

Water Safety Plans for Rural Water Supply in India

Policy Issues and Institutional Arrangements



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Abbreviations and Acronyms

AFPRO	Action For Food Production
ASHA	Accredited Social Health Activist
BRC	Block Resource Center
CBO	community-based organization
CLTS	Community Led Total Sanitation
DASCOH	Development Association for Self-reliance, Communication, and Health
DDWS	Department of Drinking Water Supply
DESME	Department of Economics, Statistics, Monitoring, and Evaluation
DWSM	District Water and Sanitation Mission
DWSP	Drinking Water Safety Plan
ERRA	Earthquake Reconstruction and Rehabilitation Authority
GIS	geographic information system
GP	Gram Panchayat
H ₂ S	hydrogen sulphide
HACCP	Hazard Analysis Critical Control Point
IEC	Information, Education, and Communication
IRSP	Integrated Rural Support Program
ITN	International Training Network
IWA	International Water Association
KP	Khyber–Pakhtunkhwa
NGO	nongovernmental organization
NRDWP	National Rural Drinking Water Program
NRHM	National Rural Health Mission
O&M	operations and maintenance
PIEDAR	Pakistan Institute for Environment—Development Action Research
PURC	Public Utilities Regulatory Commission
RMDD	Rural Management and Development Department
SHG	self help group
SIRD	State Institute of Rural Development
SO	support organizations
TSC	Total Sanitation Campaign
VERC	Village Education Resource Center
VWSC	Village Water and Sanitation Committee
WHO	World Health Organization
WSP	Water and Sanitation Program



Executive Summary

This report outlines the key principles of water safety planning for rural water supply in India. Water safety planning represents a change of emphasis from end-of-pipe testing to the management of risks of contamination from source to mouth. End-of-pipe testing is still necessary to verify that safe drinking water is being delivered.

The focus of the report is on the policy issues concerning the adoption of water safety planning and the institutional arrangements (roles and responsibilities) needed to operationalize the approach. Recommendations are provided on demonstrating and implementing the approach to establish a full program.

Key points are:

- The main policy matter is the adoption of the drinking Water Safety Plan approach for rural supplies—this is strongly recommended; and
- There are four other policy matters which emerge from that decision:
 - How to establish roles and responsibilities;
 - Whether to use Water Safety Plan improvement programs as the basis for planning and investment;
 - How to set performance targets to reflect health objectives; and
 - How to decide on interventions to reduce risk.

There are various benefits that arise from the adoption of Water Safety Plans:



- Better management of drinking water quality by preventing contamination before it happens;
- Improved operations and maintenance (O&M) through adoption of control measures identified during the risk assessment;
- Emphasis on customer service improvements linked to improved public health, with improved infrastructure as a means to that end; and
- Water Safety Plans are based on field surveys (or sanitary surveys) that directly link water supply, hygiene, and sanitation, for example, in addressing issues such as open defecation, solid and liquid waste, and safe household storage and handling.

A Planning Coordination function is critical when moving from pilot demonstrations in a few villages to a full program. The Planning Coordination function is needed to interpret policy on service standards and cost recovery, to review village plans including their

improvement programs, to make investment decisions with priorities based on local needs, to advise on tariffs and subsidies, and to monitor implementation and performance.

There is a need for well targeted field-based training programs, including training of trainers (facilitators) who would train technical and operational staff at the village level, as well as orientation and training for higher level support functions. Training materials can be prepared and tested during pilot demonstrations, with participation and ownership by established training institutions or nongovernmental organizations (NGOs) or other support organizations (SOs).

The recommended approach to implementation of the institutional arrangements is a combination of demonstration pilots within selected villages, together with advocacy and activity mapping workshops at the district and state levels, and workshops to train the trainers.

Introduction

Modern Approaches to Water Quality Management

The approach described in this report to achieve safe drinking water quality in rural areas is based on initial work carried out in India, but is relevant to rural water supply in other regions. The approach is based on drinking Water Safety Plans, and how the institutional arrangements (roles and responsibilities) needed to operationalize the approach might be established within existing institutional frameworks.

The emphasis on means of achieving safe drinking water has changed. Internationally, in the past, there had been a trend toward adding more and more parameters to standards with an associated requirement for sampling and analysis. This is an approach which is still found in many countries, including India.

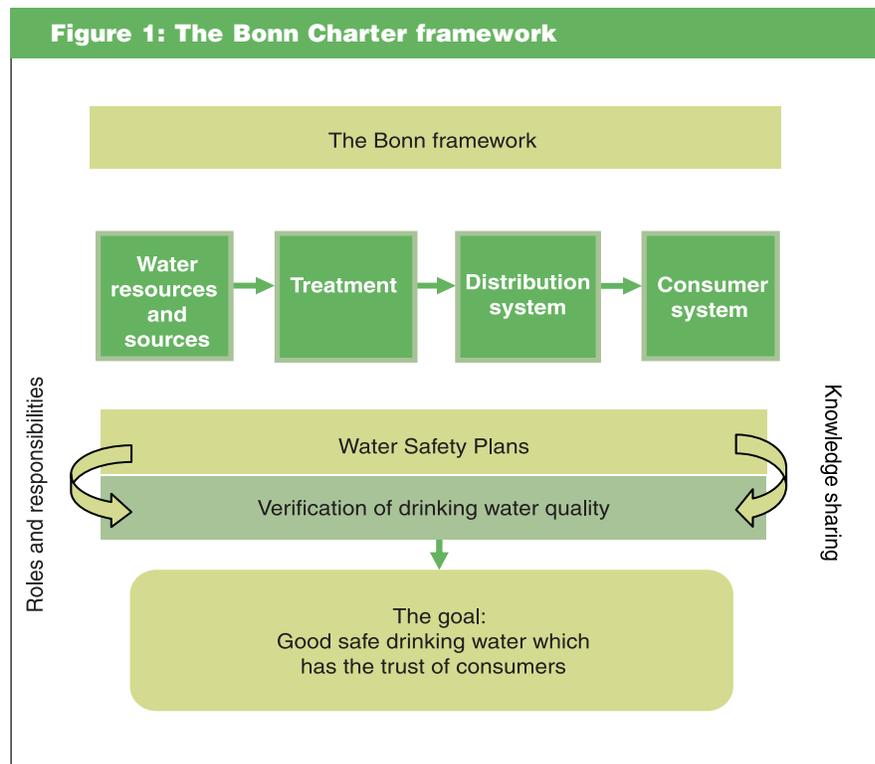
This approach is unlikely to increase protection of the public because, if there are immediate impacts on health from contamination of drinking water, people will have already become sick before the analysis is carried out and before remedial action can be taken. In countries such as India, this is particularly true in rural areas where often there are no competent laboratories in the vicinity, or the protocols for water quality testing are not well established.

In the past decade, two workshops involving key people concerned with drinking water quality were held in Bonn in Germany, one in October 2001 and the other in February 2004, to seek a better way of achieving safe drinking water. The direct output was the Bonn Charter¹ and indirectly the revised World Health Organization (WHO) Drinking Water Guidelines.² The approach is encapsulated by the Bonn Charter structure given in Figure 1.

The key principle is to consider the entire supply chain from source to mouth, and to take a risk management approach through the development of

drinking Water Safety Plans. Such plans establish the key operational controls at each stage in the supply chain. There is reference to 'verification' and this is done by sampling and testing, which is still important but is not seen as the primary means of monitoring and control. The Bonn Charter emphasizes the need for clarity of roles and responsibilities, for transparency, and for sharing of information. The goal is 'good safe water which has the trust of consumers.' This same approach is reflected in the WHO Guidelines, which are summarized in Figure 2, and which include health-based targets.

Figure 1: The Bonn Charter framework



Source: The Bonn Charter for Safe Drinking Water. IWA. September, 2004.

¹ The Bonn Charter, International Water Association, www.iwahq.org.uk

² Guidelines for Drinking Water Quality 2006, World Health Organization, Geneva. http://www.who.int/water_sanitation_health/dwq/gdwq3/en/



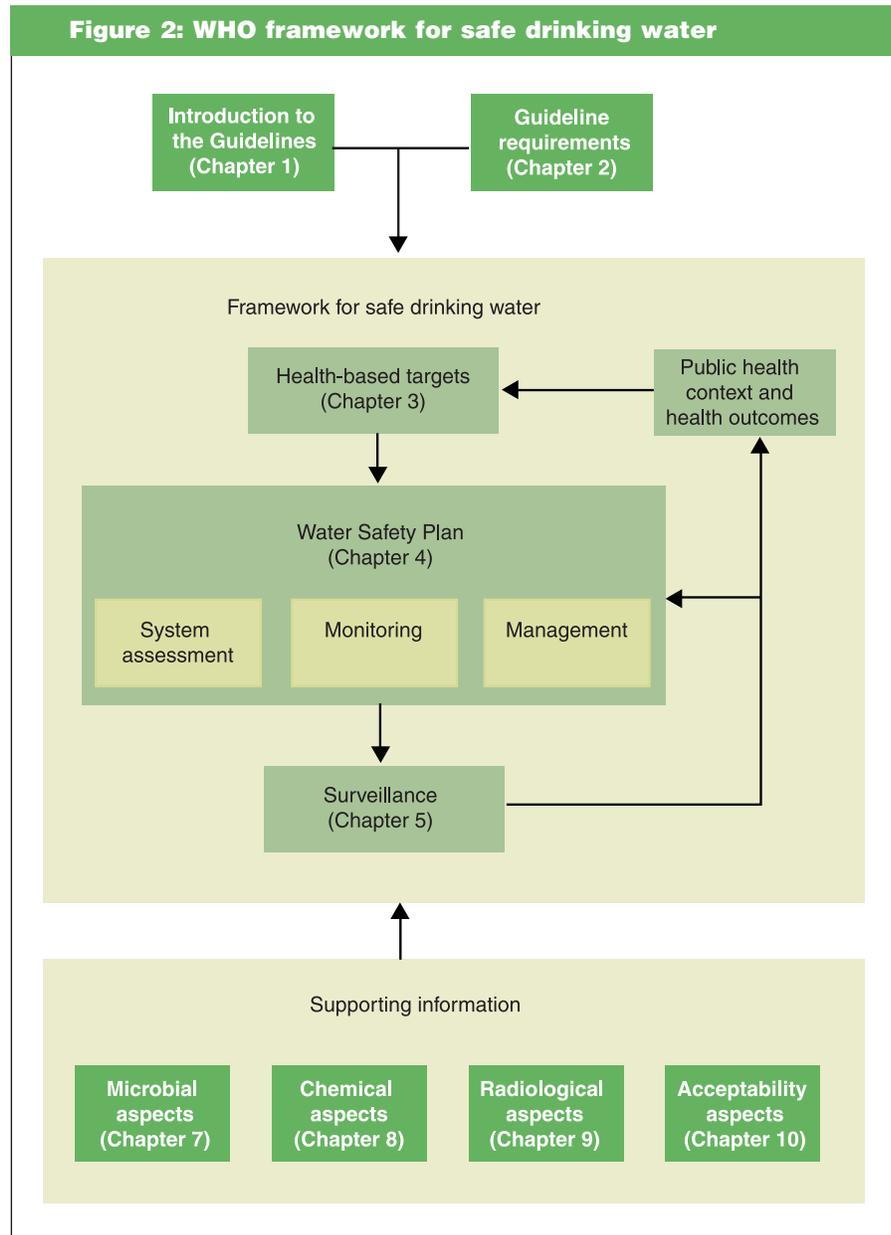
What is a Drinking Water Safety Plan?

A full description of the process of developing a drinking Water Safety Plan is given in Annex 1. In essence it involves the following steps:

- Define the supply system and form a team from those people responsible for each part of the supply chain from source to mouth;
- Consider all potential hazards and establish which ones constitute a significant risk to drinking water quality;
- Consider how each of these risks is controlled and whether the controls are adequate;
- As necessary, prepare an improvement program based on the inadequacy of controls and implement any aspects which can be put in place immediately;
- For each existing control set an action level, that is, a level at which there is concern that the control is failing and that some other action needs to be taken to protect public health; and
- Identify the monitoring of each control: who is responsible and at what frequency—the what, who, and when.

Two further steps are required which need a higher competence of operational management, and in rural India would require specific training or technical support:

Figure 2: WHO framework for safe drinking water



Source: Guidelines for Drinking Water Quality. Third Edition. WHO. 2004.

- Define what needs to be done immediately if an action limit is breached; and
- Define how it can be verified that the reaction to a loss of a control has been successful.

Background to this Report

Previous Work and Justification for this Study

In line with this evolving response to water quality management, various agencies have been or are currently piloting the development of Water Safety Plans in the South Asia region:

- In India, this includes UNICEF, WaterAid, and Action For Food Production (AFPRO) in rural areas, and WHO in urban centers;
- In Bangladesh, the Village Education Resource Center (VERC), WaterAid, and the Development Association for Self-reliance, Communication, and Health (DASCOH), are working in rural areas, and WHO is working in urban centers; and
- In Pakistan, the Pakistan Institute for Environment—Development Action Research (PIEDAR) and

Integrated Rural Support Program (IRSP) are working in rural areas in Punjab and Khyber–Pakhtunkhwa (KP), and the Earthquake Reconstruction and Rehabilitation Authority (ERRA) and UNICEF are supporting water quality management in emergencies and disasters (inclusive of water safety planning) in a number of areas such as Northern Areas and KP.

Generic Water Safety Plans for the most basic rural water supply systems, namely dug wells, tubewells, rainwater harvesting, and pond sand filters, have been developed by the International Training Network (ITN) Center in Bangladesh. To complement this existing body of work, the work carried out by the Water and Sanitation Program (WSP), which is presented in this report, has focused primarily on rural piped schemes, ranging from

simple gravity-fed schemes for a group of houses to bulk supply for multivillage schemes. In India today, there is increasing demand for piped water supply as a result of both water scarcity and depletion of groundwater, and demand for higher levels of service.

Work on Water Safety Plans carried out to date has been valuable in helping to set out what Water Safety Plans should look like at the scale of a single water supply system. The broader, institutional level, the assignment of roles and responsibilities for water quality management, the development of appropriate institutional incentives for stakeholders to undertake their assigned roles, and the critical role of individual and collective behavior change are addressed in this report.

Objectives of the Study

There are three objectives:

- To consider policies for the delivery of safe drinking water quality in rural areas;
- To provide a framework in which the various functions associated with a change of emphasis towards managing risks to the safety of drinking water can be incorporated into existing institutional frameworks, in particular building on the initiatives already taken in India to improve monitoring and surveillance of drinking water quality; and
- To suggest an approach to demonstrate and implement such a framework.





Key Policy Issues

The most important policy issue relates to the adoption of drinking Water Safety Plans as the basis for managing drinking water quality. This is discussed first; there are then four other policy issues which emerge from adopting such a framework, the key one being roles and responsibilities which is the main content of this report.

Adopting Drinking Water Safety Plans

Although sampling and analysis is important to verify the quality of drinking water, it is not an effective means of control especially for rural supplies. In India, the Department of Drinking Water Supply (DDWS) has taken steps to establish and equip district and sub-divisional water testing laboratories. Nevertheless, collecting samples in rural locations takes time and microbiological tests involve the slow process of 'growing' organisms on a suitable medium. Therefore, during the time period between sampling and reporting results, which in rural areas could be as long as a month, unsafe water could have been consumed. The emphasis should, therefore, be on good operational management with controls based on risk assessment from source to mouth. This involves the establishment of drinking Water Safety Plans and associated support being given to local service providers for their development, operation, audit, and verification.

Establishing Roles and Responsibilities

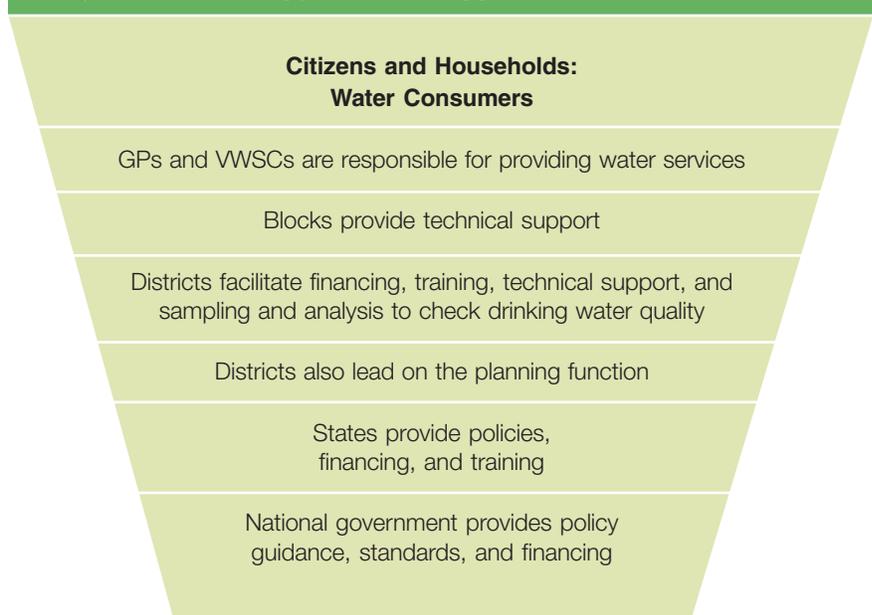
With the responsibility for service delivery resting with the village Gram Panchayats (GPs) together with Village Water and Sanitation Committees (VWSCs), they should be seen as the pivotal organizations with the 'higher' levels of government, line departments, and training institutions providing support. This can be illustrated by an inverse pyramid of support as shown in Figure 3. The individual functions are discussed in detail in Section 4, and Section 5 refers to appropriate allocation of functions.

Roles and responsibilities include two functions considered critical in moving from pilot demonstrations to a full program, namely planning coordination and training:

- **Planning Coordination:** Plans developed by GPs/VWSCs have to be considered by the district authorities through a periodic planning process, managed at the district level for logistical considerations.

The planning process is required to interpret state policy in terms of deliverables, provide planning templates and facilitate training and technical support, review and approve village plans, integrate plans and manage convergence of different development programs, monitor progress on implementation and operational performance, and provide reports to the state showing the impact on service performance.³

Figure 3: Inverse pyramid of support



³ For more details see the draft *Handbook for District Water and Sanitation Missions for Planning Coordination and Convergence* (DDWS and WSP, 2010).



together with nonpipe methods provided by tankers and water vendors, and through self provision such as shallow tubewell handpumps. Some of the most important risks to drinking water safety arise from these alternative distribution systems and other deficiencies in the quantity of water supplied. Accordingly, the associated improvement programs provide a good basis for the identification of investment priorities covering both quantity and quality requirements, and should be built into the planning and investment decision-making processes.

For more sophisticated piped water schemes, the Water Safety Plan can be combined with a technical/ financial survey which is used to gather information on the condition of assets, true operating costs, and current performance. The information captured by the survey and the Water Safety Plan then provides the basis for preparing an Operating Plan (key operating functions, proposed staff and maintenance costs, estimated income, and estimated surplus or deficit), and a Service Improvement Plan (a summary of improvement measures, proposed remedies, estimated costs, and initial prioritization or timeframe for implementation). This information also supports more effective reporting and monitoring, including simple performance indicators. Simple templates can be prepared in the local language and used for training technical and operational staff. Annex 2 provides a full list of

- Training:** Training and capacity building is critical for the development and implementation of plans by GPs/VWSCs, and for the planning process at the district level. These training/capacity building functions are discussed in outline in this paper with details given in separate handbooks and guidelines.⁴ Typically, planning templates can provide the basis for training of trainer programs targeting block-level facilitators who would then train village-level representatives.

Water Safety Plans as a Basis for Investment

The process of preparing drinking Water Safety Plans identifies problems due to either no control of specific risks or inadequate controls. Some improvements can be made quickly at little or no cost but others require a significant amount of investment. Although improved operation of existing controls will result in fewer incidents of unsafe drinking water, it can be expected that the main improvements will arise from the introduction of better controls.

Drinking Water Safety Plans should include all parts of water distribution

⁴ See the *Handbook for Gram Panchayats* (DDWS and WSP, 2010), and the *Training Manual for Village Water Safety Plans* prepared for Sikkim (Rural Management and Development Department [RMDD] and WSP, 2010).



templates that have been developed by WSP to support both village planning and district planning coordination. Annex 3 provides a sample template for a Water Safety Plan.

Setting Performance Targets to Reflect Health Objectives

The WHO Guidelines (Figure 2) refer to 'health-based targets' with a view to making interventions based on health determined benefits. The WHO framework shows health-based targets as an input to drinking Water Safety Plans. It is known from a WHO study⁵ that, in developing countries, the benefits from investment in water and sanitation greatly exceed the costs, and it is possible to set simple operational targets which can be expected to achieve health improvements.

In particular, it can be expected that there is a relationship between the presence of *E.coli* in water, as an indication of fecal contamination, and diarrheal disease. The presence of a chlorine residual in treated water is an

indication that the water is free of coliforms. So, in simple operational terms, a health-related target can be translated to a performance target such as minimum chlorine residual. This then becomes an action level in a Water Safety Plan (Annex 1). Where data on incidents of diarrheal diseases are available, it may be possible to observe the impact of continuously achieving this action level through diligent operations.⁶ In India, the development of improved water supplies at the village level should be carried out in partnership with the National Rural Health Mission (NRHM) to draw direct correlations between implementation of Water Safety Plans, water quality, and incidence of water borne or water-related diseases.

The establishment of targets and their subsequent attainment provide a powerful means to support evidence-based decision-making. Elucidating operational, water quality, and health improvements over a sustained period of time provides a basis for strongly advocating widespread implementation of Water Safety Plans.

Policies on Interventions

Drinking Water Safety Plans are likely to identify the need for improvements at each stage of the supply chain, namely:

- Better protection of sources;
- Improved removal of contaminants whether microbiological or chemical;
- Protection of distribution systems; and
- Prevention of contamination in households.

Protection of sources: With a surface water source, this may require, if feasible, control over activities (agricultural, industrial or recreational) within some boundary of a lake, stream or spring to prevent ingress of nutrients or contaminants. This could apply equally to a well but in some cases that may simply require adequate fencing to prevent access by animals. The requirement is good local knowledge coupled with some professional guidance. Locally, measures for rainwater harvesting and groundwater recharge, as well as advocacy for water conservation, can be implemented possibly in consultation with other concerned departments, for example, forestry. In India, the issue of arsenic and fluoride contamination (as well as iron, nitrate, and salinity) is given high priority under the National Rural Drinking Water Program (NRDWP) with



⁵ Hutton, G. and Haller, L., 2004. *Costs and benefits of water and sanitation improvements at the global level (Evaluation of the)*. World Health Organization 2004, WHO/SDE/WSH/04.04.

⁶ For example, field visits to Pune, Maharashtra, where the Health Department is responsible for water quality monitoring and surveillance, found that officials were analyzing results to correlate incidence of disease with water quality.



emphasis on finding alternative sources, and conjunctive use of alternative groundwater and surface water sources.

Improved water treatment: Treatment is required when it is not feasible in the short term to achieve full protection through ‘catchment’ measures, or where a contaminant occurs naturally in the source, or as essential security on microbiological quality of water. Absolute priority should be given to microbiological quality and to concerns over any chemicals occurring at toxic levels. Consideration should also be given to other chemicals which are

present at levels above the existing national standards (which should be set according to WHO guideline values, but it should be noted that most of the guideline values are based on a lifetime of consumption with a large ‘factor of safety’ so small exceedances have little impact on health). WHO provides guidance on the effectiveness of the most common treatment processes in removing various substances.⁷

Protection of distribution systems: Pipe systems are generally not at risk where there are continuous supplies, as the pressurized system prevents ingress. Where there are intermittent supplies, checks should be made for points of potential ingress of fecal matter. Other distribution systems such as tankers and water vendors are more vulnerable and critically dependent upon the operators. It is suggested that

the formal service providers regard the other distributors as an integral part of the water supply and develop control procedures with them.⁸ A key principle of water safety planning is to have multiple barriers; it is unlikely that just one remedy will prevent contamination but a combination of controls can minimize the risks of contamination. The establishment of a maintenance program that regularly checks on the condition and performance of piped networks and correlated maintenance requirements is critical to ensure that drinking water safety is not compromised.

Prevention of contamination in households: This should be part of an awareness campaign covering water, sanitation, and hygiene. In India, the Total Sanitation Campaign (TSC), and in particular the Community Led Total Sanitation (CLTS) approach, targets community-level awareness raising and behavior change to eliminate open defecation and improve hygiene practices. Water Safety Plans, with emphasis on source to mouth preventive controls, provide a very effective means of linking TSC/CLTS through water quality to improved operational management for water supply. It is recommended that, where possible, water safety planning be implemented in combination with CLTS activities. This should consider safe storage and handling of water and simple remedial actions (such as boiling) in times when water safety may be compromised in the household.

⁷ This is done on log-reduction basis (each treatment process is rated in terms of some value of log-reduction that it can achieve). It is recommended that a guidance manual is prepared which could be used by those local engineers supporting local service providers.

⁸ An example is the case of water tankers in Ghana. Water Tanker Service Guidelines. Public Utilities Regulatory Commission (PURC), 2008.



Functions to Support Drinking Water Safety Planning

This report focuses on functions related to drinking water quality management although other aspects, such as cost recovery policies which affect sustainability of water services, are critical in the delivery of safe drinking water. However, it does discuss the improvement planning function since Water Safety Plans highlight those areas where controls of risks to drinking water safety are inadequate, and improvement programs need to be put in place.

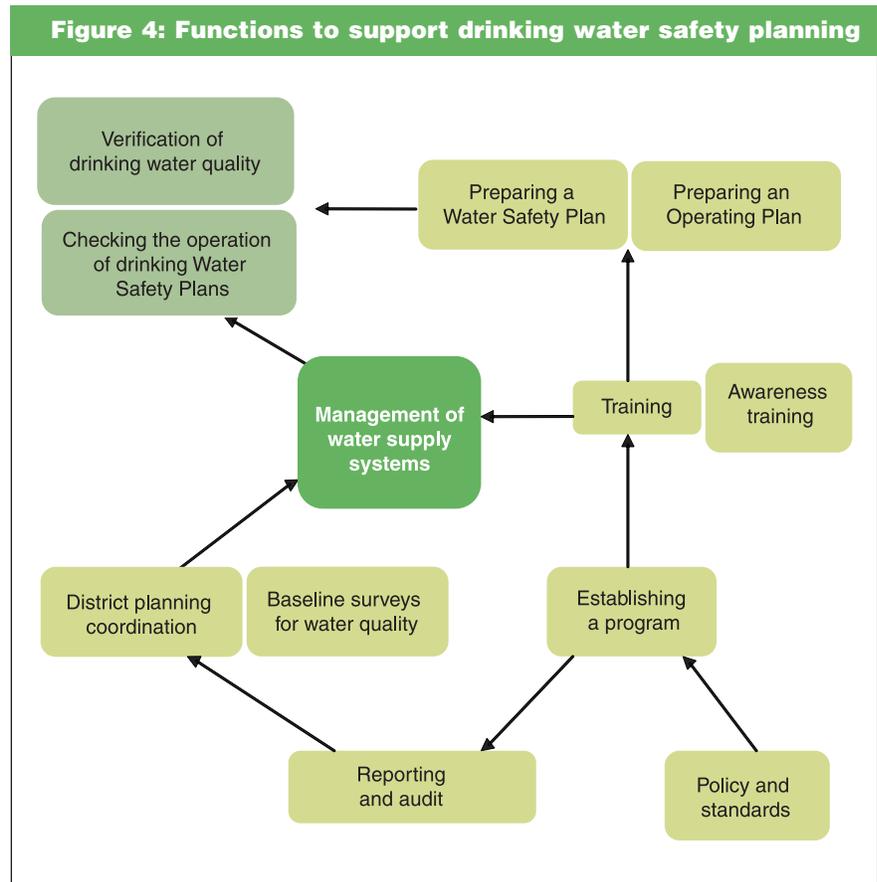
The functions to be carried out in the delivery of safe drinking water are described here with discussion on the knowledge and skills required to undertake them (Figure 4).

Policy and Standards

NRDWP provides overall policy guidance in India. The development of drinking water quality standards (BIS10500) is also a national function (currently under the Drinking Water Sectional Committee, FAD 25).

However, where there is significant variability in water source conditions, it is states that should interpret national standards appropriately and, where necessary, set interim standards to focus attention on those parameters most affecting health.

States must take decisions on policy approaches to the achievement of drinking water quality standards, including decisions on the use of drinking Water Safety Plans. Guidelines on the preparation of drinking Water Safety Plans, based initially on experience elsewhere, and



refined later in the light of local experience, are an early requirement. These are most appropriately developed within existing state training institutions.⁹ There should also be some means of sharing experience between and within states, for example, from exposure visits.

States may wish to introduce incentive schemes with progress based on performance improvements being rewarded. Water Safety Plans are concerned with improved operational management, and performance targets

can be set to reflect this objective. The results would need to be published as league tables to establish comparative competition. Such an approach would require effective audit procedures to ensure level playing fields. As an alternative to financial inducements, there can be incentives through recognized schemes in which awards are given at publicized ceremonies.¹⁰

⁹ For example, in Sikkim, the State Institute of Rural Development (SIRD) was already carrying out training workshops related to water quality monitoring and surveillance, and sanitation as well as training of GPs in their new responsibilities.

¹⁰ As under the Nirmal Gram Puraskar for sanitation.

Establishing a Program

Having decided to implement a drinking Water Safety Plan approach, there is a need for programs to be established which focus on systems of greatest concern, and to determine investment priorities. In practice, improvement programs are developed bottom-up with village plans aggregated with support from blocks into district plans. It is recommended that there be a periodic planning process, perhaps operating every five years, to provide for integrated decision-making within which there would be annual budgets. Plans and budgets should be updated annually. This programmatic approach aligns with NRDWP which provides financing, technical support, and training for village and district water security planning. Financing is no longer in the form of lumpy investments in schemes and works, but also considers the need for ongoing investment in O&M and refurbishment of assets, together with monitoring, reporting, and audit.

Reporting and Audit

Annual reports are valuable as they provide the state with a means of assessing progress. It should be a district function. The responsible district should report on progress on: (a) improvement programs; (b) drinking Water Safety Plan preparation programs; (c) operation of drinking Water Safety Plans, citing any difficulties; and (d) drinking water quality as measured in verification programs. The state would establish the data return formats and provide templates

for the preparation of the annual reports. The districts would have to decide which annual reports would be required by the GPs. An important initiative under way in India is the use of geographic information system (GIS) mapping of sources including water quality.

In a delegated system, states would wish to carry out periodic audits to check on progress and problems. The basis for the audit would be the annual reports from the districts. The audit could involve visits to districts to look at records and to GPs on a random basis to check whether the situation on the ground is truly reflected in the reports.

District Planning Coordination

Working from national or state guidelines, it should be the responsibility of districts to support programs for the preparation of drinking Water Safety Plans by GPs for their supply systems. Under NRDWP, it is anticipated that this would be achieved under the District Water and Sanitation Mission (DWSM) through Block Resource Centers (BRCs) which

would support GPs/WSCs. The sequence in which GPs are supported should be prioritized based on the results of surveys on delivered drinking water quality. However, consideration will have to be given to whether trained personnel are available.

Baseline Surveys for Water Quality

Districts must collect and review data on drinking water available for the systems in their areas. If recent surveys have been carried out, or if there are reliable monitoring data, these can be used as input to determine priorities for supporting GPs in the development of drinking Water Safety Plans, and in reviewing the effectiveness of critical controls. If recent data are not available, or there are doubts about the reliability of available data, surveys should be instigated. These require sampling and analysis at competent (ideally accredited to national standards) district or sub-divisional water testing laboratories, and samples should be collected by trained staff. Analysis should include microbiological parameters and those chemicals

District planning coordination

A critical role of the district is the planning coordination function, to interpret state policy in terms of deliverables, provide planning templates and facilitate training and technical support, review and approve village plans, integrate plans and manage convergence of different development programs, monitor progress on implementation and operational performance, and to provide reports to the state showing the impact on service performance.

For more details see the draft Handbook for District Water and Sanitation Missions for Planning Coordination and Convergence (DDWS and WSP, 2010).



known or suspected of being present at levels of potential concern. The surveys should be timed to take into account seasonal factors and might require sampling at different times of the year.

Training

Training of trainers in the preparation of drinking Water Safety Plans is required for the block facilitators and other support organizations. Subsequent training of village-level operational staff by facilitators would take place during the preparation of drinking Water Safety Plans itself and through learning by doing. During that training, they will see the significance of critical controls and their roles in monitoring and management.

Training for facilitators could be established within State Institutes of Rural Development (SIRDs), or similar institutions, and it could be integrated into training programs already in place on water quality testing and/or sanitation. The trainers in the institutes would require assistance in preparing training programs from those with direct experience of drinking Water Safety Plans. Training of facilitators, using examples of real systems, is recommended with break-out sessions to work on examples.¹¹

Special attention is required for training on checks of control measures and whether they are failing, defining what needs to be done immediately if an action limit is breached, and how it can be verified that the reaction to a loss of a control has been successful.

As water safety planning is an iterative process, with periodic reviews and



updates, training programs should be developed that support continuous education, for example, yearly refresher courses. The content of training programs should also reflect local circumstances, for example, using the outputs of water quality surveys and Water Safety Plan audits to better target training activities to practical needs. A formally accredited or certified training program may also help incentivize individuals to continuously participate in training.

Awareness Training

For successful local management of water systems and, particularly for care in protecting water from contamination in homes, everyone needs to understand the importance of hygiene

and other aspects of avoiding the ingestion of pathogens. Awareness 'training' can only take place at the village level. A lot of work has been done in raising awareness, for example, under TSC¹² in India. A concerted program running alongside the introduction of drinking Water Safety Plans is recommended. One output from drinking Water Safety Plans could be some focus on preventing contamination in the home, with preparation of awareness leaflets particularly targeted at women's groups.

¹¹ Specifically, lessons can be taken from the experience of CLTS workshops, which combine classroom work with field work.

¹² Total Sanitation Campaign, Department of Drinking Water Supply, Ministry of Rural Development, Government of India. 'Total Sanitation Campaign is a comprehensive programme to ensure sanitation facilities in rural areas with broader goal to eradicate the practice of open defecation.' <http://ddws.nic.in/tsc-nic/html/>



Management of Water Supply Systems

With a policy of devolution, responsibility for the management and operation of water supply systems will be the responsibility of GPs or their VWSCs. The introduction of drinking Water Safety Plans provides on-the-job training in the operation of the systems. In particular, the process of developing Water Safety Plans, Operating Plans, and Service Improvement Plans provides the opportunity to help train managers on issues of planning, investment, financial management, and monitoring and reporting.¹³

¹³ See the *Handbook for Gram Panchayats* (DDWS and WSP, 2010).

Preparing a Water Safety Plan

The preparation of drinking Water Safety Plans is not rocket science, but it does require a disciplined approach (Annex 1). Teams need to be formed with personnel covering all aspects of a water supply system from source to mouth. For simple single well systems, this may involve only the person responsible for maintaining the well and a user. In such cases, it is recommended that a generic drinking Water Safety Plan approach is taken with the plan adjusted for each system to reflect local circumstances. For systems which use surface water, and involve treatment and a distribution system, there needs to be a team including someone from each part of

the supply chain and a user to cover point-of-use aspects. The team leader should be local and capable of taking ownership of the plan, and assistance should be given by a trained facilitator provided by the district. The facilitators should be responsible for ensuring that the drinking Water Safety Plans are produced to the required format and standard. It is important that the documentation is simple, covering only critical controls and who should be responsible for monitoring what and when, together with steps to take if a control fails (operation reaction procedures). A detailed Hazard Analysis Critical Control Point (HACCP) type documentation as used in developed countries for urban systems is unnecessary and undesirable. A sample Water Safety Plan with typical risks and remedies, suitable for basic piped water supplies in rural India, is provided in Annex 3.

Preparing an Operating Plan

A drinking Water Safety Plan generally consists of two parts: a risk assessment plan and a management plan. Specimen tables are included in Annex 1.

- The risk assessment plan defines the critical controls, and sets target and action levels. The critical controls can be means of preventing contamination of the source, treatment to remove contaminants, operations to prevent ingress of contaminants into the distribution system, or means to prevent contamination in the household. Target levels are usually the



attainment of some standard. Action levels are the levels set which, when exceeded, indicate that some action must be taken immediately to prevent or mitigate against loss of control. Some action limits are quantitative, others are qualitative; and

- The management plan identifies monitoring requirements under the headings of what, when and who, and sets down the required operational actions to be taken if an action level has been exceeded. Monitoring can be quite simple, for example, for a single well, daily checks that animals are not getting access where they can cause contamination.

Each monitoring and action response needs to be incorporated into operational procedures with each individual involved being given clear instructions on his or her responsibilities, and provided with training as necessary. Decisions need

to be taken on operational recording of actions. If a treatment works is involved, the operator may need to tick a box daily giving the time of the check to confirm that the operation of a chlorinator has been checked. It is a good discipline to have some means of recording even the simple checks, and it is important for audit trails.

Checking the Operation of Drinking Water Safety Plans

This is a GP management function and involves checking that the critical controls are being monitored effectively and that the specified actions have been taken if an action level has been exceeded. For example, was chlorination checked at the required frequency and, if there was a failure of chlorination, were villagers advised to boil water for drinking? The function should be carried out by someone or some village organization not directly involved in the operation of the system. This could be a WWSO, or a

community-based organization (CBO). Initially, the frequency of checks could be weekly, with less frequent checks if the system is being operated reliably.

Verification of Drinking Water Quality

The principle behind the use of drinking Water Safety Plans to control drinking water quality is that end-of-pipe testing is insufficient by itself (by the time analysis results have been obtained from a laboratory, it is too late because if that water contained pathogens the consumers will already be sick). On-the-spot analysis using field kits provides for better protection, particularly if an indicator can be measured instantaneously, for example, turbidity. However, even then, it is not practical to take measurements sufficiently frequently to achieve complete protection. Also, as the kits provide less accurate results than laboratory testing, samples need to be sent to a laboratory periodically to check that the operational controls are working. The frequency of checks should be established on the likely variability of the quality of the delivered water, which is often influenced by changes in the quality of the source water due to seasonal or other factors.

It is important that test results are reported correctly so that GPs or WWSOs can respond appropriately. Also NRHM representatives need to be informed and correlations with incidence of water borne or water-related diseases made. This analysis will help to verify that Water Safety Plans are having a real impact on public health outcomes.



Assigning Roles and Responsibilities

In Section 4, there was discussion on functions to support water safety planning. Table 1 indicates some suggestions for states in India. It is based

on current discussions concerning NRDWP, and the roles and responsibilities of GPs, blocks, and districts. Actual assignment would vary state by state but

Table 1 could be used by states to map out their approaches to incorporating drinking water safety planning in their existing institutional structures.

Table 1: Functions and which organizations might handle them in India

Functions	Organization Level								Comments
	National	State	District	Block	GP/ VWSC	State Training Institute	CBO/ SHG	NGO/ SO	
Overall policy guidelines, and standards	✓								As per NRDWP and BIS10500
Policies and programs		✓							State policy including adoption of DWSPs
Incentive schemes	✓	✓	✓						e.g., Sajal Gram Puraskar
Annual reporting on management of drinking water quality			✓						DWSMs
Audit by states		✓						✓	NGOs could be given a role here
Planning coordination of DWSPs			✓						Management of programs by DWSMs
Establishing current state of source water and delivered water as input to DWSPs			✓	✓					District and sub-divisional laboratories; BRCs should support
Training				✓		✓		✓	SIRD, BRC, NGOs, and other SOs
Training on checks on operation of DWSPs				✓		✓		✓	
Quality and health awareness training				✓		✓		✓	
Management of water supply systems					✓				GPs/VWSCs should contract a trained operator
DWSP preparation				✓	✓			✓	BRCs support GPs/VWSCs
Conversion of DWSPs into operational procedures				✓	✓			✓	This can also be the basis for operator contracts
Checking operation of DWSPs					✓		✓		Day-to-day checks on operational controls—does not involve analysis
Verification of drinking water quality			✓	✓					District and sub-divisional laboratories

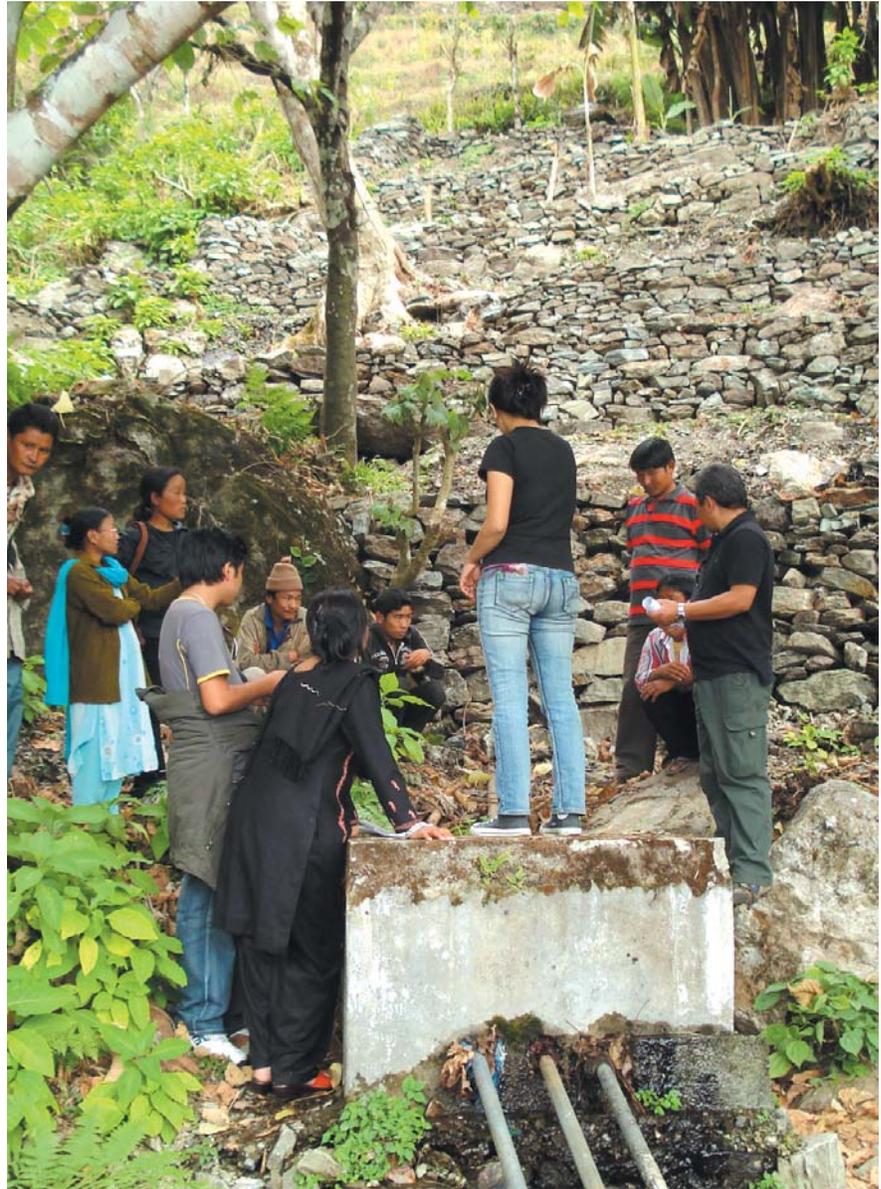
Note: For DWSP read Drinking Water Safety Plans; SHG: self help group.



Available Knowledge and Experience

There is extensive information on the WHO and the International Water Association (IWA) websites including manuals providing step-by-step guidance and a road map to support country-level implementation.¹⁴ However, it is experience based largely on developed world urban situations with strong emphasis on the use of HACCP systems. Rural situations do not require such a detailed approach, which could discourage some from the use of drinking Water Safety Plans. It is recommended that attention is given to those case studies which demonstrate a simple practical approach that can be applied by nonprofessionals in day-to-day operations. Some valuable guidance is provided by some generic drinking Water Safety Plans developed by ITN in Bangladesh for four common water system types used in rural areas, namely, rainwater harvesting, tubewells, dugwells, and pond sand filters. These examples can be downloaded from the ITN website: www.buet.ac.bd/itn.

To complement this existing body of work, WSP's work as presented in this report has focused on rural piped schemes from simple gravity schemes for a few houses to sophisticated bulk supply for multivillage schemes. Sample templates and training guidelines have been developed for this purpose, and these have been adopted under the NRDWP's *Handbook for Gram Panchayats*. The list of templates is included in this report in Annex 2.



The aim should be to focus on critical controls for delivering safe drinking water and convert those into operational procedures, train the local operators in monitoring the controls, and taking predetermined actions if a

control fails. This simple approach is illustrated by two tables included in Annex 1 to record the information from the risk assessment aspect and what that means for monitoring and action.

¹⁴ Think Big, Start Small, Scale Up: A Road Map to Support Country Level Implementation of Water Safety Plans. WHO and IWA, 2010.

A Suggested Approach to Demonstration and Implementation

A Pilot Demonstration in [xxx] Gram Panchayats in [xxx] Districts

It is suggested that a demonstration project is established to test out the proposed approach quickly and amend it as necessary to provide states with the benefits of that experience. To make rapid progress, the pilot should be run in a district where there is good data on drinking water quality, good communications, effective training systems are already in place, and strong leadership from an individual involved in the water supply system. A sample proposal that was implemented successfully in Sikkim during 2007–09 is given below, which can be adapted to the situation in districts in the different states.¹⁵

Water Safety Plans and Service Improvement Plans

1. The establishment of Water Safety Plans involves a risk assessment from source to mouth, and the identification of critical controls for managing those risks to achieve consistently safe drinking water.
2. The key activities of the proposed study are:
 - To choose EIGHT poverty affected GPs (Kamling and Chisupani would be included from West and South Sikkim), TWO each from the FOUR districts to take part in the demonstration pilot project;

- SIRD to train the Barefoot Engineer and VWSC in how to 'prepare a drinking Water Safety Plan'. They would also be supported by the Field Facilitator and block-level engineers (Rural Management and Development Department—RMDD) and health workers who would be included in the training. This would be partly in a classroom on basics but largely through the development of a drinking Water Safety Plan in the GPs;
- The training workshops (either one in each district, or two for South/West and North/East) would be linked to CLTS to include 'awareness training' on how to relate a hazard to potential illness in the community, and to include issues of fecal contamination and hygiene;
- This district-level training would be carried out by SIRD using training materials prepared with WSP;
- The drinking Water Safety Plans will also highlight the need for investment in better controls. Investment proposals (Service Improvement Plans) would be prepared for consideration by the district for funding under Accelerated Rural Water Supply and Rural Water Supply and Sanitation programs or other sources of funds, for example, departmental grants in aid, incentive funds, user fees, etc;
- Additional training would be carried out for the Barefoot Engineer and Field Facilitators in the use of field test kits for 'water quality testing.' A baseline survey of water quality would be carried out in each of the demonstration pilot GPs. In addition, as needed, tests would be carried out at the district/state referral laboratories;
- The process of verification of drinking water quality by sampling and analysis would be introduced at a frequency determined initially by checking confidence in the effectiveness of the controls, and later to take into account likely



Ensuring good safe drinking water in Sikkim

In Sikkim, the government has introduced a comprehensive drinking water and sanitation program that includes CLTS to achieve open defecation free villages, village drinking Water Safety Plans to ensure potable water, and a Springs-shed Development Program (Dhara Vikash) to ensure source sustainability.

¹⁵ Village Water Safety Planning Training Manual (RMDD, Sikkim and WSP, 2010).



concerns due to seasonal or other factors;

- The GP/WWSC would be given additional training in 'managing the water supply system,' which can include preparation of simple service agreements for those responsible for operating the water supply system, as well as the GP/WWSC's obligations related to funding;
- The WWSA and block engineers (RMDD) and Field Facilitator, or others as decided by the district, would be trained in how to 'monitor controls' of the drinking Water Safety Plans in practice and a frequency of monitoring would be established; and
- A process of 'audit and reporting' would be established, which could involve: (i) the GP reporting to the district for purposes of planning coordination and management of funding; (ii) Village Social Audit Committees to verify user satisfaction; (iii) one GP auditing another GP on implementation of Water Safety Plans; and (iv) a separate department, for example, the Department of Economics, Statistics, Monitoring and Evaluation (DESME), carrying out spot checks to verify results in terms of effective water safety planning by villages and investment by GPs/district.
- In addition to the training workshops, district-level workshops and later state-level workshops would be organized to establish the process of extending the approach



to all systems. The main objective would be to: (i) showcase the demonstration pilots of drinking Water Safety Plans; (ii) to establish roles and responsibilities to operationalize the approach across the district/state including the training programs; and (iii) showcasing how the bottom-up investment proposals related to improving the critical controls of drinking water quality might be handled by the district 'planning coordinator,' including the process of funding.

Outputs from the Study

The main outputs would be:

- Demonstration of the water safety planning approach, including drinking

Water Safety Plans operating in eight GPs in all four districts;

- Agreement on the institutional framework (roles and responsibilities) to operationalize the approach;
- Demonstration of an integrated operational management, and water sampling and analysis approach to drinking water quality;
- Realignment of financing for planning and investment based on service improvement priorities;
- Training material and a training plan for Water Safety Plan facilitators and auditors; and
- Articulation of the role of a district planning coordinator.

Annex 1

Development of Drinking Water Safety Plans

Process

In essence, the development and implementation of a drinking Water Safety Plan involves:

- Determining the supply system to be covered;
- Formation of a team covering the entire supply chain from source to mouth, to carry out a risk assessment;
- Review and development of controls to manage the identified risks;
- Establishment of target and action limits for each control with associated reaction plans; and
- Incorporation of the controls into operational procedures.

Starting Points

The first step is to identify the system to be covered in one plan. The boundaries of a system can depend upon the source, the area supplied by a treatment works, or the system supplying a defined distribution system. The choice can be for convenience, or because a particular supply system is susceptible to some risks of known concern, or to reflect a team's responsibilities. For rural supplies, a source could be an aquifer, a pond, a stream, or a rainwater harvesting scheme, or it could be part of a multivillage scheme.

Based on the choice and definition of the system being covered, a project team is formed. The team should include members from each organization in the supply chain covering the water source, water treatment, water distribution and, if possible, consumers' premises. This may involve key people from a number of different organizations, or it could involve only one or two people responsible for source and distribution in a village well system. Where there are significant informal distribution systems, for example, tankers and water vendors, provision should be made for their representatives to either be included in the team or for those systems to be considered separately. The team leader is most likely to be the key person responsible for the

operation of the village system but the choice can depend upon circumstances, and on the availability of key individuals.

A good starting point for the team is an initiation workshop/meeting facilitated by someone with experience in the process of producing drinking Water Safety Plans. A workshop provides the opportunity for the team members to get to know each other, and to understand each other's challenges. It is desirable to invite others for there to be management involvement, perhaps from a VWSC, to ensure a commitment to implementation. At this stage, it is important to assemble all available information on the system under study including recent water quality surveys, and to identify deficiencies in any of the information.

One output from the workshop should be an agreed timetable for the project, with a firm date for the completion of the first (risk assessment) stage. This first workshop/meeting could also be used to prepare a rough map of the water supply system, with any inputs the community feels are important regarding water quality or investments.

Risk Assessment

The risk assessment involves each member of the team identifying the hazards to the safety of drinking water in his or her part of the supply chain. Hazards can be from a number of sources, including pollution of sources or system failure. Consideration has to be given to the likelihood of a hazard presenting a real risk and its severity if it occurs. The WHO Guidelines provide a simple scoring system (Table A1) to assist in identifying the relative importance of risks. Such a simple system should be used only as a guide, as the main risks may be fairly obvious in a rural system, and it may not be necessary to adopt such a scoring system. If it is used, the risk-scoring table provides the following definitions that are useful but again they should be regarded only as giving some guidance and not used prescriptively:

Almost certain—once a day

Likely—once a week



Table A1: WHO suggested risk scoring

Likelihood	Severity of consequences				
	Insignificant	Minor	Moderate	Major	Catastrophic
Almost certain	5	10	15	20	25
Likely	4	8	12	16	20
Moderate	3	6	9	12	16
Unlikely	2	4	6	8	10
Rare	1	2	3	4	5

Source: Water Safety Plans, World Health Organization, 2005.

Moderate—once a month

Unlikely—once a year

Rare—once every five years

Catastrophic—potentially lethal to a large population

Major—potentially lethal to a small population

Moderate—potentially harmful to a large population

Minor—potentially harmful to a small population

Insignificant—no impact or not detectable

Each hazard and its risk assessment need to be recorded, together with any supporting information. Table A2 is an example of a recording system.

Reviewing the Controls and Priorities for Improvement

Once the risk assessment has been completed, each member of the team needs to review the controls in place to counter each risk. Is there evidence that the controls are

working? Have there been incidents where the controls have been inadequate? What preventative measures could be taken to reduce the risk? The analysis of control measures is likely to identify some priorities for improvement which can be acted on at this early stage, thus giving some early benefit for the work done on the project. Other improvements requiring investment will take longer. Although the control improvements will reduce the likelihood of an incident taking place, they will not change the consequences should it do so.

Setting Target and Action Limits

The next step is to set both target levels and action limits for each of the controls, and to record the designated reaction measures, should an action limit be breached. The target levels on controls at a treatment works are likely to include the drinking water quality standards at which, in general, noncompliance can be dealt with under routine conditions. An action level should be set at a figure at which immediate action needs to be taken. At the beginning of the supply chain and at the source end, some of the target levels are likely to be more subjective and could require longer timescales for achievement. Monitoring against the limits is critical, and it is necessary to define what is being measured, when (frequency), and by whom. The other necessary component is a means of verifying that the corrective action has worked. The outcome of this work can be recorded as in Table A3.

Table A2: Table for recording risk assessment information

Part of supply chain	Source cause	Hazard	Preventative and control measures	Likelihood	Severity	Risk	Downstream controls	Comments and further considerations

Table A3: Record of action limits, monitoring, and corrective actions

Hazard	Control	Critical Limits		Monitoring			Reaction Steps	Verification
		Target level	Action level	What	When	Who		

Operational Procedures

The above provisions should be converted into operational procedures, then operators should be trained in the new or revised procedures. The management responsible for each part of the supply chain should establish a means of checking that the procedures and training do result in an effective system for the supply of safe drinking water supply.

Checking that the Controls are Working

The first stage is for the GP/VWSC, depending upon the circumstances, to carry out daily or weekly checks that the ‘operator’ is following the operating procedures. This will involve inspections of the critical controls and of records kept by the operator on his or her monitoring. Importantly, this will include whether the operator took the specified actions if an action level was breached. These checks are the most important as they ensure that the main line of defense is secure in providing safe drinking water.

The VWSC may also establish a routine of using field test kits as a quick means to check that the water is safe to

drink. Although the kits can give both false positives and false negatives, with experience in their use, they add to the armory in achieving safe water supplies. If a test indicates contaminated water, the VWSC can request a laboratory analysis and, at the same time, both review the operation of the relevant control and, if appropriate, advise people to boil water for drinking.

Verification

The ultimate check that the controls are working is laboratory sampling and analysis. This should be carried out consistently at a predetermined frequency.

References

Village Water Safety Planning Training Manual (RMDD, Sikkim and WSP, 2010); Handbook for Gram Panchayats to Help Them Plan, Implement, Operate, Maintain and Manage Drinking Water Security (*DDWS and WSP, 2010*); and draft Handbook for District Water and Sanitation Missions for Planning Coordination and Convergence (*DDWS and WSP, 2010*).



Annex 2

List of Planning Templates

Various planning templates have been developed by WSP to support DDWS implement NRDWP.

Village Drinking Water Security Planning:

- Technical and financial survey
- Water Source Plan
- Water Safety Plan
- Operating Plan
- Service Improvement Plan
- Performance indicators

District Planning Coordination:

- Memorandum of Understanding between DWSM/BRC/WWSC
- Timetable for submission of planning applications
- Assessment sheet for each GP Plan
- District Investment Plan
- GP Annual Progress Report
- DWSM Annual Report

Annex 3

Water Safety Plan Sample Template

Name of the GP, Village, Ward, Habitation, and Scheme:

Date:

Handpumps					
Risk	Control measure	Who does it?	Who checks it is done?	Action if control fails	
				What to do?	Who does it?
<ul style="list-style-type: none"> • Livestock encroach on the well • Surface drainage getting into the well • Apron is muddy and poorly drained • Latrines are close to the well 	<ul style="list-style-type: none"> • Fencing • Raise and repair the apron • Improve drainage • Ensure clean storage containers • Relocate latrines 	<ul style="list-style-type: none"> • Handpump caretaker • Mechanic • Contractors 	<ul style="list-style-type: none"> • WWSC • Community 	<ul style="list-style-type: none"> • Contact mechanic or contractor for maintenance and repair • Disinfect household water • Sampling and analysis 	<ul style="list-style-type: none"> • WWSC

Piped water supply—Source					
Risk	Control measure	Who does it?	Who checks it is done?	Action if control fails	
				What to do?	Who does it?
<ul style="list-style-type: none"> • Animal feces • Garbage • Livestock effluents 	<ul style="list-style-type: none"> • Fencing • Public awareness, IEC—signboards • Effluent pathway should be relocated 	<ul style="list-style-type: none"> • Contract laborers • Barefoot Engineer and/or private fitter, SHG, community labor • WWSC with support from NGOs and SHGs 	<ul style="list-style-type: none"> • Panchayat Inspector with help from Forest Guard and Barefoot Engineer and/or private fitter • WWSC • Community 	<ul style="list-style-type: none"> • Clean up and repair • Disinfect household water using electro-chlorinator • H₂S vial test 	<ul style="list-style-type: none"> • Barefoot Engineer and/or private fitter • ASHA (WWSC) • NGOs



Name of the GP, Village, Ward, Habitation, and Scheme:

Date:

Piped water supply—Treatment system and sedimentation tank

Risk	Control measure	Who does it?	Who checks it is done?	Action if control fails	
				What to do?	Who does it?
<ul style="list-style-type: none"> Chemical or bacteriological contamination 	<ul style="list-style-type: none"> Check efficacy of existing treatment system Add new treatment system 	<ul style="list-style-type: none"> Operator Contractor 	<ul style="list-style-type: none"> WVSC 	<ul style="list-style-type: none"> Short term alternative supply Correct problem Build new treatment system 	<ul style="list-style-type: none"> WVSC to organize
<ul style="list-style-type: none"> Animal feces Garbage Poor design Tank damaged or leaking 	<ul style="list-style-type: none"> Install tank cover Public awareness/ IEC signboards Clean tank Regular check up on water flow and filter material 	<ul style="list-style-type: none"> Contractor Junior Engineer WVSC with support from NGOs 	<ul style="list-style-type: none"> Panchayat Inspector with help from Barefoot Engineer and/or private fitter WVSC Community 	<ul style="list-style-type: none"> Clean up Disinfect household water using electro-chlorinator H₂S vial test Repair cover Repair signboards Repair tank 	<ul style="list-style-type: none"> Barefoot Engineer and/or private fitter Contractor Junior Engineer WVSC with support from NGOs

Piped water supply—Storage tank

Risk	Control measure	Who does it?	Who checks it is done?	Action if control fails	
				What to do?	Who does it?
<ul style="list-style-type: none"> Animal feces Garbage Bathing and laundry Tank damaged or leaking Private pipelines connected at tank 	<ul style="list-style-type: none"> Install tank cover Public awareness/ IEC signboards Clean tank Regular check up on tank condition Explore options to disconnect private connections 	<ul style="list-style-type: none"> Contractor Junior Engineer WVSC with support from NGOs Barefoot Engineer/private fitter 	<ul style="list-style-type: none"> Panchayat Inspector with help from Barefoot Engineer and/or private fitter WVSC Community 	<ul style="list-style-type: none"> Clean up Disinfect household water using electro-chlorinator H₂S vial test Repair cover Repair signboards Repair tank 	<ul style="list-style-type: none"> Barefoot Engineer and/or private fitter Contractor Junior Engineer WVSC with support from NGOs

Name of the GP, Village, Ward, Habitation, and Scheme:

Date:

Piped water supply—Distribution pipeline

Risk	Control measure	Who?	Who monitors?	Action if control fails	
				What?	Who?
<ul style="list-style-type: none"> Animal feces Garbage Effluents Poorly laid pipelines in public footpaths or drains Leaking pipes 	<ul style="list-style-type: none"> Public awareness/IEC Regular check up on pipes 	<ul style="list-style-type: none"> Barefoot Engineer/private fitter Contractor Junior Engineer VWSC with support from NGOs 	<ul style="list-style-type: none"> Panchayat Inspector with help from Barefoot Engineer and/or private fitter VWSC Community 	<ul style="list-style-type: none"> Clean up Disinfect household water using electro-chlorinator H₂S vial test Realignment of pipelines Repair of leaking pipes 	<ul style="list-style-type: none"> ASHA (VWSC) Barefoot Engineer and/or private fitter Contractor Junior Engineer VWSC with support from NGOs

Household storage and personal hygiene

Risk	Control measure	Who?	Who monitors?	Action if control fails	
				What?	Who?
<ul style="list-style-type: none"> Unclean storage container Absence of lid on storage container No ladle to remove water 	<ul style="list-style-type: none"> Public awareness/IEC Point-of-use treatment 	<ul style="list-style-type: none"> ASHA (VWSC) NGOs Teachers Health workers Anganwadi workers 	<ul style="list-style-type: none"> VWSC Sanitary Inspector 	<ul style="list-style-type: none"> Disinfect household water using electro-chlorinator H₂S vial test 	<ul style="list-style-type: none"> ASHA (VWSC) NGOs
<ul style="list-style-type: none"> No hand washing with soap Uncut nails 	<ul style="list-style-type: none"> Public awareness/IEC Empower women groups to advocate personal hygiene 	<ul style="list-style-type: none"> ASHA (VWSC) NGOs Teachers Health workers Anganwadi workers 	<ul style="list-style-type: none"> VWSC Sanitary Inspector 	<ul style="list-style-type: none"> Disinfect household water using electro-chlorinator H₂S vial test 	<ul style="list-style-type: none"> ASHA (VWSC) NGOs

ASHA: Accredited Social Health Activist; IEC: Information, Education, and Communication; H₂S: hydrogen sulphide.



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