; Davison *et al.*, 2005) needed to be modified to reflect local conditions.

This report consolidates the experience of the development of 'model' WSPs for key rural water supply technologies and of implementing WSPs in communities by NGOs and the Department of Public Health Engineering (DPHE). Three NGOs and DPHE undertook pilot projects to implement WSPs in a number of areas in Bangladesh and for a variety of technologies. Detailed reports from the individual NGOs and BAMWSP can be downloaded from the APSU website (www.apsu-bd.org). In addition, the DPHE-UNICEF arsenic project has also implemented WSPs in a further 23 Upazilas.

The model WSPs and community monitoring tools were developed through an expert consultation process to ensure these were appropriate to local conditions. These have been tested in communities. This experience provides the sector with an understanding as to how WSPs can be replicated at scale and the modifications that may be required for scaling up.

The field test results and experience gained from the piloting will help planners, implementers and policy makers in understanding the importance of WSPs and the process steps required to implement WSPs in field conditions. It is also expected that they will also be able to realize the real benefits and the challenges of WSPs and to identify the areas where emphasis should be given.

2.0 BACKGROUND

Like many other developing countries, diarrhoea, dysentery and other waterborne diseases constitute major health burden in Bangladesh. According to the 2005 Bangladesh health and injury report on children, 36,000 children under 5 die every year from diarrhoea (Rahman *et al*., 2005). The Bangladesh Bureau of Statistics and UNICEF estimated that children under 5 suffered from 3 to 5 episode of diarrhoea each year, each of which lasted for 2-3 days and sometimes more than two weeks (BBS & UNICEF, 2000).

Many factors lead to high morbidity from diarrhoea, including poor sanitation, poor hygiene and contaminated water. Properly designed and implemented WSPs are able to address issues of water source protection and water handling hygiene, and also support other initiatives to promote sanitation.

In addition to microbial risks, the safety of drinking water in Bangladesh is also threatened by chemical contamination. The principal risk is derived from arsenic contamination and up to 20-25 million people are at risk from arsenic in drinking water above the Bangladesh standard of 50µg/l (meaning that they have ready access to a contaminated tubewell). The number of people exposed (people who consume arsenic contaminated drinking water) is certainly lower. These figures would increase significantly if a comparison is made to the WHO Guideline Value 10µg/l.

The ongoing programme of installing alternative water supply options has raised the problems of risk substitution with microbial contamination in arsenic affected areas (Howard, 2003; Ahmed *et al*., 2005). Other chemical contaminants such as manganese and boron are also locally important and the presence of toxins from cyanobacteria affect some surface waters used for drinking water supply (Welker *et al.*, 2005).

The 3rd edition of the WHO Guidelines for Drinking-Water Quality advocates for the use of risk-based approaches to water safety, which are based on scientific evidence and which emphasize a catchment to consumer approach (WHO, 2004). The new Guidelines emphasize the need for an overall water safety framework in order to ensure that safe drinking water is delivered. This requires good design, construction, operation and maintenance of water supplies and for attention to be focused on the delivery of safe water rather than simply testing water quality. This approach includes establishing health-based targets, implementation of water safety plans and undertaking independent surveillance.

2.1 WHO Water Safety Framework

The WHO water safety framework is composed of three key elements:

1. Health-based targets
2. Water Safety Plans
3. Surveillance

2.1.1 Health-based targets

Health based targets provide a basis for identifying safety requirements and are of four types (WHO, 2004). These are:

- Health outcome (using either risk assessment or epidemiology to define reductions in risk of disease or recorded disease);
- Water quality (specified concentrations of substances in water that are considered to be of low or no risk to health or acceptability);
- Performance (targets for quantifiable reductions in the concentrations of microbes and chemicals in water, usually through treatment processes but sometimes through source protection measures); and
- Specified technology (targets that establish the type of technology that can be used; or specify design requirements for technologies; or that specify particular processes for treatment works).

In Bangladesh, a risk assessment of arsenic mitigation options was conducted to assess health risks associated with the technologies used as alternative options to shallow tubewells (STW) in arsenic affected areas and to help define health outcome targets (Ahmed *et al*., 2005). The study was able to define the likely disease burdens that would be associated with the use of the different technologies. Using the findings of the study, a ranking of options preferred for arsenic mitigation was made. This translates to specified technology targets that are underpinned by quantitative health assessment data. In addition, targets were also identified for the minimum treatment requirements and upgrading of design for dug wells (DW) and pond sand filters (PSF). The findings will also be used in the process of revision National Policy for Arsenic Mitigation, Implementation Plan for Arsenic Mitigation in Bangladesh and the Bangladesh Drinking Water Standards.

2.1.2. Water Safety Plans (WSPs)

Water safety plans are a systematic approach to securing drinking-water safety from catchment to consumer. A water safety plan emphasizes the effective *process control* in water supply as the principal means of ensuring water safety. Under a WSP, water quality analysis is mainly used for periodic verification of water safety.

The design and construction phases of water supply provision should take into account risks of contamination and provide means of controlling the risks identified and this should be based on the concept of a WSP. Ongoing control of risks through proper process control requires good operation and maintenance, with simple, rapid approaches to monitoring that allow problems to be detected early and for remedial action to be taken immediately. Thus WSPs can be developed and implemented for both new and existing water supplies.

WSPs require documentation to show that plans are in place for immediate reaction to detected problems. This may mean a number of forms of documentation, such as the formal WSP for a supply or types of supply, records of monitoring (which may be in the form of community committee meeting minutes) and records of verification (which for rural water supplies is likely to be the same as surveillance).

2.1.3 Surveillance

Surveillance is a process of water quality testing, inspection and audit undertaken to verify that safe drinking water has been supplied. It is preferred that surveillance is undertaken by an agency not involved in water supply provision, but in practice this is often difficult in rural areas of developing countries. In Bangladesh, the Department of Environment has the legal responsibility for surveillance, but has limited capacity to implement a surveillance programme. DPHE and NGOs have had to undertake surveillance, a situation that is likely to continue for some time.

3.0 INTRODUCTION OF WATER SAFETY PLANS IN BANGLADESH

After the recommendation in the 3rd edition of the WHO Guidelines for Drinking-Water Quality to develop WSPs for all water supplies, Bangladesh responded quickly to undertake preparatory works in order to introduce the concepts and approaches for WSPs. The Department of Public Health Engineering (DPHE), WHO and the Arsenic Policy Support Unit (APSU) of Local Government Division jointly organized a workshop in Dhaka in July 2004 on water quality management. The July 2004 workshop was participated by Ministry of LGRD & Co., Ministry of Health and Family Planning, DPHE, Directorate of Health, NIPSOM, Department of Environment, NGOs, and key water sector development partners in Bangladesh.

The rationale for introducing WSPs and experience with applying WSPs in other countries was discussed at the workshop, as well as broader issues of water quality management. The sector professionals recognised WSPs as an appropriate approach under which water safety can be secured and it was agreed to work jointly to develop a guiding framework and implementation tools based on the local context.

3.1 Development of WSPs and supporting materials

During the workshop and the following months, sector professionals identified a number of tasks that were required as preparatory works before development of a framework for water safety of small water supplies in the country. The critical tasks were:

- development of outline 'model' WSPs for each technology based on stakeholders experience about the risks that could occur, how these could be managed and what simple monitoring processes could be deployed to demonstrate control measure status;

- development of tools that are accessible for communities in understanding the risks that may affect their water supply, how these could be controlled and how the community could monitor these;

- agreement on a verification mechanism that could demonstrate whether the WSPs were working properly (including testing, inspection, frequency of visits and feedback); and

- implementation of a number of pilot projects to test the model WSPs to observe whether all risks are identified, whether the model WSPs work under local conditions and to document the experience gained from the piloting.

3.1.1 Developing the model WSPs

During November 2004, two workshops were organized by APSU to develop model WSPs for each technological option. These workshops brought together sector professionals from Government agencies, NGOs, academia and development partners.

Through a consultative process facilitated by APSU, draft WSPs were developed for each technological water supply option for community based rural water supplies. For each technology a small group of experts undertook a systematic analysis of likely hazards that could affect the water supply. A hazard event analysis was then done to see how the hazards identified could enter the water supply and a semi-quantitative risk assessment (in terms of severity of impact and probability of occurrence) was undertaken to help determine priorities.

For each risk, appropriate control measures and how these could be monitored were identified. An action plan was then drawn up to define what actions were required to improve the water supplies. Finally the means of validating the control measures and plans for verification were prepared. This information was then consolidated into a set of formal documents for the following water supply technologies:

1. Water safety plan for dug wells;
2. Water safety plan for pond sand filters ;
3. Water safety plan for rainwater harvesting;
4. Water safety plan for deep tubewells;
5. Water safety plan for small piped water systems from a tubewell source;
6. Water safety plan for small piped water systems from a surface water source and multi-stage filtration; and
7. Water safety plan for small gravity piped system from a spring source

These WSPs can all be downloaded from the APSU web site (www.apsu-bd.org).

A guideline for urban WSPs was also developed during a second consultative process. This was then taken forward to develop a system specific WSP for one Pourashava (Chapai Nawabganj) as discussed further in section 4.5.3.

3.1.2 Monitoring tools for use by community caretakers

The WSPs are detailed written documents of risk identification and risk management for ensuring the safety of water from source to the point of consumption. These are technical, formal documents that may be difficult for communities to understand and to turn into action. In order to overcome this problem, a set of tools were developed for caretakers and other community members to use for monitoring their water supply. These tools assist the community in assessing the hazardous events that could affect their water supply, the actions required to promote effective water safety management and how control measures can be simply monitored.

The tools developed are pictorial in nature and are based on the hazard event analysis undertaken in the development of the WSPs and the sanitary inspection forms used in surveillance. Each monitoring tool demonstrates hazard events, actions to be taken and the desired or corrected condition of the option through pictures. Figure 3.1 shows examples of the model WSPs and community monitoring tools that have been developed.

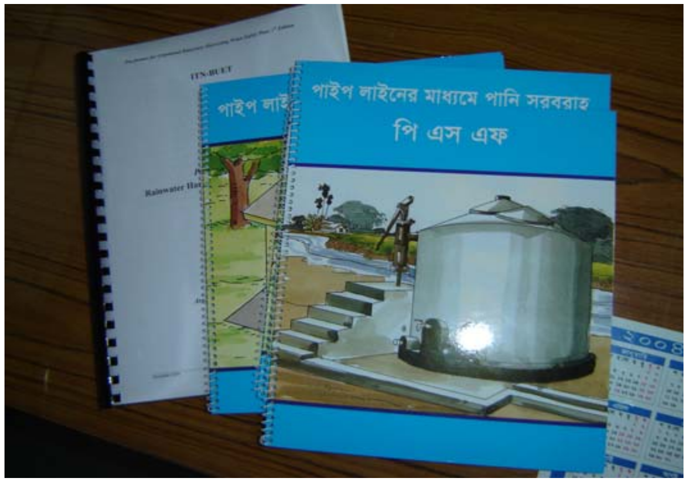


Figure 3.1 Pictures of WSP and monitoring tools for communities

3.1.3 Development of verification tools

Verification is the final component of a water safety plan and for rural water supplies it is usually undertaken under a surveillance programme. Verification requires water quality testing and sanitary inspection to support ongoing assessment of risks. It also requires the development of tools to assess hygiene practices and to provide feedback to the community of the findings of verification and the actions required to improve the water supply.

In Bangladesh, some verification tools are widely available and routinely used (for example sanitary inspection, and water quality testing methods) and these have been incorporated into a DPHE surveillance protocol. In addition, a number of projects have developed tools for capturing information about hygiene practices. These were also used in the pilot projects. Under the pilot projects, the various NGOs and DPHE also developed mechanisms for feedback to water supply management committees or village development committees. Examples of these verification tools are given in Annex 1.

3.2 Pilot projects to implement WSPs

Once the technology specific WSPs and the other materials were developed, it was considered important to test the practical application of the WSPs under local conditions. The APSU provided support for a series of pilot projects to be implemented. Three NGOs and DPHE expressed their willingness to carry out such piloting in their own projects or areas of interventions.

3.2.1 Pilot project objectives and timeframe

The broad objective of the pilot projects was to develop country-based experience that could be used to improve the WSPs, associated monitoring and verification tools and to develop guidance and training materials for WSPs that are relevant and appropriate for Bangladesh.

The pilot projects were primarily carried out in rural communities with community-managed water supplies, although early work was completed in Chapai Nawabganj to implement a WSP for an urban piped water scheme. The pilot projects were implemented by a number of organisations over slightly different periods, during the periodFebruary 2005 to November 2005. Communities where pilot projects were implemented were identified across the country.

3.2.2 Participating organisations

The organisations undertaking pilot projects were:

1. Bangladesh Water Supply Program Project (World Bank-DPHE);
2. NGO Forum for Drinking Water Supply and Sanitation;
3. Dhaka Community Hospital (DCH);
4. Environment and Population Research Centre (EPRC); and
5. GOB-UNICEF arsenic mitigation project.

Of these organisations, only the first four received direct assistance from APSU, the GOB-UNICEF arsenic mitigation project undertook piloting with their own funds.

The four organisations undertaking pilot projects for APSU were asked to undertake the following key tasks:

- select a number of communities where the organisation has previously provided water supplies;
- undertake a baseline assessment of water quality and sanitary integrity of the water options;
- undertake a baseline assessment of existing practice of water collection, handling, transportation and water storage at home;
- using materials (WSPs and tools) developed by APSU, undertake training of community operators and committees in monitoring and management of water supplies;
- undertake a mid-term assessment of water quality and sanitary condition of a sample of supplies to review implementation of the WSPs;
- undertake a final assessment of water quality and sanitary condition of the water supplies to evaluate the impact of the WSPs;
- make suggestions for the revision of the draft WSPs; and
- document project experiences and share these with ITN-BUET.

APSU asked ITN-BUET to undertake the following activities:

- help facilitate the consultative process to develop model WSPs;

- develop a detailed plan with participating organisations for next stages of implementation;
- undertake follow up field work with participating organisations to review progress and work with the organization in developing WSP; and
- document experience gained in Bangladesh and developing appropriate training and guidance material for roll-out of WSP in the country.

3.3.3 Pilot project approach and methodology

Each participating organisation first selected the areas where they would implement the pilot projects from areas where they had previously provided water supplies. It was considered important that the organisation returned to communities that they had previously supported. This meant that they would have an existing rapport with these communities that would allow the pilot projects to be established and implemented more rapidly.

The number of target communities and water supply options were determined based on financial and human resources, and the time available for each pilot project. Once the project areas and the target communities were finalised, each organisation formed a core WSP team at the central level. Generally this team comprised of six to nine persons from different technical backgrounds.

Once central core WSP teams were formed, local WSP teams were formed with the staff from the local offices in the areas where the pilot projects were being implemented. One or two-day training courses on WSPs and hygiene promotion were organized for the local WSP team by the central WSP team.

Baseline surveys, sanitary inspection and water quality testing was then carried out at each water supply as the first stage of implementing the WSP. Baseline surveys were carried out to collect information on existing hygiene practice of the community and the sanitary integrity of the selected water options. Standard sanitary inspection forms were used during the survey, which were linked to the hazard event analysis of the WSP to ensure that these were relevant.

Limited key water quality parameters were also analysed in the baseline survey. The choice of water quality parameters varied between water supply options and areas. Selection of parameters was based on option type and previous knowledge on existing water quality situation of respective areas. The surveys on present hygiene practice used a semi-structured questionnaire. Examples of the sanitary inspection forms, key water quality parameters analysed and the hygiene practice assessment questionnaires used are shown in Annex 1.

At the start of each pilot project in communities, a half-day orientation programme was conducted with the participation of the members of Village Development Committee (VDC). In some project areas similar committees are active under different names, for instance the Option Maintenance Committee (OMC). These committees are usually an influential group of villagers who play important role in the development process of their respective villages.

The basic aspects and importance of WSPs was explained in the orientation meeting in the context of frequent cases of diarrhoea within communities and the present water supply operation and maintenance and the hygiene practices of rural communities. The roles that VDC/OMC members were playing in the development process in the village were recognized. The WSP team called on the VDC/OMC members to play an expanded role in ensuring safety of water through implementation of a WSP in their area. The VDC/OMC members were asked to oversee the overall WSP activities and in particular, supervise the caretaker's activities.

In community managed rural water supplies, the caretakers are the local focal point who have received training in the maintenance of the water supply and who perform all minor repairs (and in some cases major repairs) and maintenance works of their water options. As the key approach of WSP is to emphasize the need for operational monitoring and preventive maintenance of water supplies, the caretakers were considered as the most important person at a community level. The caretaker would in effect become the principal WSP operational staff at the community level and would undertake monitoring, preventive maintenance and corrective measures. In recognition of this, a full day training programme was organised for caretakers on operational monitoring, repair and preventive maintenance of water options. At the training programme the tools for monitoring the water supply were explained and distributed to the caretakers.

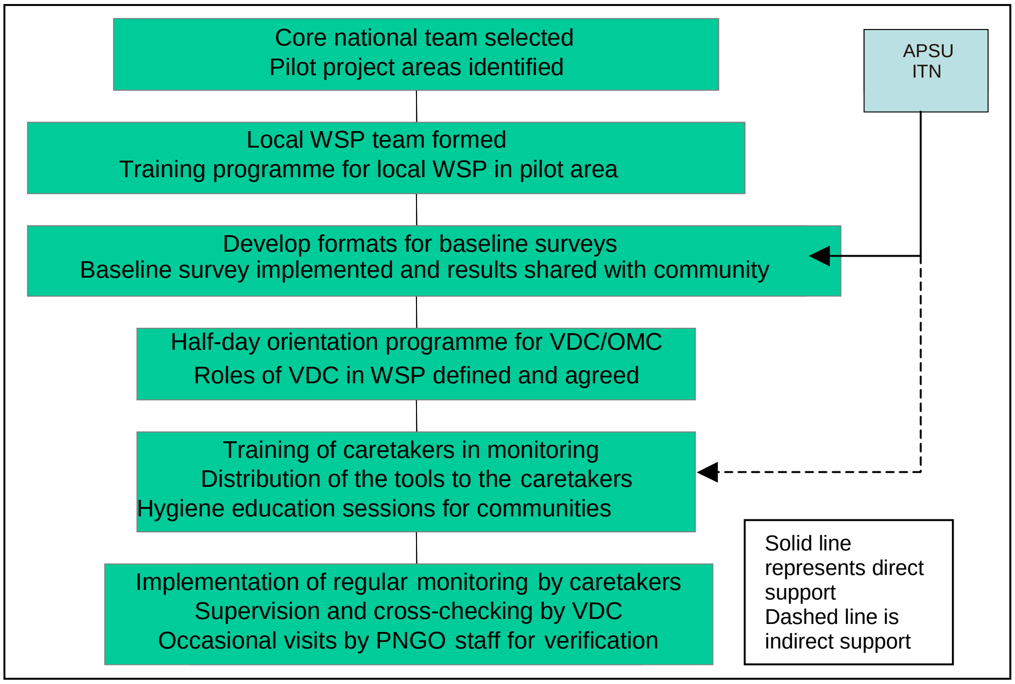
Since a WSP extends beyond the point of collection and goes up to the point of consumption, hygiene practices in water handling is an important component. Hygiene sessions were therefore conducted both for men and women separately. During the hygiene sessions the following topics were covered:

- what is safe water;
- how water can be contaminated particularly during collection, transportation, storage and usage;
- good hygiene practice; and
- water safety plans and role of the users.

The sessions were participatory and different tools (e.g. flash cards) were used, which have been proved to be effective.

After the training, the implementation of the WSP was initiated by the caretaker and was cross checked and supervised by the VDC/OMC members. VDC's supervision was also supported by visits made by the local WSP team members. The generic process steps for the implementation of WSP pilots are illustrated in Figure 3.2.

Figure 3.2: Stages of implementation of the pilot projects



4.0 FINDINGS FROM THE PILOTS

This section presents a brief overview of the key lessons and experience gained by the individual organisations who conducted the WSP pilot projects. More detailed reports from each organisation can be downloaded from the APSU website (www.apsu-bd.org) or obtained from the organisations themselves.

4.2 NGO Forum for Drinking Water Supply and Sanitation

4.1.1 Organization profile

NGO Forum for Drinking Water Supply and Sanitation is the apex organisation for NGOs in the water and sanitation sector. NGO Forum plays a key role in coordinating and supporting service delivery by local, national and international NGOs, CBOs and private sector actors who implement safe water supply and environmental sanitation programme at the community level. It has been working country-wide in a decentralized approach in association with 665 partner NGOS and CBOs and private sector actors.

4.1.2 WSP project area

The WSP pilot project was implemented in five Districts in Bangladesh. The project was implemented in two phases. During first phase 24 villages with 103 water points using 7 different technologies were covered. In the second phase 14 villages with 93 water points using 6 different technologies were included. Table 4.1 shows the details of working areas with the technologies covered under the WSP pilot.

Table 4.1: Area and Technological options covered by the pilot project

Division	**Upazila**		**No. of villages**		**Technologies included**	
	1st phase	**2nd phase**	**1st phase**	**2nd phase**	**1st phase**	**2nd phase**
Barisal	Agoiljara Babugonj Gouranadi	Muladi Wazirpur	4	3	PSF, AIRP, RWH, DTW	PSF, AIRP, RWH, DTW
Dhaka	Baniazuri Baliakhora Betilamitora	Ghior Manikganj	5	3	AIRP, RWH, DW, DTW, STW, Piped	AIRP, RWH, DW, STW
Chittagong	Daudkandi Laksham Chandina	Comilla Sadar Laksham	4	3	AIRP, RWH, DTW, STW, Piped	AIRP, RWH
Rajshahi	Mohonpur Paba Charghat Bagha	Mohonpur Charghat	5	2	AIRP RWH, DW, DSP	RWH, DSP
Sylhet	Jaintapur Zakigonj Srimangal	Jaintapur Srimangal Sunamganj	6	3	PSF, AIRP, RWH, DW, STW	AIRP, DW RWH, DTW
Total			24	14		

4.1.3 Community perceptions of water safety and operation and maintenance

At the start of the WSP pilot project, focus group discussions were undertaken in selected communities to get an understanding of community perception on safe water and on the implementation of operation and maintenance. Arsenic contamination was known to most of the participants as a cause of unsafe drinking water, but people were less clear on how microbial contamination of water may occur. Even though people were aware of different kinds of pathogens that affect water quality, they still lacked awareness about safe water handling and storage.

It was encouraging, however, that many participants identified possible contamination events in relation to specific technologies. Most of the respondents noted that if the filtration chamber is not cleaned regularly, water in a pond sand filter could become contaminated. In case of rainwater harvesting, respondents expressed their view that the catchments area should be kept clean in order to keep water safe.

Participants said that the caretakers of water supplies in the villages were volunteering for the sake of society. Most of the caretakers were aware of the community nature of the options, but sometimes the users of the technology are reluctant to contribute in cash to repair the water source. This appeared to reflect the sole ownership feelings of some of the caretakers. For example, one caretaker said:

" In dry season here exists some water crisis in the source. In the morning some volume of water is available and the amount is not sufficient for all the users. What do you think? Should not I be preferred to preserve my necessary amount of water? See, everyone is interested in taking water but no one is here to take responsibility during the worse condition of the water source."

As good operation and maintenance is key for a successful WSP, addressing these problems is critical. The villagers of one village developed an 'innovative' plan to face these realities. They have planned to sit together with all the users of the single water source. Every water source is the base for the formation of a *Samity* or group in the community who will contribute a minimum amount in every month. This amount of money it to be used for the operation and maintenance costs of the water source. They also planned to propose the formulation of a rule that no caretaker would be the cashier of the group.

There was an important gender division of responsibility for operation and maintenance, which varies between villages. For example, in Jaintapur women were principally responsible for operation and maintenance whereas in Mohajerabad the men were primarily responsible. It was suggested that such division of responsibility might be related to the quality of water because NGO Forum observed that Jaintapur village water supply had less microbial contamination than that of Mohajerabad. In most cases women are actually undertook the caretaker tasks even though officially men are caretakers. Women generally are not reluctant to undertake this responsibility but they said that their workload increased as a result.

In the groups interviewed, there was limited awareness of the need for regular water quality testing. Most villagers considered that they understood whether the water was of good quality. One of the caretakers said,

"*I never thought of testing water. We can understand by looking at or drinking the water whether it is good or not. In addition to this, long ago bhaira (field worker of NGOs) tested the water. "*

This illustrates that the WSP approach is likely to match the roles perceived by the community for monitoring, operation and maintenance, as it reduces the need for water quality testing. These findings also emphasise the need for external verification.

4.1.4 Key findings: water quality and sanitary integrity

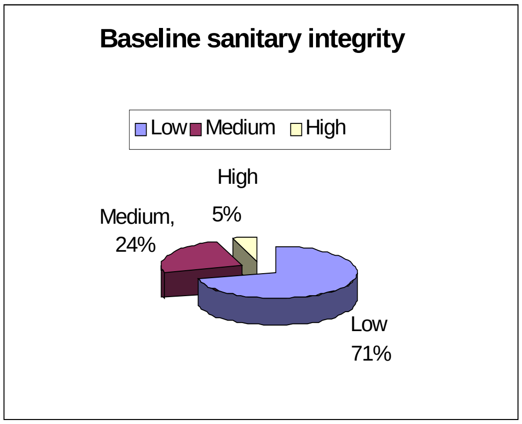
NGO Forum collected information regarding incidence of diarrhoeal diseases during the baseline survey and final assessments. Households were asked whether anyone in their house has had diarrhoea within the previous month. A 12% reduction in diarrhoea incidence was observed in the final assessment compared to the baseline assessment.

Sanitary inspections and limited water quality testing were undertaken at all water options during the baseline and the end of the project. Additional sanitary inspections and water quality tests were performed on a sample of water supplies at the mid-point of the pilot project. When interpreting the sanitary inspection data, NGO Forum used the classification shown in Table 4.2 below. The sanitary inspection forms had between 9 and 13 questions, with the majority being either 9 or 10. For inspection forms with over 9 questions, NGO Forum used an additional category of very high (10 and above), but we have not included this category in this report because the numbers of water supplies in this category were very small.

Table 4.2: Sanitary risk categories

Risk category	Risk score
Low risk	0-3
Medium risk	4-6
High risk	7 and above

Sanitary inspection survey results revealed that during the first phase of the pilot project about 30% water options were in either the medium or high risk categories (Figure 4.1). This was reduced to 14% at the end of the project (Figure 4.2).



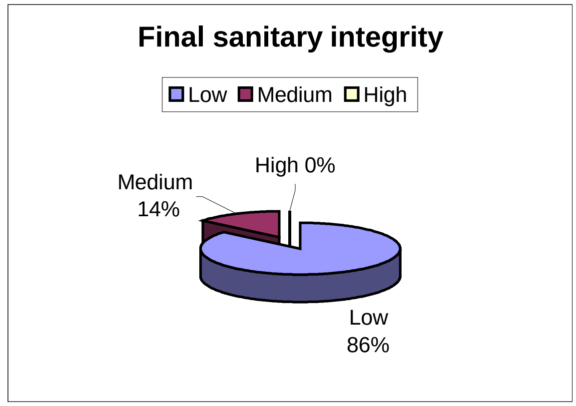


Figure 4.1: Sanitary risks at baseline **Figure 4.2: Sanitary risks in final survey**

During the baseline survey rainwater harvesters had the highest numbers of sources in medium to high risk, followed by arsenic-iron removal plants (AIRPs) and dug wells (Table 4.3). It was unexpected for the rainwater harvesters to be the source with the highest numbers at medium to high risk. The underlying reasons for this are not clear. One possible reason, however, is that the rainwater harvesters were not in use during the baseline survey as this was done in the dry season. Equally, it may also reflect that rainwater harvesters are not a popular option. Piped water supply system always demonstrates good sanitary integrity, with all supplies in the 'low risk' category.

Table 4.3: Comparative analysis of sanitary risk scores during baseline and final assessment of water technologies under first phase

Technology Type	Baseline assessment		Final assessment	
	Risk category		Risk category	
	Low (%)	Medium to high (%)	Low (%)	Medium to high (%)
Dug well	78.6	21.4	92.8	7.2
Rainwater harvester	50	50	76.60	23.40
Arsenic-iron removal plant	69.6	30.4	78.3	21.7
Pond sand filter	80	20	66.7	33.3
Deep tubewell	100	0	100	0
Shallow tubewell/ Deep set pump	81	19	90.5	9.5
Piped water supply	100	0	100	0
Overall	70.6	29.4	86.4	13.6

Similarly in the second phase, there was a noted overall reduction of water sources in the medium to high risk categories During the baseline survey in the second phase, 47.5% water options were in the medium and high risk categories. After the

WSP pilot, the proportion of water sources in the medium to high risk categories was reduced to 16.2%. This pattern was seen for all technologies, with the exception of the pond sand filters where the proportion of water supplies in medium to high risk increased from baseline to final survey. This indicates that the transfer of knowledge and ensuring this translated into practice was not effective for pond sand filters and indicates the need for further modification of the WSP. Rainwater harvesters were again the technology with the greatest proportion of water supplies at medium to high sanitary risk. All the deep tubewells were in the low sanitary risk category (Table 4.4).

Table 4.4: Comparative analysis of sanitary risk scores during baseline and final assessment of water technologies selected under 2nd phase

Technology Type	Baseline assessment		Final assessment	
	Risk category		Risk category	
	Low (%)	Medium to High (%)	Low (%)	Medium to High(%)
Dug well	80	20	100	0
Rainwater harvester	41.7	58.30	78.9	21.1
Arsenic-iron removal plant	70	30	85	15
Pond sand filter	50	50	50	50
Deep tubewell	100	0	100	0
Shallow tubewell/ Deep set pump	18.2	81.8	72.7	27.3
Overall	52.5	47.50	83.8	16.2

Microbial quality was assessed for all water options under the pilot project during the baseline survey, mid-term assessment and final assessment. The mean thermotolerant coliform (TTC) count in source waters was 18 cfu/100ml and 25 cfu/100ml in the baseline surveys of the 1st and 2nd phases respectively. In the final assessment (which included both 1st and 2nd phase communities) the mean TTC count had reduced to 14 cfu/100ml.

About 51.5% water options were found contaminated by TTC during baseline survey, which was reduced to 44.6% at the end of the intervention. In the 2nd phase 50% water options were found contaminated and at the end of the intervention it was reduced to 46.7%. The technologies most likely to be contaminated were the rainwater harvesters (reflecting the high sanitary inspection scores), arsenic-iron removal plants and dug wells. However, all technologies showed at least some examples of contamination including both the deep and shallow tubewells and the pond sand filters (although the number of pond sand filters was very low). These data suggest that it is difficult to achieve an absence of thermotolerant coliforms for small community rural water supplies and what is more important is an overall reduction in the sanitary risks and microbial contamination (WHO, 2004; Lloyd and Bartram, 1991).

Apart from water quality and sanitary risk it was observed during visits to the communities that general cleanliness of the surrounding of the water points was improved to a considerable extent. Figure 4.3 demonstrates such improvements.

Figure 4.3: Improvements in water source maintenance and water storage

Water quality tests were also carried out for TTC at different stages of the water supply chain. In the first phase, TTC counts at the household level (i.e. at the point of storage or usage) were higher than those at the water sources. The mean TTC count at sources was 18 cfu/100ml, which increased to 38 cfu/100ml from samples from household storage containers. A similar result was found in the second phase where the TTC count increased from 25 cfu/100ml at sources to 42 cfu/100ml in household containers.

In the final assessment, the TTC count in household water was reduced to 25 cfu/100ml as a result of improved hygiene promoted under the WSP pilot. This figure is still considerably higher than the average contamination at water sources, indicating the importance of hygiene promotion as part of WSPs.

4.1.5 Key findings: KAP and social factors

An assessment of knowledge, attitude and practice (KAP) with regard to water, sanitation and hygiene was undertaken during baseline and final surveys. When asked about how water can be contaminated, about 66% replied that water can be contaminated by arsenic, about 8% replied that it is due to animal excreta and 19% expressed their ignorance (Table 4.5).

Table 4.5: Knowledge about how water can be contaminated

How water is contaminated	% Respondent
Presence of arsenic	65.9
Presence of iron	5.5
Excreta of human, animal or bird	7.8
Do not know	18.5
Others	2.3

Water handling practice was studied during baseline and final survey. During the baseline survey, about 8% of the respondents were found to dip their hands during water collection to remove excess water from the container. After intervention through hygiene education and motivation, only 2% respondents were found to continue with this practice. During the baseline assessment it was found that about 74% of the respondents covered water containers during transportation, with the remaining respondents leaving the container open. In the final survey after hygiene education under the WSP pilot, 95% users were found to have covered their vessels during transportation of water (Figure 4.4).

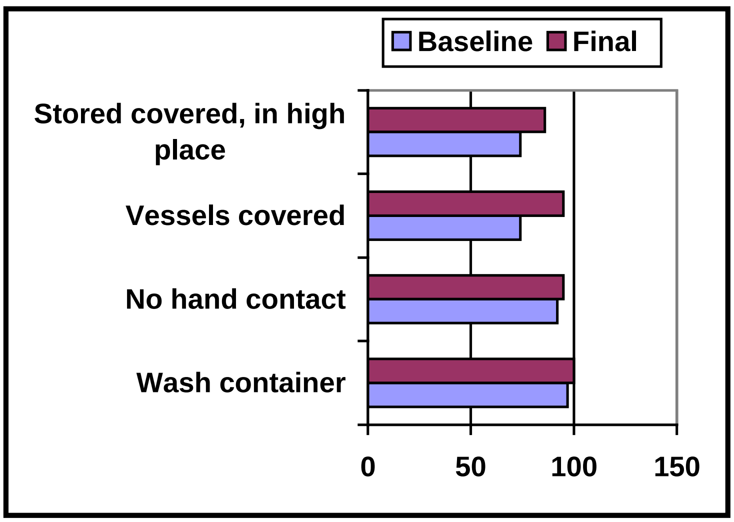


Figure 4.4 Overall Improvement of Hygiene Practice

Hygiene education and awareness campaigns by both the WSP team members and the VDC members resulted in significant positive impact on the community. Good examples were found in practice, motivation and physical safety measures. One of the many examples of this kind was found in Sylhet where one owner of a house shifted her pit latrine that was too close to the water supply to a safe distance.

Operation and maintenance is also related to social systems. For example in Jaintapur about 22 families use one ring well, but this does not include a family neighbouring the well because they were in conflict with the caretaker (who is a relative). One day when the quarrel was acute, one of the neighbours unfastened the screws of the upper part of ring well at night. In the morning when users tried to collect water from the well, they soon felt that it was out of order. This example illustrates how social relations affect the water quality issues. In another villages, there were also examples where someone threw a dead rat, dust etc into the ring well to take revenge on the caretaker. In implementing WSPs it was recognised that dealing with community issues is as important as the technical aspects.

4.1.6 Experience with the community monitoring tools

As part of implementation process of NGO Forum, two volunteers (preferably one male and one female) are selected from each community for each technology to operate and maintain the technology. The caretakers are trained and provided with necessary tools required for operation and maintenance. In the WSP project, every caretaker of the selected water points was involved.

In the WSP pilot, the caretakers were provided refresher training on operation and maintenance of the water points. They were also trained on relevant community monitoring tool and its use in monitoring their water supplies. The feedback about the WSP pictorial tool from caretakers was that they appreciated it because it is simple and pictorial and so easy to understand. It was felt the tools played a vital role in guiding caretakers in monitoring and taking corrective actions for the water supply options.

No community monitoring tools were available for Arsenic-Iron Removal Plants (AIRP). To address AIRP in a similar way to the other technologies, a Bangla checklist regarding the possible associated risks was developed and provided to the caretakers to monitor their water points (Figure 4.5). The caretakers were asked to monitor the water points using the pictorial tools every 15 days. They were also provided with notebook and pen to note down the information about their periodic monitoring. The caretakers were asked to keep records in their notebook about the following information in Bangla. In the cases where the caretakers were not literate, they took the help from their children or neighbours.

Date of inspection	Problem identified	Solution / Action recommended	Date of action taken and signature of the caretaker	Countersigned by VDC member

Figure 4.5: Checklist for caretakers

The above format was drawn in the notebook of the caretakers prior to distribution and the checklists were translated in easy Bangla. The objective of keeping records was to make an opportunity for crosschecking by the VDC members, which generated a greater sense of responsibility among the caretakers.

Existing VDCs were given the tasks of supervising the caretakers and to some extent resolve some community issues. During the pilot project the role of VDC was found proactive and effective in addressing water safety issues. It was also found that a mutual understanding and cooperation among the VDC, caretakers and NGOs can make them accountable to each other and can facilitate to a great extent the safety of water.

4.3 Environment and Population Research Centre (EPRC)

4.3.1 Organization Profile

Environment and Population Research Centre (EPRC) is a multi-disciplinary research, education and networking organization with a mission to achieve effective and sustainable development through incorporating strategic research, training, technical service, laboratory analysis and networking.

EPRC has a number of activities in major development areas such as water supply, sanitation and hygiene; appropriate technology; renewable energy; water resources management; climate variability; seed production; air pollution; education; flood control; and women's development. EPRC coordinates an information exchange network, the Global Applied Research Network for Water Supply and Sanitation in South Asia (GARNET-SA) among more than 430 organization members. It runs an environmental and food laboratory. EPRC is also providing higher educational guidance and placement of post-graduate students from Universities in Bangladesh and other countries in its projects.

4.3.2 Project Area

The pilot project was implemented in Kalia Upazila of Narail District in Southwest Bangladesh. The project was implemented in two phases. In both phases field level interventions and experiments on chlorination were conducted. Altogether six technological options were brought under the pilot programme. Details of the villages and the technologies included in the pilot project are show in Table 4.6.

Table 4.6: Villages and technologies included in the pilot project

Working Area	Technologies					
	Dug well	**Deep tubewell**	**Pond sand filter**	**Rainwater harvester**	**Piped water**	**Green shallow tubewell**
Bauisena Union						
Dunuria			✓	✓		
Jogania		✓		✓		
Bauisena	✓					
Kalabaria Union						
Kalabaria	✓			✓		
Boaliarchar			✓	✓		
Khasial Union						
Khasial		✓			✓	
Surigati		✓				
Tona						
Salamabad Union						
Joka		✓				
Jokarchar		✓				
Baka					✓	
Pauroshava						
Kulsur	✓					
Choto Kalia	✓					
Sitarampur	✓					
Mirzapur	✓					
Joynagar Union						
Keshabpur	✓					
Debdun	✓					
Pahardanga Union						
Sarashpur			✓			
Surigati		✓				
Purulia Union						
Kalamonkhali			✓			
Hamidpur union						
Modongati						✓
Silimpur						✓
Mosondrapur						✓

4.3.3 Methods

The WSP pilot interventions were carried out by a WSP team of 6 members. The pilot project activities were carried out in two phases. The project adopted experimental, intervention and observation designs. Observations were done at baseline, follow-up and post-intervention stages as well as between intervention and comparison (control) groups.

The WSP intervention mainly included community based educational, behavioural and operation and maintenance improvement of the technologies from WSP perspectives. Development of chlorination technology was done through research in laboratory scale, experimental trials at field level and incorporation of the knowledge into the intervention groups as part of the WSP.

The pilot was implemented in two phases. The intervention study designs slightly varied between the phases. Phase I mainly focused on the development of knowledge in controlled conditions and Phase II on its transfer to communities. The options sampled in Phase I were observed throughout the study.

In each phase four groups were included:

(i) WSP education interventions only;
(ii) WSP education interventions and household chlorination;
(iii) WSP education interventions and source chlorination; and,
(iv) control group with no interventions (no WSP training nor chlorination).

In group (i), educational interventions about WSPs focusing sanitary/hygienic management of the water were carried out at the source and supply points (handpump for dug wells and taps for PSFs) as well as through collection, transportation and storage by the caretakers and the users. In group (ii), educational intervention about WSP and chlorination at household level were given. In group (iii), educational intervention and chlorination at source-supply point were provided. In group (iv), observation was made under controlled conditions but similar to the real field conditions.

In the first phase, dug wells were included in all the intervention and control groups. There were 5 dug wells in every group (in total 20 dug wells). Deep tubewells were included in all the study groups except intervention Group III. There were 15 deep tubewells in total. There was at least one pond sand filter in each group and 5 in total. Two piped water systems; Baka and Khasial systems were studied. The Baka piped water system supplied water to 215 households through 32 community taps. The Khasial piped water system supplied water directly to about 30 households. Five random taps and one pump discharge point were observed (total six sampling points) from every system. In the second phase 30 water options were covered and similar methods were applied as that of first phase. The same control group was used in both phases.

The purpose of the chlorination experiment was to develop a simple chlorine dosing method for community use, as part of an overall WSP. The chlorination component of the project included experiments and interventions at two levels:

1. Chlorination at source. Various doses and methods of chlorination were tested at the different sources;
2. Chlorination at household level of the users of the study water options.

Chlorination was first explored by Jar tests on water samples from all the sources/supply points of the different kinds of options. Field controlled tests were performed based on the results of Jar tests at sites selected outside the study area. The field-controlled tests helped to narrow down the number of probable options to 3 from several options. These 3 options were tested in the intervention groups of the main observation design. Bleaching powder (BP) was used as the chlorination agent. BP is more or less available in all Upazilas.

4.3.4 Pilot Findings: water sources

The water use pattern for different options of the project area was studied. It was observed during baseline, that almost all households who have access to deep tubewells, pond sand filters and piped water drink the water from these sources. The proportion of households with access to dug wells that drank this water was only 76%, due to its poor aesthetic quality particularly during dry season. After the WSP intervention, it was observed that drinking of dug well water improved to about 90%. Rainwater was not available throughout the year and therefore was not the sole source of drinking water for households.

The sanitary condition of the water points was studied during the baseline and final surveys. A comparison of sanitary scores has been shown in Figure 4.6, which shows that the proportion of water sources in the low risk category increased by almost 30% by the end of the pilot project and the high risk group was reduced by almost 9% to only 1.5% of sources. The sanitary risks at dug wells significantly improved with 15 out of 50 dug wells in the no to low risk category in the final survey compared to none in this category in the baseline surveys.

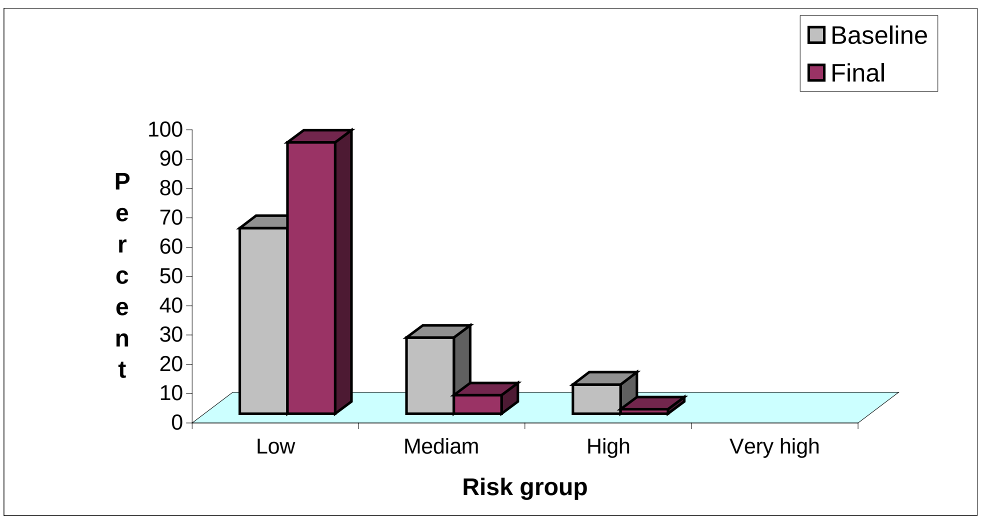


Figure 4.6 Sanitary score of the water option

The impact of the improvement of the WSP pilot project on the microbial quality of water of the water sources was studied by comparing the quality at the baseline survey and the final survey. In assessing the microbial quality, EPRC used the water quality categories set out in the DPHE Protocol for Water Quality Surveillance (DPHE, 2005) which are linked to estimated disease burdens as developed from the quantitative health assessment tool developed as part of the RAAMO project (Ahmed *et al*., 2006). The categories used are shown in Table 4.7.

Table 4.7: Water quality categories

TTC (cfu/100ml)	Water quality category
0	Conformity with standard. Water safety is verified.
1 - 10	Low risk. Water safety can be considered.
10 - 100	Intermediate risk. Water cannot be considered as safe.
100 - 1000	High risk. Water is unsafe.
> 1000	Very high risk. Water is extremely hazardous.

The analysis of data showed that the proportion of the samples in the high to very high risk category taken from water supplies with WSPs reduced by almost 20% to only 3% of water sources in the final survey for phase 1 communities and by over 30% for the phase 2 communities. Overall there was an increase in the proportion of water supplies in the low risk category from 20% at the baseline to 48% of water sources at the end of the WSP pilot project.

The improvement in microbial quality was significant for individual technologies. For instance, for dug wells the proportion of samples in the no to low risk category was increased by 40% during the period of the pilot and the proportion of samples in the high to very high risk categories decreased by 20% (Figure 4.7). It was noted, however, that the quality of water deteriorated between the intermediate and final surveys. This was attributed to a depression just before the final survey, which resulted in heavy rainfall. The community also noted deterioration in the aesthetic quality of the water (colour and smell) suggesting rapid recharge of contaminated water. This suggests that chlorination is required to secure water safety throughout the year and should be incorporated into the WSP.

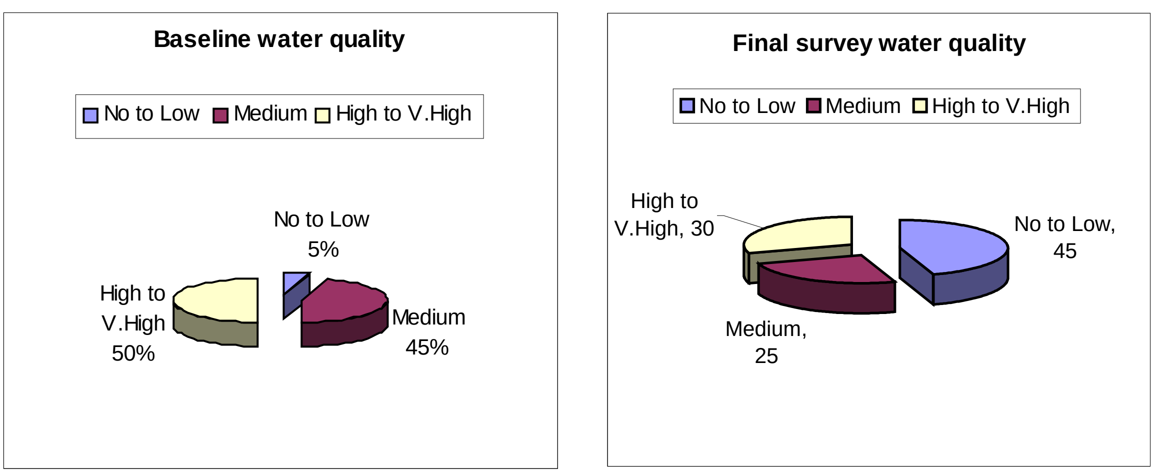


Figure 4.7 Microbial quality of dug wells at baseline and final survey

The effect of chlorination was pronounced on the quality of water from dug wells. For dug wells where source chlorination and WSP training was provided, the median contamination decreased from 160cfu/100ml at baseline to 20 cfu/100ml in the final survey for phase 1 communities and from 200 to <1cfu/100ml in the phase 2 villages. By contrast, training on WSPs alone led to a reduction from 100 to 40 cfu/100ml in the phase 2 villages and showed an increased in contamination in phase 1 villages. The latter was probably due to excessive caused by the depression noted above. In the phase 1 villages, water quality deteriorated between the intermediate and final surveys, as the chlorination technology was transferred to communities. These findings reinforce the need for chlorination of dug wells and suggest chlorination should be included in the technology WSP. This will, however, raise issues of the ease of transfer of the technology to communities.

For pond sand filters, a reduction in the number of samples in the high and very high risks categories decreased by 40% and the proportion of samples in the no to low risk category increased by 20% (Figure 4.8). Overall the median concentration of thermotolerant coliforms also decreased significantly between the baseline and intermediate surveys (185cfu/100ml and 60 cfu/100ml) and the final survey (36 cfu/100ml).

The effect of chlorination at pond sand filters was again seen as important for improvement in water quality. For pond sand filters where both source chlorination and WSP training was provided, the median contamination reduced from 48cfu/100ml at baseline to 17cfu/100ml at the final survey. Again, quality deteriorated between intermediate and final surveys (median at the intermediate survey was <1cfu/100ml), which coincided with transfer of the chlorination technology to the community. For communities receiving WSP training alone showed a progressive improvement in water quality from 280 cfu/100ml at baseline to 37 cfu/100ml at the final survey.

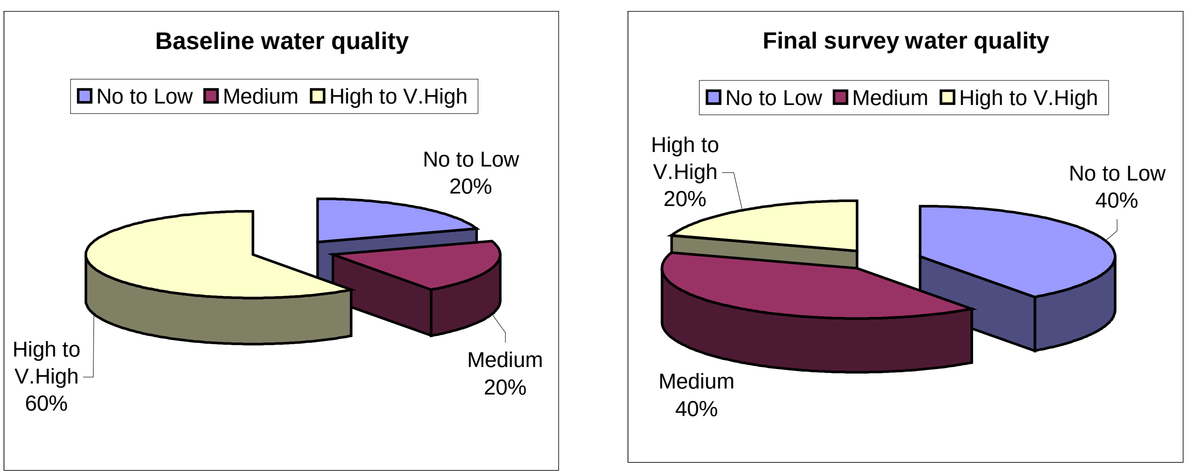


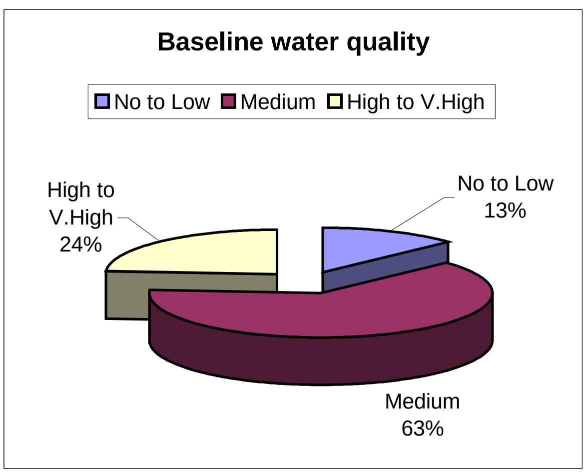
Figure 4.8: Microbial quality of pond sand filters at baseline and final survey

Deep tubewells were always of good microbial quality, with 94% of samples in the no to low risk category at baseline and this performance continued in the final survey. The median concentration of thermotolerant coliforms remained at <1cfu/100ml throughout the pilot project. Sanitary risks also remained in the low risk category during this time. However, when contamination did occur, this was at relatively high levels of up to 50 cfu/100ml. This is likely to result from the use of contaminated priming water and shows the need for the WSP to focus on key operational issues. The shallow green tubewells included in the pilot project were of poorer quality than the deep tubewells, with a median TTC at baseline of 14cfu/100ml and 8 cfu/100ml respectively. This suggests that the presumed high quality of water from shallow tubewells has in fact often not been the case.

Piped water systems were of good quality, but showed improvement over the project, as median TTC contamination decreased from 8cfu/100ml at baseline to <1cfu/100ml at the final survey. The system that had regular chlorination in the first phase showed better quality than the unchlorinated supply, although the difference was not great. Rainwater harvesters provided lower than expected quality and although there was some improvement from the phase 2 baseline survey (50 cfu/100ml) in the final survey (29cfu/100ml) this is not as significant as expected.

4.3.5 Project findings: household water

The microbial quality deteriorated during collection, transportation, storage and use for all water supply technologies. The WSP pilot focused on hygiene education about water handling practices and this resulted in some improvement in the quality of water stored in the home. The proportion of samples in the no to low risk category increased by 20% and the proportion in the high to very high risk categories reduced by 15% (Figure 4.9). However, the data suggest the need for ongoing hygiene promotion for effective results.



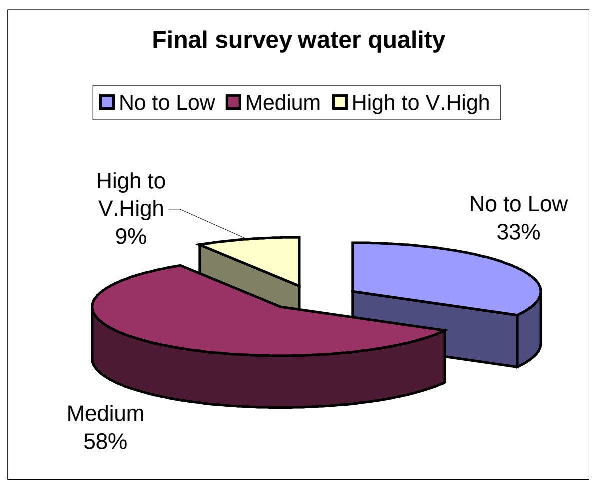
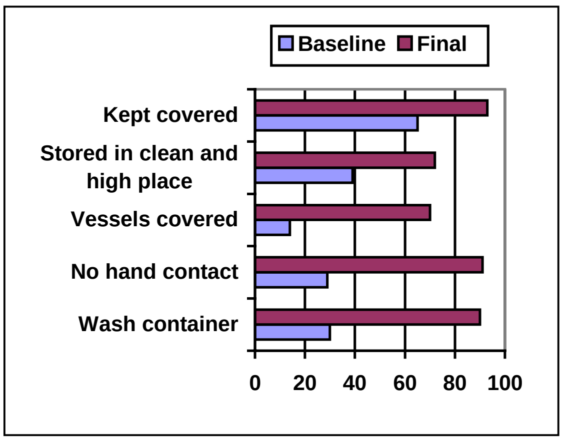


Figure 4.9: Microbial quality of water stored in houses at baseline and final survey

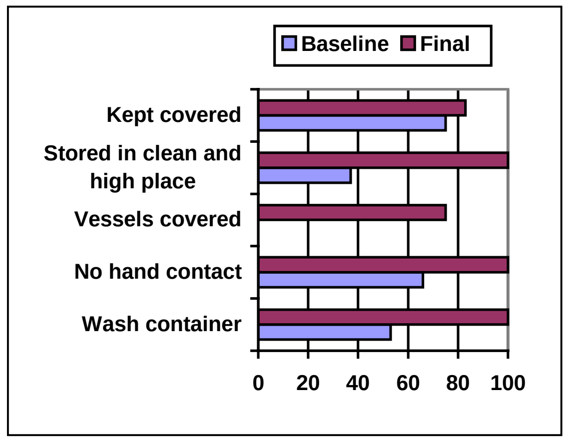
The quality of water stored in the home improved for users of most of the technologies. The biggest improvement was noted with households using a pond sand filter, where median TTC contamination decreased from 102 cfu/100ml at baseline to 35 cfu/100ml at the final survey. This mirrors the improvement in water quality from the pond sand filters. The improvement in households using dug wells was less pronounced with TTC counts reducing from 90 to 65cfu/100ml, although at the intermediate survey the median was 8 cfu/100ml. This is probably related to the variation in the quality of the dug well water itself. The improvement in household quality among users of en shallow tubewells was also significant (41 cfu/100ml at baseline to 12 cfu/100ml at final survey), but the reductions in TTC were more limited among users of deep tubewells and rainwater harvesters and the latter remained at relatively high levels of contamination.

The hygiene practices of communities using different technologies were also studied. Figure 4.10 illustrates the hygiene practices related to water handling and storage at the baseline and final survey for users of different technologies. This shows that hygiene practices improved significantly for these technologies as a result of increased awareness on safety aspects of water through hygiene education intervention of the WSP pilot project.

Dug well



Pond sand filter



Rainwater harvesters

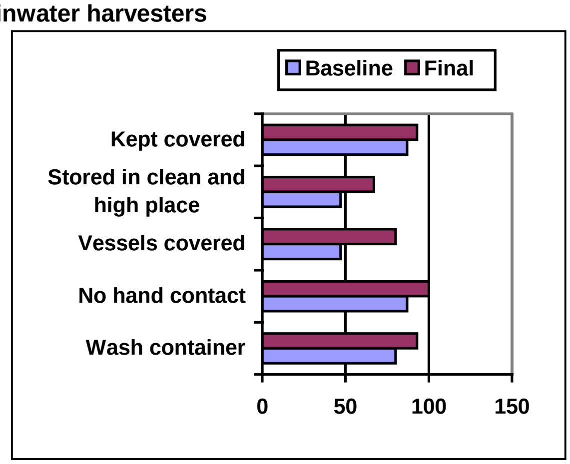


Figure 4.10: Hygiene practices by users of different technologies

4.3.6 Experience with chlorination

As part of the WSP pilot, EPRC undertook experiments to develop an appropriate chlorination technology and approach that could be transferred to communities.

Both source chlorination and household chlorination were tested both for technical performance and social acceptability.

A number of approaches were tried for dug wells, pond sand filters and piped water systems. The research showed that shock chlorination repeated on a 5-day cycle was most appropriate for dug wells, as microbial contamination remained under control and residual chlorine remained at reasonable levels (0.1mg/l or higher). For pond sand filters, the recommended chlorination approach is a drip chlorination method with chlorine solution fed into the final chamber over a 24 hour period and repeated daily. For piped water supplies a continuous drip-feed system was recommended.

The acceptability and performance of chlorination technologies once transferred to communities was variable. Users of dug wells appeared to appreciate chlorination and were most likely to continue to practice chlorination once transferred. Sustaining the chlorination of pond sand filters and piped water systems was more difficult and communities were more likely to either abandon chlorination or only to practice this intermittently.

These findings may reflect that the approach for dug wells was much simpler and chlorination was required less frequently than those for piped water and pond sand filters. Thus although chlorination is considered as an essential component of WSPs for these technologies, clearly more work will be required on community transfer. Household chlorination was largely rejected by households and very few were found to sustain the practice consistently over longer periods of time.

4.3.7 Experience with the community monitoring tools

The WSP approach was highly appreciated by the community. They took it as a logical and beneficial approach for health protection. The preventive maintenance of the water points was not new to communities; however, its implication on water safety was not previously understood. The hygiene issues of WSP related to water collection, transportation, storage and usage also gave a new dimension in their present perception on water safety.

A record-keeping chart was attached to the APSU community monitoring tool to keep a record of actions, but it was found that caretakers were reluctant to keep written records. This was reflected in a random survey that about 58% of the caretakers did not complete the record-keeping chart. The WSPs for dug wells and pond sand filters should probably have chlorination as standard and therefore the community monitoring tools will need to incorporate chlorination management. This may require simple water quality testing equipment as well as the pictorial tools.

4.4 Dhaka Community Hospital (DCH)

4.4.1 Organization Profile

Dhaka Community Hospital is a trustee owned private, non-profit making and self-sustainable health care providing organisation established in 1988. Its primary goal is to improve the health status of the least advantaged section of the Bangladesh population in rural and urban areas through ensuring their participation in health care management, research and human resource development.

DCH is well known for its pioneer role in the field of identification and mitigation of the arsenic problem in the country. In addition to routine health care activities, it has a number of initiatives in the field of arsenic screening and mitigation, research, community mobilization and capacity building programme.

4.4.2 Project Area

DCH implemented the pilot activities in four Upazilas of Pabna and Munshigonj districts. In Pabna 10 Villages of three Upazilas and 11 Villages of one Upazila were covered in the project. A total of 35 water points of 3 different technological options were studied. The Table 4.8 shows details of working areas with the technologies that have been covered under the pilots.

Table 4.8: Area and technology options covered by the DCH pilot project

District	Upazila	Union	Villages	Technologies
Pabna		Jatshskini	2	Dug wells
	Bera	Mashumdia	1	Dug wells
		Ruppur	1	Dug wells
	Sujanagar	Ahmedpur	2	Dug wells
		Sagorkandi	1	Dug wells
	Santhia	Ahmedpur	2	Dug wells
		Karamja	1	Dug wells
Munshigonj		Rashunia	2	Dug wells, Rainwater harvesters
		Latabdi	2	Dug wells, Rainwater harvesters
	Sirajdikhan	Bairagadi	2	Dug wells
		Malkhannagar	2	Pond sand filter, river sand filter
		Kola	1	Pond sand filter
		Ichhapura	2	Dug well

4.4.2 Pilot findings

The sanitary integrity survey reveals that all the dug wells in Sirajdikhan are within 'no to low level risk' category using the same classification as in the EPRC pilot project. However, dug wells in Pabna district exhibited risk in the 'very high category', the median value of sanitary inspection score being 9 out of 10.

Good design and quality construction of water points are pre-requisite for production of safe water. DCH found construction defects in some dug wells in Pabna district and as a result undertook a programme of rehabilitation for these dug wells. After rehabilitation of the dug wells, the sanitary risks were assessed again and it was found that all the dug wells moved from high risk to low risk category. This is shown in Figure 4.11.

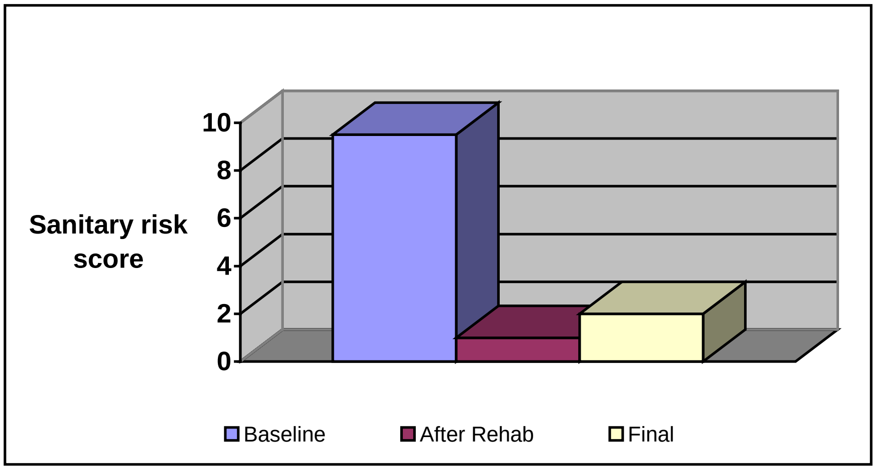


Figure 4.11 Improvement of dug well sanitary integrity in Pabna

Reductions in sanitary risk were found for both dug wells and pond sand filters over the course of the pilot project in all areas, as shown in Figure 4.12. In the case of dug wells, the reduction in the overall median sanitary risk is greater and is equivalent to 56%. This reduction meant that the median sanitary risks for dug wells in the DCH pilot project were in the low risk category in the final assessment (2/10) from the medium risk category in the baseline assessment (5/10). Significant improvement was also observed in the pond sand filters where there was a 41% reduction in the median risks, although pond sand filters sanitary risks were relatively low at the baseline. Rainwater harvesters showed an increase in sanitary risks between the baseline and the final assessment, suggesting that the WSP for rainwater collection had been less effectively transferred.

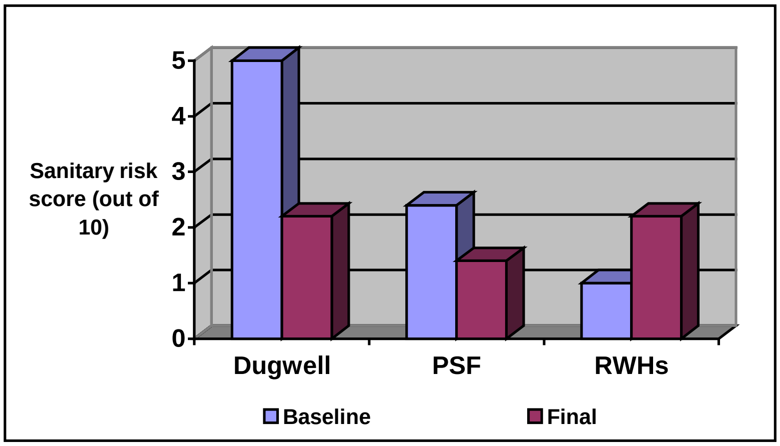


Figure 4.12: Median sanitary risks score in the DCH pilot

The microbial quality of all water points was assessed and compared to the categories defined in the DPHE surveillance protocol (see Table 4.7). The assessments showed that the microbial quality of technologies was in the low risk category even during the baseline survey. The range of TTC count was 0-13 for dug wells, 5-12 for pond sand filters and 2-3 cfu/100ml for rainwater harvesters in the baseline. The low figures for the dug wells even with high sanitary inspection scores are likely to be because the baseline was undertaken in the dry season.

The sanitary risks identified are often significantly influenced by season, with contamination occurring when the risks are present during the monsoon. After implementing the WSP pilot project no dug wells showed microbial contamination. Pond sand filters in the final assessment still showed some contamination, but the numbers of TTC identified were very low.

In addition to providing training to caretakers, DCH also provided hygiene education and promotion using the existing materials used in the other DCH programmes. The DCH report notes a significant improvement in hygiene practice on water handling and usage.

DCH also evaluated the community based monitoring tools developed by APSU for caretakers and discussed these with the caretakers and village committees to get their perceptions. The tools were found to be user friendly and effective. The WSP tool was well received by the caretakers and was considered to be important in assisting them in monitoring and taking corrective actions for the water supply options. However, these tools used pictures of old model of dug wells and pond sand filters. The new designs are different from the old ones for some components and thus corrective actions are also different. It was recommended that the tools be updated and expanded to cover different designs of key technologies.

4.5 Bangladesh Water Supply Program Project (BWSPP)

4.5.1 Organization Profile

The Bangladesh Water Supply Program Project (BWSPP) is a project of DPHE funded by the World Bank. It follows on from the previous World Bank supported Bangladesh Arsenic Mitigation Water Supply Project (BAMWSP). BWSPP primarily focuses on provision of piped water schemes to large villages and small towns in both arsenic affected areas and non-arsenic affected areas. In addition, BWSPP provides some point source water supplies in smaller arsenic affected villages. As BWSPP is just starting, the number of piped schemes is limited and thus the pilot project is focused on point sources and one Pourashava piped water supply.

4.5.2 Project Area

Pilot activities for non piped rural water supply were undertaken in four Upazilas in Bagerhat, Khulna, Manikgonj and Sherpur districts. A total of 57 water points of 4 different technological options were studied. A WSP was defined for the Chapai Nawabgonj Pourashava piped water supply based on the new water sources installed by BWSPP. Table 4.9 shows details of working area with the technologies that have been covered under the pilots.

Table 4.9: Area and technology options covered by the BWSPP pilot project

District	Upazila	No. water points	Technology Covered
Chapai Nawabgonj	Pourashava		Piped Water supply system (Ground water)
Bagerhat	Mollahat	3	Pond Sand Filter
Khulna	Digholia	20	DTW
Manikgonj	Singair1	4	DW
Jamalpur	Sadar	30	STW, DTW

4.5.3 Pilot findings for rural water supplies

For the users, the WSP concept opened a new window of thinking regarding safety of water in an integrated way. The WSP team was able to make the community understand about the possible causes of water contamination in the water source and within their domain (i.e. during water handling from collection to consumption point). The reorientation of knowledge on water safety provided an impetus to communities in keeping their water points clean and in practicing improved hygiene during water handling, Figure 4.13.

Figure 4.13: Caretakers are maintaining clean environment around the tubewell

The caretakers had received training on the repair of water points at different times under different programmes. The approach of training had been to make them able to restore the supply of water through repairing. However, the WSP concept clarified the possible pathways of contamination at source as well as during handling. This knowledge shifted the focus to preventive maintenance from repairs to damage. Caretakers were seen to undertake repairs of cracks and damaged areas of tubewell platforms and painting of the handpump (Figure 4.13). Painting was done to give a better aesthetic value to the water point and to emphasise its safety, as shown in Figure 4.14. In addition improvements in the cleanliness of tubewell platforms and other water supplies were noted, as shown in Figure 4.15.

Figure 4.14: Caretakers painted their tubewell as a symbol of a safe water point

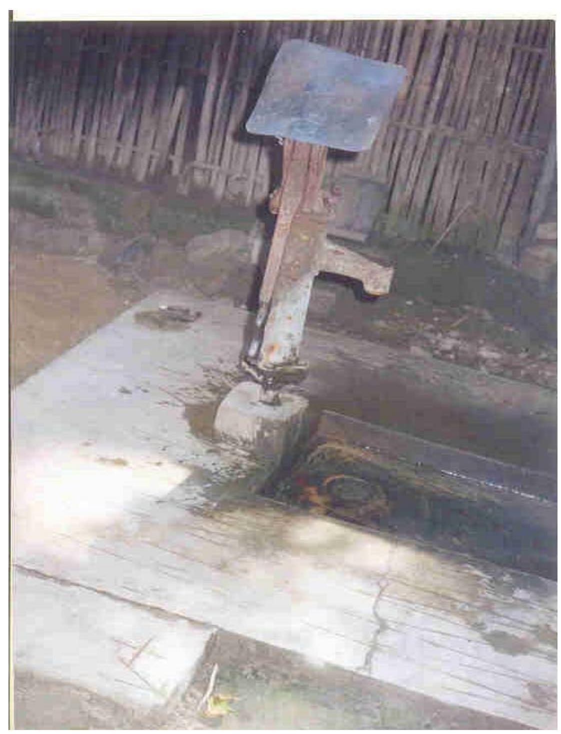


Figure 4.15: Cleanliness of tubewell surroundings improved

In Gaola and Sugandha Villages the users and the caretakers set good examples. They shifted all the pit latrines and animal pens, which were too close to water points, to a safe distance. These are significant achievement of WSP because the shifting of toilets is expensive for the villagers. Unless people are motivated and understand the potential impact on their water supply, it is hard to expect this type of action.

The community based monitoring tools developed by APSU was found to be user friendly and effective. However, this tool provided pictures of old model of dug wells and pond sand filters, therefore revised tools with the new designs are needed. For household water, the existing hygiene education materials were used to support the WSP. These were found effective as they cite practical examples of villagers' daily life.

4.5.4 Key findings for Pourashava pilot project

In addition to the rural pilots, activities have been initiated for the piped water scheme in Chapai Nawabganj Pourashava. A system specific WSP was developed for the water supply by a small team of experts from BWSPP and ITN-BUET, in collaboration with local DPHE staff and staff from the Pourashava. The WSP was peer-reviewed by an international expert from Australia during a site visit in 2005.

The Chapai Nawabganj WSP sets out all the major hazards, hazard event analysis, control measures, monitoring requirements and verification schedule. The WSP document has been prepared and given to the Pourashava. The Chairman of the Pourashava has supported the process and made commitments to raise water safety issues in all forums dealing with water supply. A formal launch of the WSP is planned for early 2006.

Stakeholders of the water supply system - the users, local leaders (ward commissioners), piped water supply staff and the Pourashava Chairman were given separate orientation programmes on WSP. The response and support from all quarters was encouraging and the experience so far from Chapai Nawabganj has been positive.

The Pourashava has an arsenic problem in some production wells. As a first safety measure, the Pourashava stopped supplying water to the network from these tubewells. Consumers were found cleaning their underground and rooftop tank and vigilant about the presence of leaks within their domain, as their level of knowledge on the possible pathways of contamination was increased. When any leak or damage have been seen, the consumers of Chapai Nawabganj Pourashava have reported this to the piped water supply staff.

Operational monitoring on some indicators has already been started by the pump-drivers and line-men. They are also being supervised by the Pourashava superintendent more closely. Furthermore, some key messages on hygiene, water handling, usage and hazard events are printed on the backside of the consumers water bills.

4.6 DPHE-UNICEF Arsenic Mitigation Project

Water Safety Plans are being piloted in 19 Upazilas through the DPHE/UNICEF arsenic mitigation project. To date no direct data has been provided, but the feedback from UNICEF is given below to give a sense of key lessons emerging from a half-day workshop in September 2005 with the 8 NGOs involved in the piloting (which included DCH and EPRC).

Limited water quality testing was conducted; the focus was on use of sanitary inspection and community monitoring tools. NGOs provided specific feedback on three sets of tools: the formal WSP Pro Formas, the sanitary inspection forms, and the APSU community monitoring tools. The NGOs were also asked to provide more general feedback on the utility of the WSP materials, and on the scope for having communities make use of the tools for operational monitoring. Working groups reviewed these materials separately for dug wells, pond sand filters, rainwater harvesting, and tubewells based on their experiences.

4.6.1 Pro Formas

Many participants noted that the formats are complex, even for central managers. Some were not clear on how these would be used. During discussions, UNICEF clarified that the pro formas were not intended for data collection. The WSPs are tools for helping top-level managers to fully understand the various components of the various water supply systems, what hazards might be encountered at each step, and what corrective actions should be taken. In this way they would help central managers ensure proper training of field staff, and design of operation and maintenance protocols. The pro formas should be reviewed at the central level and endorsed, which could be done at the beginning of a project phase during training and orientation of project staff. Further modifications could be made as needed and then kept on file.

Participants felt that the content of the pro formas (notably the hazard analysis) was accurate and useful, but should be translated into Bangla. A few additions were recommended by the dug well group:

- the size of apron recommended should be revised taking into account different approaches. For instance, one NGO deliberately used a small diameter apron to prevent its use for washing and other activities which may cause contamination;
- additional chemical parameters of concern should be included, for instance ammonia, chloride, and nitrite;
- the pro-forma should clarify that the purpose of the recommended test tubewell is to avoid installing dug wells in areas where peaty layers or very coarse sand layers would make water quality problems likely;

- it was felt that chlorination twice yearly is not enough: every four or even two months would be better. There was an unresolved debate over whether water would need to be pumped out of the well after chlorination and the level of dosing, for example using hyper-chlorination or aiming for a residual suitable for consumption.
- the next edition of the WSP should resolve this and make clear recommendations; and,
- the priming of the suction pump with unsafe water should be included in the hazard analysis in the same way as for all technologies using a handpump to lift drinking water (for example deep and shallow tubewells and community rainwater harvesters).

4.6.2 Sanitary inspection formats

Sanitary inspection formats were provided originally in English and in Bangla. There were a few key comments that should be considered in revising the material prepared to support WSPs. In some cases the Bangla translation did not perfectly match the original English version and this needs to be rectified.

4.6.3 APSU community monitoring tools

Overall, the NGOs had very positive experiences with the use of the APSU community monitoring tools. They felt that caretakers would be able to use them easily to monitor the water points. They would like to include the tools in caretaker training, as a complement to the operation and maintenance manuals. There were some comments for improvement:

- the tools should be more closely linked to the sanitary inspection forms with one page per question. It would also help if the pages were numbered;
- the current design has blue arrows pointing to the poor situation, with question inside. It would be easier to understand if the question was in a box above the picture, with the arrow pointing to the good situation, and text indicating the corrective measure required. The picture on the left representing a bad condition could be reinforced by putting a red X through the graphic;
- more women should be depicted taking corrective actions;
- although it is good to have low-text pages, literacy is increasing. Therefore, having one page of text at beginning or end of book, with more detailed information, and perhaps the SI format should be considered;
- include a simple format for recording caretaker monitoring with tick marks at the back of the book, with small pictures of the monitoring activities or provide a separate paper format with pictures;
- the distances are hard to gauge in some of the pictures, for instance the difference between good and bad situations is not clear for latrines. In the dug well book, the latrine showed as a good example of ‘lower than the dug well’ seems to be closer than 30 ft; and,
- some pictures should be included with a fence around water supply.

4.6.4 General comments about the WSP Pilot

Overall, the NGOs were positive about the WSPs, the use of sanitary inspection formats and APSU tools, and felt that these could improve caretaker training and performance. So far, the formats have been filled out by NGO workers, and in many cases NGO workers keep the APSU tools as they have only a limited number. In other cases, NGOs have left the APSU tools with communities, which is how the tools are meant to be used. The sanitary inspection formats and monitoring tools can be easily integrated into standard caretaker training modules, after some revisions.

5.0 KEY FINDINGS, CHALLENGES AND FUTURE NEEDS

5.1 Key findings

The overall feedback from the WSP pilot projects has been very positive and the success of a diverse range of organisations in implementing WSPs provides confidence that their use can be scaled up. The water safety plans themselves have been well accepted by the NGOs and DPHE as an effective guide for understanding how water safety can be assured. A number of suggested improvements and changes have been identified for the ongoing process of revision of the WSPs.

The pilot projects implemented with direct support from APSU showed consistent reductions in sanitary risks, and improvements in microbial quality. These are not uniform, however, and some caretakers performed better than others. This indicates the need for periodic follow-up with communities through surveillance, which could also be used as a means of verifying the WSP.

The quality of design and construction of water supply options is critical for ensuring safe water and these stages must address water safety issues. Water options that are unable to produce good quality water due to poor quality design or construction will require rehabilitation. The assessment in Sirajdikhan reveals that rehabilitation work during WSP pilots result in significant improvement in the water quality.

The improvements in microbial water quality varied between the technologies, with tubewells (particularly deep tubewells) being the best microbial quality, as would be expected. In many cases, WSPs for dug wells and pond sand filters showed significant improvements, but chlorination is likely to be required at least seasonally and should be incorporated in the WSP and community monitoring processes. This will present challenges in ensuring that appropriate technologies can be developed and successfully transferred to communities. To date, the experience suggests that dug well chlorination may be easier to transfer than chlorination of pond sand filters.

Rainwater harvesters showed a disappointing performance, perhaps because these are mainly household supplies and thus the training and support requirements are much greater. Nonetheless, for both rainwater harvesters and safe shallow tubewells, more work will be needed to improve roll-out.

Household chlorination appears to have been far less successful in these pilots than source chlorination, although other projects have been more successful. This suggests that there needs to be greater cross-learning from different initiatives.

This report has not discussed chemical or physical water quality in detail, although some improvements in physical quality were found with reductions in turbidity. The main chemical hazards in Bangladesh (arsenic, iron, chloride, manganese and boron) are natural. The WSPs currently prepared rely on the source selection stage to resolve chemical water quality problems. However, in some cases new WSPs are required for technologies designed for chemical removal – for instance the arsenic iron removal plants and arsenic removal technologies. The WSPs for these technologies must include simple operational parameters for monitoring.

Community responses are very positive and encouraging towards the WSP approach and the introduction of WSP was highly appreciated by communities. The community readily accepted the community monitoring tools and recognised the need for regular sanitary inspection and action. The pictorial tools for community monitoring encouraged the caretakers to undertake prompt preventive maintenance to ensure safety of water. There have been a number of examples where the use of WSPs have led to direct action by caretakers that will improve the safety of the drinking water. This included repairs to damaged water source infrastructure, moving of sources of contaminants such as latrines and animal pens, and cleaning of the surroundings of the water supplies. These all point to the accessibility and usefulness of these tools.

At the same time, a number of improvements were noted as being required for the tools to reflect different designs and to improve comprehensibility. The use of some written components on the tools is an interesting suggestion, but the value of this is likely to vary depending on the particular communities, as literacy is variable and many caretakers are not literate. The experience from the pilot projects indicates that developing standard tools may not be realistic. It may be more effective for different programmes and projects to adapt the tools to meet local conditions and for guidance to concentrate on ensuring that the key message are included.

Some concern was raised in the pilot projects that despite communities appreciating the value of the tools, some caretakers undertook the monitoring and corrective actions irregularly. Further work will be needed to find the most appropriate ways of transferring these tools and WSP concepts to caretakers to ensure effective implementation.

The existing VDC/OMC/CBOs can play important roles in the implementation of WSP through supervising and cross-checking caretakers activities. The involvement of these committee can be vital in ensuring that caretakers continue to follow best practice. It was also found that the caretakers can play an effective role in the motivational activities towards safe water handling by the community.

The ongoing sanitation and hygiene campaigns across the country make the implementation process easier to promote WSPs. It will be important for projects and programmes implementing WSPs to integrate training about WSPs with hygiene promotion, caretaker training and awareness-raising. The use of existing processes and approaches will be more cost-effective and are likely to be more sustainable than stand-alone activities.

5.2 Key challenges

There are some key challenges for scaling up WSPs. The biggest challenge is the scale of activity required, given that there are between 7.5 and 10 million shallow tubewells in the country, most of which are owned by households. Rolling out WSPs will have to consider how this will be achieved. It is likely that in the first instance, the most appropriate approach will be to focus on community water supplies (in arsenic affected and unaffected areas). A strategy is required for rolling out information and training on WSPs for household rainwater harvesters and safe shallow tubewells.

For some of the actions to improve water safety, such as relocation of latrines, there are serious space constraints. Furthermore, at present there is no widely accepted information no minimum safe distances for Bangladesh. This requires further work to define minimum safe distances and where these cannot be assured to define other interventions that could improve water safety.

The WSP pilots have benefited from expert input from a number of national and international resources. It will be important for future scaling up that the pool of expertise is increased and that a group of experts able to guide and provide technical assistance is developed.

5.3 Future needs for the development of WSPs

All major water supply projects in Bangladesh have committed to implementing WSPs in their projects and the sector development plan (SDP) notes the need to implement WSPs as part of an overall water safety framework. This effort should be supported and the different agencies and programmes encouraged to meet regularly to share experiences. It should be recognised, however, that the process of WSP implementation will take time and this has been the experience of other countries implementing WSPs.

The WSPs are by their nature dynamic and require regular review and updating as new information is obtained about performance of WSPs, hazards and risk events. It will be useful to set out a formal process for this through a regular stakeholder forum. This could be led by a national WSP core group with support from the Policy Support Unit in Local Government Division.

A national WSP core group could be used to develop expertise in implementing WSPs and to encourage wider uptake and support the mainstreaming into GOB, donor and NGO projects. They could also provide technical support to projects and programmes in implementation of WSPs and working with communities. The national core team will also require policy support and thus the WSP core team should develop an advocacy programme to incorporate WSPs into policy and in revising the Bangladesh drinking water quality standards.

The DPHE Sub-Assistant Engineers and laboratory personnel should be involved in the process of WSP implementation in future interventions, particularly during water quality testing for playing verifying role in WSP. This is important because DPHE will carry out water quality surveillance across the country under the newly approved *DPHE Water Quality Surveillance Protocol.*

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ANNEXES

WATER SAFETY PLANS IN BANGLADESH: EXPERIENCES FROM PILOT PROJECTS

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This report was prepared by a team from the Arsenic Policy Support Unit (APSU) and the International Training Network Centre of the Bangladesh University of Engineering and Technology (ITN-BUET) in collaboration with the Environment and Population Research Centre (EPRC); NGO Forum for Drinking Water Supply and Sanitation; Dhaka Community Hospital (DCH); Bangladesh Water Supply Program Project (BWSPP); and, DPHE-UNCIEF Arsenic Mitigation Project. The activities undertaken by ITN-BUET, EPRC, NGO Forum, DCH and BWSPP were done with financial support from the Department for International Development (UK) through their funding of APSU.

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Annex 1a

SANITARY INSPECTION FOR THE ASSESSMENT OF RISKS OF CONTAMINATION OF DUG WELL

I.	**Type of Facility**	**:**	**DUG WELL WITH HANDPUMP**
1.	General Information	: : :	Caretaker :……………………………………….. District…………………..Upazila :……………… Union………………….Village………………….
2.	Name of the PNGO	:	…………………………………………………….
3.	Code Number	:	……………………………………..…..
4.	Date of Visit	:	…………………………………………

5. Water sample taken?……………… Sample No……………….. FC/100ml…………..…

II. Specific Diagnostic Information for Assessment

		Risk
1.	Is there a latrine within 10m of the Dug Well?	Y/N
2.	Is the nearest source of faecal pollution on higher ground than the Dug Well?	Y/N
3.	Are there any other sources of faecal pollution within 10m of the Dug Well?	Y/N
4.	Is the drainage faulty allowing ponding within 2m of the Dug Well?	Y/N
5.	Is the apron less than 1m in radius?	Y/N
6.	Does spilt water collect in the apron area?	Y/N
7.	Is the hand pump loose at the point of attachment to apron	Y/N
8.	Is the trunk loose at the base plate of the tube well?	Y/N
9.	Is the apron cracked or insanitary?	Y/N
10.	Does the vent have mosquito meshing in torn/damaged condition?	Y/N

Total Score of Risks ….…………/10

Risk score: 10 = Very high 7-9 = High; 4-6 = Medium; 0-3 = Low

III Results and Recommendations:

The following important points of risks were noted: (List nos. 1-10)

Signature of sanitarian………………………………

SANITARY SURVEY FORM FOR THE ASSESSMENT OF RISKS OF CONTAMINATION OF DEEP HAND TUBEWELLS

I.	**Type of Facility**	**:**	**DEEP TUBEWELL WITH NO. 6 HANDPUMP**
2.	General Information	: : :	Caretaker :…………………………………….. District…………………..Upazila :……………… Union……………………Village ………………..
2.	Name of PNGO	:	……………………………………………………
3.	Code Number	:	…………………………………….…..
4.	Date of Visit	:	…………………………………………
5.	Water sample taken?…………		Sample No……………….. FC/100ml…………..…

III. Specific Diagnostic Information for Assessment

		Risk
1.	Is there a latrine within 10m of the DHTW?	Y/N
2.	Are there any other sources of pollution within 10m of DHTW?	Y/N
3.	Is the nearest source of pollution on higher ground than the DHTW?	Y/N
4.	Is the drainage faulty allowing ponding within 2m of the DHTW?	Y/N
5.	Is the platform less than 5 ft x 5 ft dimension?	Y/N
6.	Does spilt water collect in the apron area?	Y/N
7.	Is the apron cracked or damaged?	Y/N
8.	Is the hand pump loose at the point of attachment to apron	Y/N
9.	Is the trunk loose at the base plate of the tube well?	Y/N

Total Score of Risks ….…………/9

Risk score: 7-9 = High; 4-6 = Medium; 0-3 = Low

III Results and Recommendations:

The following important points of risks were noted: (List nos. 1-9)

Signature of sanitarian………………………………

Is the fence missing or faulty (Please comment)?

Annex 1c

SANITARY SURVEY FORM FOR THE ASSESSMENT OF RISKS OF CONTAMINATION OF SHALLOW HAND TUBEWELLS

I.	**Type of Facility**	**:**	**SHALLOW TUBEWELL (NO. 6 HANDPUMP)**
3.	General Information	:	Caretaker :………………………………………..
		:	District…………………..Upazila :………………
		:	Union………………….Village………………….
2.	Name of PNGO	:	…………………………………………………….
3.	Code Number	:	……………………………………….…..
4.	Date of Visit	:	…………………………………………
5.	Water sample taken?	:	Sample No……………….. FC/100ml…………….

IV. Specific Diagnostic Information for Assessment

		Risk
1.	Is there a latrine within 10m of the SHTW?	Y/N
2.	Are there any other sources of faecal pollution within 10m of DHTW?	Y/N
3.	Is the nearest source of faecal pollution on higher ground than the DHTW?	Y/N
4.	Is the drainage faulty allowing ponding within 2m of the DHTW?	Y/N
5.	Is the platform less than 5 ft x 5 ft dimension?	Y/N
6.	Does spilt water collect in the apron area?	Y/N
7.	Is the apron cracked or insanitary?	Y/N
8.	Is the hand pump loose at the point of attachment to apron	Y/N
9.	Is the trunk loose at the base plate of the tube well?	Y/N

Total Score of Risks ….…………/9

Risk score: 7-9 = High; 4-6 = Medium; 0-3 = Low

III Results and Recommendations:

The following important points of risks were noted: (List nos. 1-9)

Signature of sanitarian………………………………

Is the fence missing or faulty (Please comment)?

SANITARY SURVEY FORM FOR THE ASSESSMENT OF RISKS OF CONTAMINATION OF RAINWATER HARVESTER

l.	**Type of Facility**	**:**	**RWS** *(Type: individual/community)*
4.	General Information	:	Caretaker :………………………………………..
		:	District…………………..Upazila :………………
		:	Union………………….Village………………….
2.	Name of PNGO	:	…………………………………………………….
3.	Code Number	:	………………………………….…..
4.	Date of Visit	:	…………………………………………
5.	Water sample taken?	:	Sample No……………….. FC/100ml…………..…

ll. Specific Diagnostic Information for Assessment

		Risk
1.	Is the bypass line for first flushing missing?	Y/N
2.	Is the down pipe for flushing dirty inside?	Y/N
3.	Is rainwater collected in an open container?	Y/N
4.	Are there visible signs of contamination on the roof catchment? (e.g. plants, dirt, hanging branch of trees etc.)	Y/N
5.	Is guttering that collects water dirty or blocked?	Y/N
6.	Are the top or walls of the tank cracked or damaged?	Y/N
7.	Is water collected directly from the tank (no tap on the tank)?	Y/N
8.	Is the tap leaking or damaged?	Y/N
9.	Is the concrete floor under the tap defective or dirty or watery	Y/N
10.	Is there any source of pollution around the tank or water collection area?	Y/N
11.	Is the tank dirty inside?	Y/N
12.	Is the drainage cap leaking or damaged?	Y/N
13.	Is the net or screen at overflow pipe and inlet gutter torn or not clean?	Y/N

Total Score of Risks …./13

Risk score: 10 -13 = Very high; 7-9 = High; 4-6 = Medium; 0-3 = Low

III Results and Recommendations:

The following important points of risks were noted: (List nos. 1-13)

Signature of sanitarian………………………………

Is the fence missing or faulty (Please comment)?

Annex 1e

SANITARY SURVEY FORM FOR THE ASSESSMENT OF RISKS OF CONTAMINATION OF PSF

I.	**Type of Facility**	**:**	**PSF** (Model: *DPHE-Unicef/ITN/ NGO forum/ AAN/ other,Pl* **specify the model)**
5.	General Information	:	Caretaker :………………………………………..
		:	District…………………..Upazila :………………
		:	Union………………….Village………………….
2.	Name of PNGO	:	……………………………………………………
3.	Code Number	:……………………………….…..	
4.	Date of Visit	:…………………………………………	
5.	Water sample taken?	:	Sample No……………….. FC/100ml………….

V. Specific Diagnostic Information for Assessment

II A (Regarding Pond)

		Risk
1.	Is there a latrine within 10m of the Pond/river/baor(water source)?	Y/N
2.	Does any polluted stream flow into the source?	Y/N
3.	Are there any other sources of pollution within 10m of the Pond? (e.g. animal sheds, fertilizers etc)	Y/N
4.	Is the pond not protected by fence?	Y/N
5.	Is the fence around the pond faulty or broken?	Y/N
6.	Is the pond used for fish culture or bathing	Y/N

II B (Regarding Filter Chamber and Storage Tank)

7.	Is the drainage channel cracked, broken or need cleaning?	Y/N
8.	Does the PSF lack a minimum head device (i.e. can last filter bed dry out)	Y/N
9.	Does the PSF cover remain open?	Y/N
10.	Is the hand pump loose at the point of attachment to PSF?	Y/N
11.	Is the filter bed dirty or clogged ?	Y/N
12.	Is the tap leaking or damaged?	Y/N
13.	Is the position of the strainer at least 3 feet above the bottom of pond during dry season?	

Total Score of Risks …..…………/13

Risk score: 10-13 = Very high; 7-9 = High; 4-6 = Medium; 0-3 = Low

III Results and Recommendations:

The following important points of risks were noted: (List nos. 1-13)

Signature of sanitarian………………………………

Annex 1f

SANITARY SURVEY FORM FOR THE ASSESSMENT OF RISKS
OF CONTAMINATION OF PIPED WATER WITH SERVICE RESERVOIR

I. Type of Facility PIPED WATER WITH SERVICE RESERVOIR

6. General Information : Caretaker:……………………………………………….
: District: Upazila :
: Union: Village :
2. Name of PNGO : ..………………………..
3. Code Number : ……………………………………..…..
4. Date of Visit : …………………………………………
5. Water sample taken? : 1. Sample No (S)……………………FC/100ml…………….
2. Sample No (SP)…………………..FC/100 ml……………..
3. Sample No………………………..FC/100 ml……………..

II Specific Diagnostic Information for Assessment
II A Rain Water Harvesting System and underground reservoir

1. Is the bypass line for first flushing missing? Y/N
7. Is the down pipe for flushing dirty inside? Y/N
8. Are there visible signs of contamination on the roof catchment? Y/N
(e.g. plants, dirt, hanging branch of trees etc.)
9. Is guttering that collects water dirty or blocked? Y/N
10. Does the reservoir clean inside? Y/N
11. Is the roof of the reservoir cracked or damaged Y/N
12. Is there any source of pollution around the reservoir? Y/N
13. Is the reservoir clean inside? Y/N
14. Is the net or screen at overflow pipe and inlet gutter torn or not clean? Y/N

Total Score of Risks …./9

Risk score: 7-9 = High; 4-6 = Medium; 0-3 = Low

II B Dug well

1. Is there a latrine within 10m of the Dug Well? Y/N
2. Is the nearest source of faecal pollution on higher ground than the Dug Well? Y/N
3. Are there any other sources of faecal pollution within 10m of the Dug Well? Y/N
4. Is the hand pump loose at the point of attachment to apron Y/N
5. Is the apron cracked or insanitary? Y/N
6. Does the vent have mosquito meshing in torn condition? Y/N

Total Score of Risks …./6

Risk score: 4-6 = Medium; 0-3 = Low

Risk **Sample No**

(Please indicate at which sample sites the risk was identified)

1. Do any standpipes leak at sample sites?	Y/N	…………
2. Does water collect around any sample site?	Y/N	…………
3. Is area uphill eroded at any sample site?	Y/N	…………
4.Are pipes exposed close to any sample site?	Y/N	…………
5. Is human excreta on ground within 10m of standpipe?	Y/N	…………
6. Sewer or latrine within 30m of sample site?	Y/N	…………
7. Has there been discontinuity within last 10 days at sample site?	Y/N	…………
8. Are there signs of leaks in sampling area?	Y/N	…………
9. Do users report pipe breaks in last week?	Y/N	…………
10. Is the supply main exposed in sampling area?	Y/N	…………
11. Is the service reservoir cracked or leaking?	Y/N	…………
12. Are the air vents or inspection cover insanitary?	Y/N	…………

Total Score of Risks ……/12

Risk score: 10-12 = Very high; 7-9 = High; 4-6 = Medium; 0-3 = Low

III Results and Recommendations:

The following important points of risk were noted: (list nos. 1-12)

Signature of Health Inspector/Assistant:

Comments:

Annex 1g

Hygiene behavior questionnaire (used by NGO Forum)

Village: **Union:**

Upzilla: **District:**

1. House No:

2. Date:

3. Name of the respondent: ....

4. Age: Year

5. Gender:

1	Male	
2	Female	

6. Occupation:

1	Agricultural Works	
2	Business	
3	Service	
4	Household Works	
5	Others (Mention it):	

7. Religion:

1	Islam	
2	Hinduism	
3	Buddhism	
4	Christian	
5	Others (Mention it):	

8. Education:

1	Elementary	
2	Secondary	
3	Higher Secondary	
4	Tertiary	
5	No academic education	
6	Others (Mention it):	

9. Total households member:

Male	
Female	

10. Children: (Under 5 years old)

Male	
Female	

11. Name of father/husband of respondent: ______________________________

12. Occupation of household: ______________________________

13. Type of rooftop:

1	Tin	
2	Semi concrete	
3	Concrete	
4	Bamboo/Straw	
5	Others (Mention it):	

14. Type of wall:

1	Tin	
2	Semi concrete	
3	Concrete	
4	Bamboo/Straw	
5	Others (Mention it):	

15. Have any cultivated land own by household?

1	Yes	
2	No	

16. Total households' income: [ ] Taka

17. What do you know about safe water?

18. Source of safe water:

1	Shallow Tube Well / Deep Set Tube Well	
2	Deep Tube Well	
3	Rain Water	
4	Dug Well	
5	Pond / River	
6	Pond Sand Filter	
7	Arsenic Removal Filter	
8	Pipe Line	
9	Ab¨vb¨ (D‡jL Ki“b)	

19. Source of drinking water:

1	Shallow Tube Well / Deep Set Tube Well	
2	Deep Tube Well	
3	Rain Water	
4	Dug Well	
5	Pond / River	
6	Pond Sand Filter	
7	Arsenic Removal Filter	
8	Pipe Line	
9	Others (Mention it):	

20. Source of cooking water:

1	Shallow Tube Well / Deep Set Tube Well	
2	Deep Tube Well	
3	Rain Water	
4	Dug Well	
5	Pond / River	
6	Pond Sand Filter	
7	Arsenic Removal Filter	
8	Pipe Line	
9	Others (Mention it):	

21. How contaminate the water:

1	Arsenic Contamination	
2	Iron Contamination	
3	Fecal Contamination	
4	Contaminated by Animal / Bird	
5	I have no idea	
6	Others (Mention it):	

22. Is it cleans the surrounding area of the water source?

1	Yea	
2	No	

23. Is it maintains the area of the water supply?

1	Yes	
2	No	

24. If yes, then who does the work?

1	Male	
2	Women	
3	Children	
4	Others (Mention it):	

25. Type of water container:

1	Earthen Pot	
2	Aluminium Pot	
3	Plastic Pot	
4	Others (Mention it):	

27. Is it cleans the container before taking water?

1	Yes	
2	No	

28. Is it cleans the hands before taking water?

1	Yes	
2	No	

29. If yes, then what kind of water?

1	By drinking water	
2	By cooking water (if different from drinking water)	
3	By pond water	
4	Others (Mention it):	

30. Is container covered when carrying?

1	Yes	
2	No	

31. If yes, then how?

1	Bowl	
2	Paper	
3	Cloth	
4	Others (Mention it):	

32. Is the user can put hand in the container during collection of water:

1	Yes	
2	No	

33. Is it cleans the surrounding area of the water tank?

1	Yes	
2	No	

34. Is container covered when reservation?

1	Yes	
2	No	

35. If yes, then how?

1	Bowl	
2	Paper	
3	Cloth	
4	Others (Mention it):	

36. Is it cleans the water tank?

1	Yes	
2	No	

37. Is it continues clean the water container?

1	Yes	
2	No	

38. What type of toilet in use:

1	Hygienic	
2	Unhygienic	
3	No toilet at all	
4	Others (Mention it)	

39. How far is the toilet from drinking water supply?

40. How far is the toilet from cooking water supply?

41. Do you think the necessity of cleaning the hands after? use a toilet

1	Yes	
2	No	

42. If yes, then how you should wash?

1	Only water	
2	Soap	
3	Ash	
4	Soil	
5	Others (Mention it)	

43. Do you wash the hands after use a toilet?

2	No	

44. Do you think the necessity of cleaning the hands before preparing a food?

1	Yes	
2	No	

45. If yes, then how you should wash?

1	Only water	
2	Soap	
3	Ash	
4	Soil	
5	Others (Mention it)	

46. Is wash the hands before preparing a food?

1	Yes	
2	No	

47. If yes, then how you should wash?

1	Only water	
2	Soap	
3	Ash	
4	Soil	
5	Others (Mention it)	

48. Is there food covered?

1	Yes	
2	No	

49. Do you think the necessity of cleaning the hands before a meal?

1	Yes	
2	No	

50. If yes, then how you should wash?

1	Only water	
2	Soap	
3	Ash	
4	Soil	
5	Others (Mention it)	

51. Is wash the hands before taking a meal?

1	Yes	
2	No	

52. If yes, then how you should wash?

1	Only water	
2	Soap	
3	Ash	
4	Soil	
5	Others (Mention it)	

53. Is the water container clean?

1	Yes	
2	No	

54. Do you think the necessity of cleaning the hands before? serving a meal?

1	Yes	
2	No	

55. If yes, then how you should wash?

1	Only water	
2	Soap	
3	Ash	
4	Soil	
5	Others (Mention it)	

56. Do you wash the hands before serving a meal?

1	Yes	
2	No	

57. If yes, then how you should wash?

1	Only water	
2	Soap	
3	Ash	
4	Soil	
5	Others (Mention it)	

58. Have any wastes around the area of dining?

1	Yes	
2	No	

59. Where are you expel the excreta of children (if any children)

1	Toilet	
2	Drain	
3	Courtyard	
4	Water	
5	Others (Mention it)	

60. Do you think that, you need to wash your hands after lave the child?:

1	Yes	
2	No	

61. If yes, then how?

1	Only water	
2	Soap	
3	Ash	
4	Soil	
5	Others (Mention it)	

62. Do you wash your hands after lave the child?

1	Yes	
2	No	

63. If yes, then how you should wash?

1	Only water	
2	Soap	
3	Ash	
4	Soil	
5	Others (Mention it)	

64. What do you know about perfect wash of your hands?

1	Wash both of your hand properly	
2	Wash only one of your hand	
3	Others (Mention it)	

65. Where are you expel the wastes

1	Assign dumping site	
2	Drain or canal	
3	Courtyard	
4	Water	
5	Others (Mention it)	

of domestic animal?

66. Do you broom the courtyard routinely?

1	Yes	
2	No	

67. Have there any stake of wastes on the courtyard?

1	Yes	
2	No	

68. Have there any water logs on the courtyard?

1	Yes	
2	No	

69. Where are you expelling the wastes of food?

1	Assign dumping site	
2	Drain or canal	
3	Courtyard	
4	Water	
5	C[illegible]	

70. Have anyone of your households been suffered fr

1	Yes	
2	No	

71. If yes, then whom.

Serial No	Name	Sex	Where he/she has been treated.

72. What can be done for the prevention of diarrhoea diseases? (Discuss this)

Name of Enumerator: -- Dated: ---------------------