

DPHE-ITN



April, 2006

Introduction

The first edition of the model water safety plan for Rain Water Harvesting Systems was prepared in December, 2004 for use in Bangladesh. The model WSP was then tested by several organizations in their respective pilot projects to observe its appropriateness for application under local context. The pilots were implemented over a period from February to November 2005 with slight difference in their durations. The experience of the pilots has been captured and documented in March, 2006. Based on the experience and lessons gained from the pilots projects the first edition has been revised.

The projects or organizations can either apply the water safety plan directly or make further changes based on their own water supply system. A separate sheet is added to this edition to keep record of the changes already made or to be made in future.

Below is the process through which WSP for PSF was developed and revised:

- A workshop was organized by APSU in November, 2004 with the sector professional from government organization, NGOs and Development partners.
 - During the workshop one group was assigned to prepare the outline of a model WSP for PSF through systematic analysis and consultative process.
- During November and December, 2004 a complete WSP document for PSF was prepared as a first edition.
- During a period from February 2005 to November 2005 WSP for RWHS was tested in the field in pilot projects
- During March, 2006 APSU organized a workshop to review the first edition in the light of the experience gained from the pilots.
- Based on the review results and recommendations of the March, 06 workshop ITN-BUET and DPHE has revised the first edition to form the second edition of the model WSP fro PSF as of April 2006.

Document Change Record Sheet

Location	Changes made	Remarks
General Page-3	Insert <i>Document change record sheet</i>	To be filled in by individual organization making changes in the document
Page-4	Insert <i>Document development history and approval table:</i>	To be updated by individual organization implementing the WSP
Table 2	Rewrite description of process steps: i) 'water source', ii) 'distribution of water'	
Table 3	Shift 'iron' and 'zink' from safety parameters to aesthetic parameters	Previous testing negative for Zn (<i>RAAMO study, 2005</i>)
Table 6	Add a column for additional control measures Delete last 2 columns: 'Basis' and 'action required'	
	- Rewrite existing control measures - Rewrite additional control measure column	
Table 7	Change in the order of the Tables. Table-8 was brought to front as Table 7 and renamed as <i>Operational Monitoring schedule</i>	
	Table 7 was brought down as Table-10 and renamed as Improvement Action Plan.	
	Specify the support programmes and link them to Table 10:Improvement Action plan	
Table-8	Delete testing for Zn from verification schedule	
Table-9	Delete column 'signed off by' Rewrite responsibility column	Based on real situation
Table10	Add this table to delineate various support programmes for smooth implementation of WSP	

Proformas

1. The WSP Team

The first step of implementing the WSP is to form a team of people from implementing organization/s and DPHE working on water safety plans for pond sand filters. It is preferred that the team will include people having different discipline and those with technical ability to develop and implement WSP.

Table 1. The WSP Team

Name	Organization	Title	Role in WSP team	Contact Information	
				Address	Telephone, E-mail

The WSP documents are dynamic documents. As new information and experience becomes available about the water supply technology system and as the system improves the WSPs can be improved and modified to reflect these changes. Therefore, the implementing organizations should assign a person who will be responsible for updating the WSP and disseminate it to WSP team members through a set process of the organization.

Document development history:

Edition	Date
<i>1st edition</i>	<i>November 2004 by Guy A. Howard, APSU</i>
<i>2nd edition</i>	<i>April 2006 by SG Mahmud , ITN</i>
<i>3rd edition</i>

Document Approved by:

Name:

Date:

Table 2. Water supply process description.

Step	Description
Water source	Rain water: rain water is harvested from roofs and stored in a tank
Water treatment	Water is not treated at the source as a consequence, no other chemicals are currently added to the water in terms of treatment and need not be considered further.
Distribution of water	Water is carried into the home by households, generally using clay or metal pitchers and plastic jars
Storage after treatment	Although water is not treated, after distribution, water is transferred into a kulshi for storage in the kitchen area. Storage kulshis are generally kept above the floor but are not covered.
Any special controls required?	Control of pathogens from vermin and birds is essential (e.g. leptosporosis, salmonella) Control of risks of vector-borne diseases, particularly dengue fever When close to industrial areas, chemical quality may deteriorate
Water quality requirements?	Water quality is compared against the Bangladesh Standards for drinking water (GoB, 1997) and will be informed by the results of the QHRA.

Table 3. Intended uses of water and nature of consumers, information capture form.

Intended Use	Intended Consumer
<ul style="list-style-type: none"> <input type="checkbox"/> Water is obtained from rainwater and collected in tanks and is intended for use in the home for drinking and cooking. <input type="checkbox"/> A caretaker looks after the rainwater harvesting system. <input type="checkbox"/> Water should meet safety and quality (aesthetic) standards i.e. the Bangladesh Drinking Water Standards (GoB, 1997): <input type="checkbox"/> Safety (subset of parameters): <ul style="list-style-type: none"> <input type="checkbox"/> <i>E. coli</i> <input type="checkbox"/> Turbidity <input type="checkbox"/> Lead and iron (where sheeting is old) <input type="checkbox"/> Sanitary Inspection Score <input type="checkbox"/> Aesthetic requirements (includes sanitation and clothes washing issues): <ul style="list-style-type: none"> <input type="checkbox"/> Taste not unpleasant <input type="checkbox"/> Colour <input type="checkbox"/> Turbidity 	<ul style="list-style-type: none"> <input type="checkbox"/> The users of the water are people residing in villages and include the healthy, young, old, pregnant, disabled and immunocompromised. <input type="checkbox"/> A number of users transport water in vessels that are not kept solely for drinking water use and store water in unsanitary conditions, which can lead to contamination. Controlling these risks requires hygiene education about the safe water chain by hygiene education staff working at the Union and Upazila level. <input type="checkbox"/> Communal rainwater harvesting systems are tested on commissioning and community was informed of the results. At present no system is in place for community to access water quality testing, but this is being established in the DPHE Upazila office.

Table 4. Technology description (should be supported by community water and sanitation maps prepared for individual communities and sanitary surveys)

TO BE COMPLETED BY EACH ORGANISATION APPLYING WSP FOR RAINWATER HARVESTING









Issue	Information	Attached documents
Standard design		
Usual setting		
Materials specification		
Source protection measures required		
People served by an individual facility		
How technology is managed		
Training requirements		
Requirements for tests prior to commissioning		
Data on facilities constructed		

Date Prepared:

Date Revised:

Date Approved:

Table 5. Process flow diagram.

<u>Code</u>	<u>Step</u>	<u>Description</u>	<u>Responsibility</u>
R1		Source (roof)	Community
R2		Transport (guttering)	Community
R3		Storage (tank)	Caretaker
R4		Tap	Caretaker
R5		Water collected in vessel	Villagers
R6		Water transported in vessel	Villagers
R7		Storage at point of use	Villagers
R8		Use	Villagers

Symbols:






<u>Key:</u>		
		Operation
		Transport
		Storage
		Inspection
		Delay

Table 6. Hazard analysis

Process Step	Hazardous Event	Hazard Type	Existing Control Measures	Risk	Additional Control Measures
R0 Social exclusion	Poor members of community excluded from use of source because of income, gender to other social barriers	Social	Ensure that all members of the community involved in water supply development from start	U	Design of programmes and involvement of communities in water source development
R1&2 Catchment	Rainfall insufficient	Quantity	Design based on expected rainfall, use of full roof catchment to collect water	U	Training of communities and households in water conservation
	Faecal contamination of roof from vermin and birds	Microbial (B,V)	Regular cleaning of roof and gutter, at least before start of monsoon; remove all overhanging branches	S	Training of communities and households on roof catchment cleaning
	Leaching of chemicals from roof material (sheets and timber etc)	Zinc; lead	Selection of roofing sheets; age of sheet	S	Material specification
	Chemical contamination of water from air pollution	Heavy metals (e.g. lead)	Sites selected for communal rainwater harvesting systems should not be close to major traffic routes or major industrial plants	S	Site selection
R3 Rainwater tank	Contamination of tank from contaminated water in first flush	Microbial (B,V)	First-flush diversion system used to divert first rainwater away from tank	S	Installation of diversion system, training of households and communities in use of diversion system
	Ingress of contaminated water through tank or tank base	Microbial (B,V,P)	Tank must have a cover and be in good structural condition; base to be protected by proper drainage to prevent undercutting	S	Good design and maintenance schedules
	Rainwater collection tank becomes a breeding site for mosquitoes	Biological	Ensure vents have mosquito meshing in good condition	S	Ensure all vents have mesh in good condition
	Contamination of stored water through use of buckets to withdraw water	Microbial (B,V)	Ensure tank has a tap as the outlet for water from the tank		Ensure all tanks have a tap as the outlet for water
	Increased turbidity and biofilm development in tank due to poor cleaning	Turbidity and aesthetic quality	Tank to have an oval base inside and flushing outlet at the centre of the base of the tank; flushing outlet to have a cap		Training of households and communities in tank cleaning
R3 Rainwater tank	Lack of conservation of water leads to shortage and use of alternative sources	Quantity	Ensure that tank design takes into account water demand and that use is restricted to drinking and cooking		Training of households and communities in water conservation

Process Step	Hazardous Event	Hazard Type	Existing Control Measures	Risk	Additional Control Measures
R4 Tap	Poorly maintained tap leads to leakage and wastage	Quantity		S	Ensure taps do not leak through use of proper materials in construction and regular maintenance Training of users in basic maintenance
R5 Collection of water	Collected water becomes contaminated due to dirty container	Microbial (B,V,P)		S	Vessel should be cleaned regularly with clean water and if possible soap Hygiene education in community
	Water becomes contaminated from unclean hands used to direct water into vessel	Microbial (B,V,P)		S	Ensure that vessel is put close to spout to allow direct entry of water Hygiene education in community
R6 Transport of water	Water becomes contaminated during transport in an uncovered container	Microbial (B,V,P)		U	Ensure vessel has a cover Hygiene education in community
R7 Water stored at home	Water becomes contaminated from animals in home	Microbial (B,V,P)	Water stored at elevated levels	S	Ensure vessel is covered at all times when water not being used Hygiene education in community
	Water becomes contaminated because dirty utensils used to collect water	Microbial (B,V,P)		S	Use clean dipper or cup to withdraw water Tip water from container into drinking vessel Hygiene education in community
	Water becomes contaminated because users dip unclean fingers into the pot	Microbial (B,V,P)		S	Use clean dipper or cup to withdraw water Tip water from container into drinking vessel Hygiene education in community
R8 use	Water contaminated before consumption because dirty drinking utensil used	Microbial (B,V,P)		S	Use clean cup for drinking Hygiene education in community

NB: B = bacteria; V = viruses; P = protozoa
S = significant; U = uncertain; I = insignificant

Table 7. Operational Monitoring Schedule.

Process Step	Performance Indicator	Monitoring		Critical Limit	Corrective Action		Supporting Programs	
Roof catchment	Roof catchment condition	What:	Sanitary condition of the roof and guttering; proximity of branches to roof	No visible sign of dirt, leaves rust or algae on roof or in gutter; no branches close to roof or other sites for roosting or perching of birds	What:	Clean roof and gutters, cut back branches	Maintenance and user education	
		How:	Sanitary inspection of the roof catchment and gutters		How:	Clean roof with broom and clean water; cut back branches		
		When:	Before monsoon and weekly intervals during monsoon		When:	As soon as identified		
		Where:	At the roof		Who:	Household or caretaker (for communal systems)		
		Who:	Household or caretaker (for communal systems)					
Rainwater tank	Quantity of water in tank	What:	Quantity of water in tank	Before water level reaches point when quantity insufficient for demand; damage to tap	What:	Control use of water and fix tap	Maintenance and user education	
		How:	Check water level in tank		How:	Household/community daily collection restricted; replace faulty valves		
		When:	Weekly during dry season		When:	Immediately		
		Where:	At the tank		Who:	Household; caretaker (communal system)		
		Who:	Household or caretaker (for communal systems)					
	Sanitary operation	Sanitary operation	What:	Condition of the first flush diversion system	First foul flush diverter not blocked or damaged	What:	Repair of diversion system and replace screen	Maintenance and user education
			How:	Sanitary inspection		How:	Replace joints or screen if damaged	
			When:	Before monsoon, monthly during monsoon		When:	As soon as identified	
			Where:	At the tank		Who:	Household or caretaker (for communal systems)	
			Who:	Household or caretaker (for communal systems)				

Rainwater tank	Sanitary integrity of tank	What:	Sanitary condition of tank, cover and tank base	Cracks in tank walls, roof or base; displacement/damage to cover	What:	Repair of cracks, cover; replacement of cover if displaced	
		How:	Sanitary inspection		How:	Mortar into cracks; repair of faults	
		When:	Before monsoon; monthly during monsoon		When:	Within 7 days	
		Where:	At tank		Who:	Household; caretaker (communal systems)	
		Who:	Household; caretaker (for communal systems)				
	Cleanliness of tank	What:	Sanitary condition of inside of tank	No visible dirt or algae in tank; loss of cap from flushing outlet	What:	Cleaning of tank and disinfection; refit cap on flush outlet	
		How:	Sanitary inspection		How:	Use bleaching powder	
		When:	Before monsoon		When:	Before monsoon	
		Where:	Inside tank		Who:	Household; caretaker (communal system)	
		Who:	Household or caretaker (for communal systems)				
	Sanitary withdrawal system	What:	Water withdrawal from tank	Single bucket used for collecting water	What:	Sanitary withdrawal of water	
		How:	Sanitary inspection		How:	Install tap	
		When:	On commissioning		When:	Immediately	
		Where:	At tank		Who:	Household, caretaker (communal systems)	
		Who:	Household; caretaker (communal system)				
	Protective maintenance	What:	Prevention of mosquito breeding	No damage to mosquito mesh on vents	What:	Repair damaged mesh on vents	Training of households and caretakers, see section 2 of Table 10. Improvement Action plan
		How:	Sanitary inspection		How:	Replacement of mesh	
		When:	Monthly		When:	Within 3 days	
		Where:	Mesh on vents and inside the well		Who:	Caretaker	
		Who:	Household; caretaker (communal systems)				

Tap	Condition of tap	What:	Whether tap leaking or showing signs of wear	Tap does not leak	What:	Repair or replace leaking tap	Training of caretakers and users, see section 2 of Table 10. Improvement Action plan
		How:	Visual inspection		How:	Replace with new tap using plumbers tape	
		When:	Monthly		When:	As soon as leaks notice	
		Where	Point of attachment to tank		Who:	User/caretaker	
		Who:	User/caretaker				
Post source	Hygienic water use	What:	Hygiene practice during collection, transport and storage	Water collection, transport and storage is hygienic	What:	Key hygiene messages	Hygiene education materials and training of community hygiene promoters, see section 3 of Table 10. Improvement Action plan
		How:	Hygiene inspection		How:	Hygiene education	
		When:	Regularly within community		When:	Ongoing	
		Where	With households and in community		Who:	Community hygiene promoter	
		Who:	Community hygiene promoter				

Table 8. Verification or Surveillance schedule

Activity	Description	Frequency	Responsible Party	Records
Effectiveness of water safety management	Regular meetings with community and/or water and sanitation committee	Regular sample of communities visited each year	NGO or DPHE	Data stored at local levels and transferred to national water supply information centre
Reduction of social exclusion to source	Regular meetings with community and/or water and sanitation committee	Regular sample of communities visited each year		
Sanitary inspection	Inspection form to include all major hazard events that may occur due to poor infrastructure condition and poor roof catchment protection	Communal systems: twice per year (dry season and monsoon) Household systems: random sampling Household storage: random sampling		
Testing of microbial quality	Thermotolerant coliform analysis using either field kit (De/Agua, Potatest etc) or laboratory Confirmatory testing for <i>E.coli</i> on 10% of positive samples	Communal systems: twice per year (dry season and monsoon) Household systems: random sampling Household storage: random sampling		
Testing of chemical quality	Lead Iron	If sheeting is old: communal systems on installation; household systems: random sampling If sheeting is old: communal systems on installation; household systems random sampling		
Testing of physical quality	Smell Turbidity Colour Taste	Twice per year (dry season and monsoon) to coincide with sanitary inspection		

Table 9. Validation schedule

Process Step	Hazardous Event	Validation
All processes	Introduction of pathogens	Use of verification data in quantitative health risk assessment model to assess changes in potential disease burden
Social inclusion	Members of community have no/restricted access to water source	Community meetings demonstrate that access is assured to all
Catchment	Introduction of pathogens and zinc via hazardous events identified in form 6	Combined analysis of water quality and sanitary inspection data from verification to assess whether protection measures have been effective; analysis of chemical water quality
Rainwater tank	Introduction of pathogens into well via hazardous events identified in form 6	Combined analysis of water quality and sanitary inspection data from verification to assess whether protection measures have been effective
	Quantity of water	Community/households report on availability of water throughout the dry season
	Breeding of mosquitoes in tank	Mesh shown to be effective in preventing entry of mosquitoes into tank
Post source	Introduction of pathogens via hazardous events identified in form 6	Analysis of water quality and sanitary inspection data from verification to assess whether hygiene education has been effective

Table 10. Improvement Action plan

Issue Identified		Action Required	Procedures or Records?	Responsibility	Time Frame
No.	Issue				
1	Ensuring sufficient quantity	Design to take into account demand and rainfall quantity; training of households and communities on water conservation	Follow approved standard designs	DPHE/option provider /NGOs responsible for commissioning or undertaking construction	Short
2	Maintenance of roof and tank	Training of households and caretakers in sanitary maintenance include: -washing of roof -maintenance of first flush device -fixing or repairing of mosquito net -fixing and repairing of taps	Follow standard training and develop maintenance manual	VBO members and NGOs responsible for undertaking hygiene education programme	Short
3	Ensuring safe water handling post source	Provide hygiene education programmes to community to include: -washing of hands before water collection; -washing of vessels before collection of water; -keeping the vessel covered; -storing of water at clean and elevated place; -safe handling of water during usage.	Follow guidelines on hygiene education	VBO members and NGOs responsible for undertaking hygiene education programme	Medium