Rural Water Supply and Sanitation Project in Western Nepal Phase II

2015

Water Safety Planning Guideline for Gravity Schemes

With integrated Operation & Maintenance Plan and Water Tariff Calculation

Project Support Unit
FCG International Ltd
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Contents

Acronyms

DDC	District Development Committee
DMC	District Management Committee
DoLIDAR	Department for Local Infrastructure Development and Agricultural Roads
D-WASH-CC	District WASH Coordination Committee
LCDP	Litres per capita per day
NPR	Nepalese Rupee
O&M	Operation & Maintenance
RWSSP-WN	Rural Water Supply and Sanitation Project in Western Nepal
VDC	Village Development Committee
VMW	Village Maintenance Worker
V-WASH-CC	VDC WASH Coordination Committee
WASH	Water, Sanitation and Hygiene
WSP	Water Safety Plan
WUSC	Water Users and Sanitation Committee

Reference materials

1. Handbook on Community-wide Water Safety Planning, MoFALD/DoLIDAR, 2013.
2. Water Safety Plan Handbook 2070, Department of Water Supply and Sewerage
3. Recharge Pond Handbook for WASH Program, MoFALD/DoLIDAR, 2013.
4. Step-by-Step Manual for Sustainable Water Supply Services, 2013, RWSSPWN-II
5. WASH Climate Resilient Development. Local participatory water supply and climate change risk assessment: Modified water safety plans. Global Water Partnership and UNICEF 2014.

This guideline has been prepared to instruct Water Supply and Sanitation User's Committee (WUSC) and water safety planning facilitators in the preparation and implementation of Water Safety Plan (WSP) and providing training on the same.

WSP+++ concept combines Water Safety Plans which pays attention also to Climate Change Adaptation & Disaster Risk Reduction, and Operation & Maintenance together with water tariff

STEP-BY-STEP TO WATER SAFETY PLAN (WSP)

1. Formation of WSP Team

- Call for a users´ mass meeting
- Ensure users´ commitment to prepare and implement WSP
- Select the members to WSP team (members should be users of the scheme); form 1
- Discuss the basis of succesful WSP; form 2

2. System analysis

- List out the scheme structures; form 3
- Prepare a combined community & scheme layout map; form 4
- Describe source characteristics in terms of discharge & seasonality; form 3
- Define the catchment area land uses; form 4

3. Hazard assessment

- Identify areas and ways of water contamination; form 6a
- Water quality testing; form 5
- Assess rainfall pattern and seasonal distribution
- Assess natural hazards, such as floods, landslides and source depletion, and their impact on water resources and scheme structures; form 6
- Assess possible degradation processes in the catchment area

4. Prepare & implement

- Short-term plan for regular opearation & maintenance activities and minor repair and improvement activities; form 6a
- Long-term plan for major repair and upgrading activities and larger hazard mitigation and prevention measures; form 6b

5. Monitor & verify

- Monitor the implementation of WSP; form 6a and 6b
- Re-testing water quality; form 5
- User satisfaction survey to verify the effectiveness of WSP; annex 1

6. Review & report

- Review the effectiveness of the WSP
- Discuss the results and way forward with the users in a mass meeting
- Plan for any improvements to the WSP
- Report to and request assistance from VDC, V-WASH-CC, D-WASH-CC or DWSS

1. Background

This guideline has been prepared to instruct Water Users and Sanitation Committee (WUSC) and water safety planning facilitators in the preparation and implementation of **Water Safety Plan (WSP)** and providing training on the same. The primary responsibility of each WUSC is to provide safe supply as well as safe quality drinking water to the people of its scheme area. Safe water supply refers to quantity of water and functionality of the scheme, where as safe quality drinking water is free of bacterial and chemical contamination.

WSP ensures the safe supply and quality of drinking water through the use of a comprehensive risk assessment and risk management approach that covers all steps in water supply scheme from catchment to consumer. WSP addresses the following:

- Possible areas of water contamination, its causes and how to prevent contamination;
- Direct and indirect environmental and climate-induced hazards to continuous water supply and how to mitigate or adapt to them;
- Monitoring the implementation of the Water Safety Plan, i.e. implementation of control measures and hazard mitigation and adaptation measures;
- Ensuring the continuous distribution of safe drinking water.

WSP training will be provided to the WUSC members and WSP Team to improve their capacity in preparation and implementation of WSP. This guideline has been prepared with the objective that each WUSC will be capable to *implement* their WSP in their scheme.

2. Introduction to Water Safety Plan

Safe supply and quality of drinking water can be assured through a variety of interventions at different levels, from households to entire communities often with an excellent cost–benefit ratio. The main reasons why each drinking water supply scheme should have their own WSP are listed below:

- WSP secures public health by ensuring safe quality drinking water in water supply systems;
- WSP helps to secure continuity of water supply by mitigating and adapting to direct and indirect environmental and climate-induced hazards that may threaten safe water supply. Measures can be taken to prevent direct hazards such as landslides, floods/excess runoff and depletion of water sources. Catchment degradation, such as degraded vegetation and exposed soil, is an indirect hazard that can be the main cause of other direct hazards;
- Prevention of water contamination and hazards to the scheme is less costly and more effective than acting after the damage has already taken place. Thus it is essential to identify the possible areas of water contamination and assess direct and indirect hazards that can affect the scheme in each and every component of the WS scheme, from catchment to the mouth, and plan for preventive actions;

- Operation and Maintenance (O&M) plan is integrated along with the water safety plan;
- It is of utmost importance to collect adequate water tariff to cover regular operation and maintenance and repair works. WUSCs can also plan for upgrading or improving the scheme and catchment with collected O&M funds. Tariff calculation methods are introduced at the end of this guideline.

2.1. Objective of Water Safety Plan Implementation

- To increase the awareness of consumers regarding the provision of safe supply and safe quality of drinking water;
- To help the consumers/water users to maintain and upgrade their scheme for the provision of safe supply and safe quality of drinking water;
- To prevent the water sources from contamination, and to prevent contamination of water during collection in the reservoir tank, distribution, storage, and use;
- To take necessary measures to mitigate or adapt to direct and indirect environmental and climate-induced hazards than can disrupt safe water supply in different ways: Landslides mainly cause damage to the scheme structures; floods or excess runoff can cause damage to structures and also contaminate water; source depletion and dry-up affect the availability of water. Measures can be planned and implemented to prevent such hazards, reduce their impact and to adapt to live with the changes.

2.2. Basis for Successful Water Safety Plan

WSP indicates the various activities that need to be performed to maintain safe supply and safe quality drinking water, from catchment to mouth. User's participation and commitment is essential to keep the water safe. Therefore, for the successful implementation of water safety plan, following points should be fulfilled:

- WUSC registered in District Water Resources Committee;
- WUSC conducting meetings regularly;
- Public auditing & hearing and mass meetings conducted on regular basis;
- Establishment of Operation and Maintenance (O&M) fund and development of operation and maintenance regulation;
- WUSC carrying out minor repair and maintenance work on regular basis;
- Trained maintenance worker(s) who carry out their work regularly;
- Regular collection of sufficient water tariff;
- Committed WUSC with 50% representation of women and proportional representation of Disadvantaged Groups;
- Active Village Water Supply, Sanitation and Hygiene Coordination Committee (V-WASH-CC), their cooperation and participation in preparation and implementation of WSP;
- After completion of the scheme, all the tools and remaining fittings/pipes and other materials are collected, recorded, properly stored and managed by an assigned person. Tools and left-over materials and components should be used for the maintenance and repair of the scheme.

3. Steps of Water Safety Plan

There are six steps in the cycle of WSP which are explained below. First, the WSP Team is established from among the users of the scheme. After that, the water supply system and the status of the scheme is analyzed. The third step is to identify different hazards that can cause water contamination or otherwise disrupt the safe supply of water. Measures to address these hazards are discussed and included in WSP under the step four. The short-term WSP consists of regular (day to day) activities and minor improvement activities that can be implemented with WUSC´s own resources. Long-term measures that are likely to require outside support can be implemented gradually. Implementation of the WSP should be monitored regularly (step 5). The final step is to review the effectiveness of the WSP and plan for any corrective measures to improve the WSP.

3.1. Formation of WSP Team

As the first step, a team dedicated to preparation, monitoring and verification of WSP will be formed by the scheme users. Members of the WSP Team should also take responsibility for implementation of activities identified in WSP, although also other users (those who are not members of the WSP Team) or groups can be named responsible for implementing different activities. The WSP Team must coordinate with other stakeholders to obtain the necessary resources in order to support the WUSC in implementing the water safety plan and other activities related to it.

The WSP Team should be formed as follows:

- Call for a mass meeting of all the users;
- Discuss the above mentioned basis of successful WSP in a mass meeting and fill the findings in the format 2. At this point, the users´ commitment to implement those points should be ensured; Format 2 also includes information that is needed for the calculation of adequate water tariff rate.
- Select the members of the Water Safety Planning Team in the mass meeting. The WSP Team should consist of the users of the scheme only. The WSP Team should include WUSC members, other representatives of the users and the VMW. Other optional members (if available among the users) include representative of V-WASH-CC, women health worker or volunteer, teachers and VDC's technical person.
- WUSC Chairperson shall be the Team Coordinator. It is mandatory for the WSP Team to include the WUSC Chairperson and VMW.
- The composition of the WSP Team should be recorded in the format 1.
- The WSP Team shall decide which water quality parameters should be tested before starting the WSP preparation.

Tasks of WSP Team are as follows:

- Conduct the **steps 1, 2, 3 and 4** for the WSP preparation:
    - Analysis of the water supply system and its surrounding environment. Fill the formats 3-4.
    - Visit the scheme from the water catchment (i.e. upstream of the source) to tap to identify and analyze the probable causes and areas of water contamination

and direct and indirect environmental and climate-induced hazards. Fill up the formats 6a;
    - Prepare the short and long term 'action' plan using the same formats 6a and 6b. The plans should include measures to prevent water contamination and to mitigate or adapt to the identified environmental and climate-induced hazards;
- Conduct the **steps 5 and 6** concerning monitoring, verification, review and documentation of WSP. In case the control measures or mitigation and adaptation measures do not work, other improvement measures must be formulated and implemented in coordination with WUSC;
- Verify the control measures adopted under WSP to safe guard the water from contamination by testing water quality (**step 5**). Carry out written record of all activities, including monitoring and verification;
- Follow up on the environmental and climate-induced hazard mitigation and adaptation measures to assess whether they are effectively implemented and are leading towards the expected impacts (**step 5**);
- Users' satisfaction survey is to be conducted every 6 months to assess the effectiveness of WSP implementation from the perspective of public health and continuity of water supply, as well as to address the complaints of users regarding the water facilities (**step 6**).
- The findings of the WSP monitoring, users´ satisfaction survey and water quality tests, as well as any corrective/improvement measures to the WSP will be discussed in a mass meeting.

3.2. Analysis of the water supply system

The WSP Team should get an understanding of the water supply system as a whole and its components and their locations. The purpose and operation processes of different components must be clear to all WSP Team members:

- The WSP Team should list all structures of the scheme in the format 3.
- The WSP Team should draw a community/layout map (format 4) of the water supply system, showing all components (source, intake, collection and distribution chambers, wash-out and air valves, transmission and distribution lines and tap stands), community features (houses/clusters, buildings, roads) and environmental features (forests, grazing grounds, rivers etc.);
- The WSP Team should define the water catchment area. Different land use patterns and possible signs of catchment degradation (e.g. deforestation, overgrazing, soil erosion) as well as areas of landslides and floods should be observed and discussed. These should be recorded in the community map (format 4);
- The WSP Team shall describe the source characteristics in terms of discharge, seasonality/reliability, and record the findings (format 3);
- Nearby traditional water point sources can also be visited and its existing characteristics (quality, seasonality, reliability) should be identified.

3.3. Identifying and assessing hazards, risks and existing control methods

After the system analysis, the next step is to analyze different hazards that can disrupt safe supply and safe quality of water. The WSP Team should visit the water supply scheme from the water catchment to the tap and identify A) risks to safe water quality, and B) direct and indirect environmental and climate induced hazards that can affect safe water supply (i.e. continuity, quantity of water and functionality of the scheme). WSP Team should write down the findings of the assessment in format 6a.

A) Identifying risks to safe water quality

- Every structure of the scheme should be inspected to track down the possible areas and ways of water contamination. Water turbidity at the source should be observed. Water storage and its use should also be monitored at household level. The findings of the inspection should be filled in the “Hazard and risk assessment, plan preparation, implementation and monitoring form (format 6a)".
- The bacterial contamination of the water should be tested by a bacterial test kit (H2S bottle), or on the basis of “Presence or Absence of Vial”. The results of the tests should be recorded in the “Water Quality Test Result form (format 5).

B) Identifying direct and indirect hazards that can affect safe water supply

- Before starting the inspection of the water supply scheme (step 3.3 A), the WSP Team should discuss the current rainfall pattern, including amount of precipitation and its seasonal distribution, as well as the variability of discharge in the source (assessed under step 2). This should be based on community knowledge, including people´s experience in extreme weather events or changes in the climate pattern. The WSP Team should also discuss what are the implications for safe water supply (i.e. quantity of water);
- The WSP Team must assess the environmental and climate-induced hazards, such as magnitude and frequency of flooding, source depletion and dry-up, expanding gullies and landslides, and their possible impacts on water resources, quality of water and scheme structures. These hazards and their possible implications on water resources and the scheme should be observed during the inspection of the water catchment and the water supply structures;
- The assessment should also pay attention to indirect hazards such as the degradation processes in the catchment area of the water scheme that might undermine its sustainability in the long run. Signs of catchment degradation include, for example, rills and gully erosion, wind erosion (dust storms), sedimentation in downslopes or along water course and degraded vegetation such as cleared forests, sparse trees, over-grazed lands, poor crops and patches of bare soil.
- The identified hazards should be filled out in the “Hazard and risk assessment, plan preparation, implementation and monitoring form" (format 6a).
- Existing activities and processes that help to prevent or reduce the occurrence of a potential hazard (e.g. good watershed management practices, preservation and rehabilitation of community forests etc.) should be identified and taken into account in the WSP.

3.4. Preparation and implementation of WSP and monitoring plan

After identifying the hazards and risks to ensuring safe supply and safe quality drinking water, the control and mitigation measures to prevent the hazard and minimize the risks as well as measures to adapt to the changes (e.g. more intense droughts and floods), should be discussed. Examples of measures to address different hazards and risks are presented in chapter 4. Short-term and long-term activities should be identified and the need of internal or external support should be assessed.

- Short-term plan (format 6a) will consist of regular (day to day) activities and minor improvement measures that can be implemented with WUSC´s own resources (without external support). The short-term plan should focus on prevention of water contamination through various control measures. Similarly, simple activities for preventing natural hazards and reducing risks (e.g. awareness raising, control of deforestation, prevention of future water catchment degradation, implementation of simple technologies) should be included in the short-term plan.
- Long term plan (format 6b) should include major mitigation and adaptation activities to natural hazards, as well as major repair and upgrading works of water supply system. Implementation of the long term activities may require outside support (whether technical or financial) or long-term saving by the users; such requirements should be already mentioned in the plan.
- Both short- and long-term plan should be prepared based on discussion on the above matters. Questions on who and by when are answered to with regard to implementation and monitoring of the Plan, with clear roles and responsibilities. Specific responsible person(s) should be assigned rather than assigning a group or team of people for each of the planned activities.
- WSP prepared by the WSP Team shall be approved in a mass meeting in which the users and committee members shall commit for its implementation.
- Short-term measures of WSP should be implemented immediately and/or on regular basis (e.g. regular maintenance, control of deforestation).
- Long-term measures can be implemented gradually.

3.5. Monitoring and verification of WSP

The objective of WSP is to ensure provision of safe water supply and safe quality water by identified control, mitigation and adaptation measures. For this, WSP Team should prepare a **monitoring plan** on the same format (format 6a and 6b) and commit to monitoring the implementation of WSP (i.e. all the measures identified in WSP).

- Since the monitoring is a continuous process, it should be carried out both before and after implementing specific measures so that the impact/effect of WSP is assessed.
- Water quality testing mechanism should be established and testing carried out in regular basis. Since testing of water quality for all parameters indicated by National Water Quality Standard 2065 is often challenging, priority should be given to testing of bacterial contamination by "*Presence/Absence Vial*", for instance.

- Along with the bacterial contamination, chemical parameter such as concentration of Turbidity, pH value, iron and ammonia should be tested. Nitrate and phosphate should be tested especially when the source is located in/downstream of agricultural field. Arsenic should be tested in water supply systems located in Terai.
- All water quality tests should be recorded (example in format 5).
- Water discharge at intake can also be followed up, especially in water scarce areas where the community has taken measures to improve the condition of the water catchment.
- A user survey must be conducted at least every 6 months to find out the satisfaction level of the users and the effectiveness of the water supply scheme and water safety plan. The template is given in Annex 1.

3.6. Review, reporting and documenting

The effectiveness of WSP should be reviewed within the team, based on monitoring findings, water quality testing and user survey findings. The findings and way forward are discussed in a mass meeting, with an objective to ensure the effective implementation of WSP in future.

- Carry out a review of the monitoring findings as well as water quality test and user survey findings carried out under **step 5.**
- Discuss the results and way forward in a mass meeting. WSP can be improved based on any emerging issues.
- All forms must be filled in every 6 months or as decided by the mass meeting. Since these forms also indicate the status after the maintenance work, it helps to monitor the level of improvement in continuity of water supply and quality of water after the implementation of WSP was started.
- Information and required assistance regarding the implementation of WSP should be provided to the related VDC, V-WASH-CC, D-WASH-CC, (Sub) Divisional Office of the Department of Water Supply and Sewerage and DDC (information center).
- Documentation and review of the implementation of WSP must be done by WSP Team on regular basis.

4. Examples of measures to take under WSP

4.1. Control measures to prevent water contamination and ensure quality of water

Below are listed some examples of control measures to ensure safe water quality. The measures should be discussed among the WSP Team members and selected so that they address the risks identified in **the step 3.**

- Ensure that the source catchment (upstream of the source) is free of open defecation, solid waste and other possible contaminants. Prohibit leaving dead carcasses and other decaying or contaminating items in the catchment.
- Construction or repair of fencing around the water supply structures to avoid haphazard entrance of human beings and animals to the structures.

- Construct and maintain run off drainages around the source/intake and other structures to prevent water contamination and safeguard the structures from possible damage.
- Repair breakages in pipelines to prevent water/soil and possible contaminants entering the pipe from outside when the pipe is empty, and to prevent water leakage when there is water in the pipe.
- Bury all plastic (HDPE) pipe to a sufficient depth below the ground level.
- Cover slab of the tanks and chambers should be regularly monitored and immediately repaired if they are found broken or leaking.
- Inside and outside of all the structures, including the intake, should be regularly cleaned up.
- Rusted pipes and fittings (non-functional) should be replaced.
- Prohibit the practices of taking water from public taps to individual households using open pipes as there are more chances to contaminate the water through these open pipes.
- Protect the pipelines and other structures, fittings etc. from entering the sewerage or other any possible contaminations.
- Regular cleaning of tap stands/platforms.
- Chlorination can be considered if there is presence of bacterial contamination. Household level water treatment/purification methods are described below.

Household water treatment techniques

Although the improved structures of water supply scheme protect water from pollution, it may be necessary to treat the water at household level as well to ensure the quality of drinking water. Especially during rainy season and any diarrhea epidemics, the WSP Team should advocate all the households within their scheme area to adopt water treatment techniques and advice all consumers to use water only after its treatment if there is any doubt of water contamination.

Water can be purified by the following techniques:

- **Sedimentation**: Storing of water in a closed vessel for a day destroys approximately 50 % of harmful germs. After sedimentation of the muddy particles that normally makes water blurry, the water appears clear.
- **Filtration**: Water can be filtered using a peace of clean cloth or a ceramic filter. This method only filters the germs but does not kill them. Most filters are not fully effective because microscopic bacteria can pass through the filter. However, some filter types such as silver coated candle filter and bio-sand filter works on the microscopic bacteria as well.

Following techniques are used for destroying the germs and bacteria:

- **Boiling**: Most of the germs in water can be destroyed after boiling the water once. In places of higher altitude, water should be boiled for additional three minutes. Boiling is the best method for ensuring quality of drinking water.

- **Chlorination**: Water can be treated by using water treatment chemicals, such as Piyush and water guard, which can be bought in the market. It is utmost importance to follow the instructions written in the packet while using these chemicals; wrong dosing of the chemical can cause serious health implications. Water should be stirred properly after mixing the chlorine. After the treatment, water will be safe to drink only after half an hour.
- **SODIS technique**: This method should be used only if other methods are not available, because it rarely kills all the bacteria. Storing of clean water in a transparent plastic bottle with a closed cap in the sun for 6-7 hours destroys some of the bacteria. In a cloudy day, the exposure period should be pre-lengthened up to two days.

Other Supporting Programs

For ensuring safe water quality in the scheme, open defecating habit should be totally banned. It should be ensured that every household has constructed and is using a toilet within the scheme and the water catchment area.
To prevent contamination of water, hand washing with soap is particularly critical in the following four situations:

- After using toilet and cleaning child´s feces.
- After touching dirt.
- Before eating or feeding a baby.
- Before cooking or serving food.

4.2. Mitigation and adaptation measures to environmental and climate-induced hazards

Four different types of environmental and climate-induced hazards and measures to prevent them are discussed in this chapter.

1. **Water catchment degradation** is an indirect hazard that can be the root cause of many direct hazards. Catchment degradation includes for example deforestation, overgrazing and soil erosion, which affect the water cycle (i.e. runoff and infiltration of water). Degraded water catchment is more vulnerable to landslides and excess runoff/flooding. In the long run, catchment degradation will affect the availability of water.
2. **Source depletion and dry-up** directly impact the availability of water. There are various measures to mitigate source depletion, e.g. by restoring vegetation and constructing recharge pits and ponds. There are also various adaptation measures particularly related to better management of reduced water resources.
3. **Flooding and excess water runoff** can impact water safety in two ways: by causing water contamination (e.g. when polluted surface water enters drinking water tanks and pipelines) and by causing damage to scheme structures. There are various ways to reduce the occurrence floods/excess runoff and to reduce their impact on water structures and water quality.

4. **Landslides** mainly threaten the physical structures of the scheme, disrupting safe water supply. However, landslides can also cause water contamination for example when pipes and other structures are broken.

The measures to be included in the WSP should respond to the hazards and risks and their causes that were identified during the hazard assessment (step 3). The focus should be in preventing/avoiding the entire hazard from taking place (e.g. prevention of source depletion, flooding, landslides), or at least reducing the occurrence. When it´s not possible to entirely prevent the hazard, adaptation measures that help the users to adapt to the changed situation (e.g. managing reduced water resources) can be taken. Both mitigation/prevention and adaptation measures for the four type of hazards are listed below.

Measures to address catchment degradation

Water catchment degradation, for example due to deforestation and overgrazing, can have a detrimental effect on the hydrological circle by increasing runoff and direct evaporation from soil, and reduced moisture holding by the forests. This in turn will affect the local water resources. Measures to tackle catchment degradation are listed below. Many of them can be promoted and undertaken by the community without external support. More large-scale mitigation activities require coordination with different government departments (e.g. department of soil conservation and watershed management; department of forests).

These measures not only help to rebalance the hydrological cycle, but also contribute to wider improvements of natural resources:

- Activities related to restoration of vegetation and forest cover and prevention of deforestation. These consist of, for example, raising awareness on importance of catchment protection and prevention of deforestation or other type of catchment degradation, mobilizing plantation campaigns (ensuring suitability of species) and linking with community forest project/forest user groups etc.;
- Regulation of grazing and collection of fodder and firewood, for example prohibiting grazing in degraded areas and in the surrounding of the source and intake;
- Activities to prevent soil erosion on crop lands; e.g. soil and stone bunds, terraces with cut-off drains and artificial waterways, ploughing along contours etc.
- Gully rehabilitation and runoff management;
- Improve agricultural practices (i.e. terracing of lands, suitable species, agroforestry).

Measures to mitigate and adapt to source depletion and droughts

The above measures to address catchment degradation help to mitigate source depletion by, for example, increasing infiltration and recharge of ground water resources and by decreasing evaporative losses. In addition, there are also technical options to mitigate and adapt to water scarcity.

Mitigation measures:

- Water catchment improvement, i.e. afforestation and control of deforestation etc.
- Construction of recharge ponds, pits and multiuse ponds; managed aquifer recharge (capturing and recharging excess runoff close to wells or boreholes);
- Contour trenches and contour binding with stones for improved water retention and infiltration.

Adaptation measures:

- Collection and storage of surface water and waste runoff: e.g. construction of below ground tanks/infiltration galleries (such as cisterns) into which rainwater from the ground is directed; small reservoirs with earthen bunds to contain runoff;
- Rainwater harvesting from rooftops, and directing overflow water to recharge pits;
- Water conservation/reuse measures, such as reuse of domestic water for irrigation (sewerage water pits) conservation/drip irrigation.

Measures to mitigate and adapt to excess runoff and floods

Mitigation measures:

- Measures that address water catchment degradation, i.e. increased water infiltration and reduced runoff help to reduce the occurrence of floods. These include control of deforestation and grazing, afforestation, bioengineering, check-dams etc.

Adaptation measures:

- Household water treatment, safe storage and improved hygienic behavior;
- Improved sanitation, i.e. ending open defecation and proper waste management to prevent pollution of water sources during floods;
- Adjustments to the location and design of latrines to prevent water pollution during floods; ensuring minimum distance between latrines and water sources, raising latrines to keep minimum distance between pit and water table, regular emptying of pits, composting latrines etc.
- Emergency preparedness (e.g. water treatment kits, spare pipes and fittings) and disaster information notice.

Measures to prevent landslides and reduce soil erosion

Mitigation measures:

- Control of deforestation and grazing of livestock especially in landslide prone areas;
- Retention walls and gabion boxes to bound soils and rocks between two different elevations (e.g. terraced slopes);
- Soil conservation e.g. by bio-engineering works, check dams;
- Afforestation in areas around landslide prone slopes; use of nets to tie the soil while afforestation is taking place.

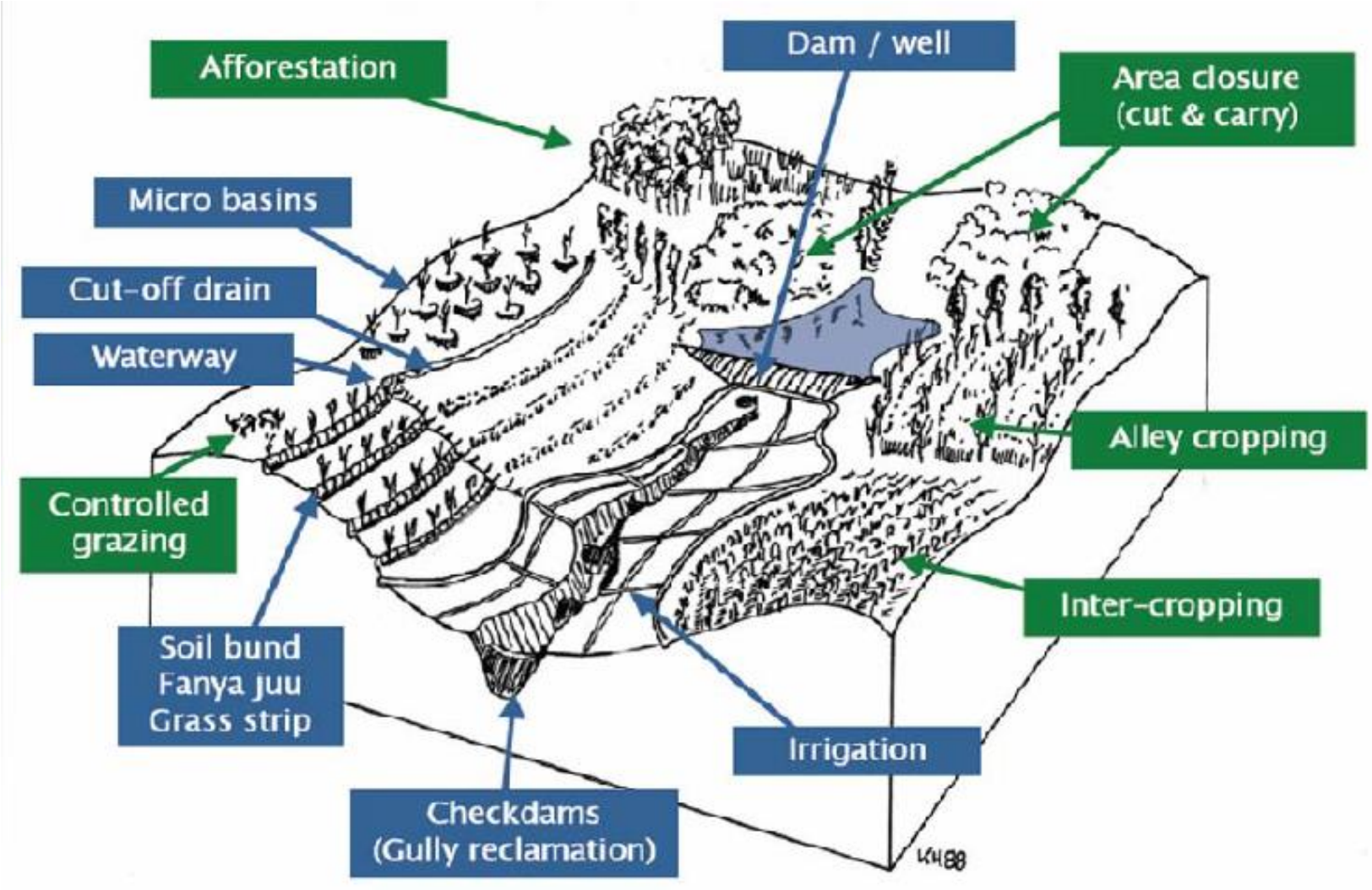

Figure 1: Watershed management practices
Source: ICIMOD. Integrated Watershed Management and adaptation to climate change in the Hindu Kush – Himalaya. Original graph by K.Herweg.

5. Water Tariff and Cost Recovery

The concept of water tariff has been introduced to raise sufficient funds for regular operation and maintenance activities, repair of damaged structures and replacement of components, for implementation of improvement or upgrading works, and pay for the VMW or other labor work etc. The O&M fund is vital for smooth operation of water supply schemes. In addition, the community should also prepare for the ´cost recovery´ of the scheme. Since the scheme needs to be rehabilitated or reconstructed at the end of its life cycle, a specific fund should be generated through water tariff collection thorough out its life cycle. The purpose of ´cost recovery´ of a water supply scheme is to prepare the community to fully rehabilitate or replace the scheme once it comes to the end of its life cycle.

Two main objectives of Introducing Water Tariff are:

- To collect fund for daily operating costs and repair and maintenance investment;
- To collect sufficient fund for the replacement of the scheme after the design period is over.

Data required to calculate the water tariff:

- Total project cost;
- Design period of the scheme;
- Estimated annual cost for maintenance and repair works;
- Annual salary and allowances of WUSC staff and maintenance workers;
- Annual WUSC and office management expenses;
- Population & Population Growth Rate (in percentage);
- Household population & household population growth rate;
- Water demand in Per capita per day;
- Annual inflation rate

Method of calculating water tariff

Uniform Rate Method: In this method, uniform rate is charged, irrelevant to amount of water used by the users. This is calculated for household cost for water use per month. This method is applicable to small scheme. Both the methods are described in detail in Annex 2.

Monthly household water tariff rate =	$\frac{\text{Annual cost recovery + annual operation cost}}{\text{12 x no. of households}}$

Consumption Rate Method: In this method the water tariff is charged according to the volume of water consumed.

Per liter rate =	$\frac{\text{Annual cost recovery + annual operation cost}}{\text{Annual water consumption in liters}}$

6. Water Safety Plan and Operation & Maintenance related formats

Format 1: Details of WSP Team

Details of WSP Team					
Scheme:		Date:			
VDC:		Village Name:			
Ward No.					
S.N	Mr/Ms. Name	Cluster Name	M/F	Designation	Remarks
1					
2					
3					
4					
5					
6					
7					
8					
9					

Format 2: Water Supply Scheme Operation, Maintenance and Management

Water Supply Scheme Operation, Maintenance and Management					
Scheme Name:			Date:		
Total project cost:			Scheme design period:		
S. N	Status of WS scheme Operation and Management	Yes/ No/ data	If No		
			How to Manage	By whom?	When ?
1	Users Committee Registration				
2	WUSC has a bank account				
3	Regular meeting of the WUSC				
4	Financial and stock management				
5	Proper management and storage of tools and components				
6	Public Auditing				
7	Annual general assembly				
8	Mobilization of VMW				
9	Implementation of O&M directive of WUSC				
10	Regular minor maintenance and repair work				
11	Operation and maintenance fund				
12	Regular collection of water tariff				
13	Estimated annual cost for maintenance and repair works				
14	Annual salary and allowances of VMW and other possible staff/workers				
15	Annual WUSC and office management expenses				
16	Population & population growth rate (%)				
17	Number of households and growth rate of new HHs (%)				
18	Water demand per capita per day				
19	Annual inflation rate				

Note: Questions 13-19 are used in calculation of the water tariff rate.

Format 3: Scheme details

Scheme Details			
Scheme Name:		No. of household:	
VDC:		Population:	
Construction Start Date:		Ward No.:	
Construction Completed Date:		VMW Name:	
Support Agencies:		WUSC's account No:	
Support organization:		Bank or Finance company:	
WUSC's Registration No:		WUSC's registration date:	
S.N	**Details**	**#/unit**	**Remark**
1	Intake and source type		
2	Discharge at source(s) (litres per second)		
3	Reservoir tank and its capacity		
4	Collection Chamber		
5	Break Pressure Tank		
6	Interruption Chamber		
7	Distribution Chamber		
8	Valve Chamber		
9	Air Valve		
10	Wash Out		
11	Total pipe line length: Transmission: Distribution:		
12	Public Taps		
13	Private Taps		
14	School Number		
15	Private Toilet		
16	Institutional Toilet		

Format 4: Community map with layout

Community Map with Layout	
Scheme Name:	VDC:
Village Name	Ward No:
Date:	

Format 5: Water quality test results

Water Quality Test Result												
	Source Name and Type:											
	Test Method &Equipment:											
	Test by:											
S.N.	Parameters	Nepal Standard	Unit	Water quality test place, date and result								
					Source (Intake) -1	Source (Intake) -2	Structure (CC / IC)	Reservoir Tank 1	Reservoir Tank 2	Tap 1	Tap 2	House hold level
1	Turbidity	5 (10)	NTU	Date								
				Unit								
				Date								
				Unit								
2	pH	6.5 to 8.5		Date								
				Unit								
				Date								
				Unit								
3	Ammonia	1.5	mg/L	Date								
				Unit								
				Date								
				Unit								
4	Bacterial Contamination	nill	*CFU/ 100 ml or /+u	Date								
				Unit								
				Date								
				Unit								

*Unit may differ depending on testing method.

Note: The quality of water to be tested before and after of WSP implementation and each year after rainy season at least for the bacterial contamination.

Format 6a: Short-term plan (regular maintenance and minor repair, control and mitigation works)

Water Safety Plan

Hazard and risk assessment, Short-term plan preparation, implementation and monitoring

Regular maintenance and minor repair, control, adaptation and mitigation works (preventive works)

Scheme Name:	Village:	Total Taps:
VDC:	Ward No.:	Name of VMW:

Structure and Place	Risk	Cause of Risk (Present Condition)	Yes /No	Immediate or regular works?	Implementation		Monitoring		
					When?	By whom?	When ?	By whom?	Implementation Status (Done /Not done)
1. Catchment	Catchment degradation ; Depletion of water in the source	Deforestatio or degraded vegetation (sparse trees, bare soils) in the catchment							
		Over-grazing or excessive collection of fodder; bare soils							
		Agricultural practices (e.g. bamboo plantation in dry areas)							
		Soil erosion, sedimentation in downslopes, dust storms							
		Rills or gullies							

Structure and Place	Risk	Cause of Risk (Present Condition)	Yes /No	Immediate or regular works?	Implementation		Monitoring		
					When?	By whom?	When ?	By whom?	Implementation Status (Done /Not done)
2. Source/ intake	Contamination of source water, washing away of intake structures	Drying or depletion of the source							
		Frequent erosion around the source							
		Risk of landslides close to intake							
		No fencing or damaged							
		Access of people or animal to the source							
		Unsafe use of toilet in the settlement above the source							
		Damage of intake cover							
		Danger of flooding of intake							
		Open source							
		Leakage of water from intake structure							
		Pipeline in landslide prone zone							

Structure and Place	Risk	Cause of Risk (Present Condition)	Yes /No	Immediate or regular works?	Implementation		Monitoring		
					When?	By whom?	When ?	By whom?	Implementation Status (Done /Not done)
3. Transmission and Distribution line	Contamination of water through pipe lines Washing away of pipe line by flood, land slide, fire	Exposed pipeline in the ground							
		Pipeline damaged by nails/pegs							
		Leakage from pipeline							
		Pipeline joint connected by plastic or clothes							
		Damage of pipe support block							
		Rust in pipe fittings							
4. Reservoir Tank and other structures	Contamination through Structures (Collection chamber, crossing, interruption chamber, wash out,	No fencing around structures							
		Settlement near structures							
		Completely damaged or cracks on covers of structures							
		Valve Chamber in damaged condition							
		Cracks and leakage from the structure							

Structure and Place	Risk	Cause of Risk (Present Condition)	Yes /No	Immediate or regular works?	Implementation		Monitoring		
					When?	By whom?	When ?	By whom?	Implementation Status (Done /Not done)
	air valve, distribution chamber, reservoir tank, break pressure)	Pollution around structures							
		Pollution inside the structures							
		Water logging around the structures							
		Water logging in the chamber having fittings							
		Condition of flooding of structures during monsoon							
		Leakage from the fittings used in the structure							
5. Taps	Contamination from taps	Cracks or broken tap stands							
		Filthy taps platforms							
		Leakage from the tap structure							
		Pollution around tap structure							
		Unmanaged drainage of waste water from the taps							

Structure and Place	Risk	Cause of Risk (Present Condition)	Yes /No	Immediate or regular works?	Implementation		Monitoring		
					When?	By whom?	When ?	By whom?	Implementation Status (Done /Not done)
		Multiple private pipes connected to the taps							
		Washing of dishes in the taps							
		Water drained in the roads							
6. Use of water at household level		No properly cleaned pots before filling water							
		Water pots are not covered in the houses							
		Water pots are easily accessed by children							
		No filtering or boiling of water							
		Dirty utensils are used to drink water							
		Pollution around houses							
		Unsafe toilets in the houses							
		No habit of hand washing with soap after using toilets							

Structure and Place	Risk	Cause of Risk (Present Condition)	Yes /No	Immediate or regular works?	Implementation		Monitoring		
					When?	By whom?	When ?	By whom?	Implementation Status (Done /Not done)
Name of the people monitoring the existing condition									

Format 6b: Long-term plan (Major repair, upgrading and risk reduction activities)

Water Safety Plan

Water Supply Scheme long term planning, Implementation and Monitoring

Major repair, upgrading and risk reduction activities

Scheme Name:	Village:	Total Taps:
VDC:	Ward:	Name of VMW:

Location and Structure	Present Status	Long-term major repair, upgrading and risk reduction activities	Source of fund (Internal or external)	Implementation		Monitoring		
				By when	By whom	By when	By whom	Implementation Status (Done/ Not done)
1. Catchment								
2. Source/Intake								

3. Transmission and Distribution Pipeline								
4. Reservoir Tank and other chambers								
5. Taps (public/private)								
Name of the people monitoring the existing condition								

Annex 1: Users´ satisfaction survey for water and sanitation scheme

Consumer Satisfaction Survey Form

Name of the head member of the household: Date:

1	Is there regular daily water supply in your tap (around the day)?		Regular	Satisfactory	Irregular	Never	
2	Is the quantity of water available to you adequate for household use?		Yes	No			
3	How many months in a year water is available (through this scheme)?		12 months	9-11 months	6-8 months	Less than 6 months	
4	How much time do you need for a round trip of water fetching?		< 15 min	15 to 30 min	30 to 45 min	> 45	
5	Do you think water is safe from its source to the tap?		Totally safe	Satisfactory	Unsafe	Too much unsafe	
6	Are you satisfied with the rate of water tariff?		Yes	No, it´s too high	No, it´s too low		
7	How the repair and maintenance is carried out in your water supply scheme?		Regular	Sometime	According to the necessity	Never	
8	Does WUSC provide enough information to the users on O&M fund (balance, tariffs collected, how it is used)		Yes	No			
9	Does the WUSC listen and take action to your complaints?		Yes	No			
10	Who mostly takes care of the water supply system?		WUSC	VMW	Consumer	Nobody	
11	How satisfied are you with the activities and services of the WUSC?		Very good	Good	Satisfactory	Bad	
12	How often is your community tap monitored by the VMW or WUSC?		Regular	Satisfactory	Irregular	Never	
13	What do you think about the cleanliness of taps/platforms in the communities?		Very clean	Clean	Satisfactory	Dirty	
14	Is there always clean water in your tap?		Always	Most of the time	Sometime	Never	
15	What do you think in general the quality of the water which you are using?		Very good	Good	Satisfactory	Bad	
16	What main improvement measures do you think that the WUSC should make in this water supply scheme?						
17	What kind of purification technique do you use for purifying the drinking water in your home?						
	Nothing	Boiling	Chlorination	Filter	SODIS technique	Sedimentation	Others (mention it)
18	Data collected within the last six months related to the water borne diseases (selected households)						
	Cholera	Typhoid	Diarrhea	Dysentery	Intestinal worms	Jaundice	Others
	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No

Annex 2: Method for Calculating Water Tariff for Cost Recover

Cost Details	First Year	Second Year	Third Year
A. Scheme Recovery Cost	Scheme total cost ÷ Scheme Project Life (years) = NPR	Previous Years Recovery Cost X (1 + Inflation rate in percentage)	Previous Years Recovery Cost X (1 + Inflation rate in percentage)
Total of A	Total of A	Total of A	Total of A
B. Annual operation cost			
1. Annual repair & maintenance cost	2% to 3% of total cost of Scheme	Previous Years Maintenance Cost X (1 + Inflation rate in percentage)	Previous Years Maintenance Cost X (1 + Inflation rate in percentage)
2. Annual salary and allowance expenses	Annual salary and allowance expenses for the First year	Previous Years Annual salary and allowance expenses X (1 + Inflation rate in percentage)	Previous Years Annual salary and allowance expenses X (1 + Inflation rate in percentage)
3. Annual office and management cost of WSUC	Annual operation and management cost of WSUC for the First Year	Previous Years Annual operation and management cost of WSUC X (1 + Inflation rate in percentage)	Previous Years Annual operation and management cost of WSUC X (1 + Inflation rate in percentage)
Total of B	Total of B	Total of B	Total of B
Total A+ B	Total A+ B	Total A+ B	Total A+ B
C. Contingency (5% to 10% of A+B)	Contingency (5% to 10% of A+B)	Contingency (5% to 10% of A+B)	Contingency (5% to 10% of A+B)
D. Total Cost (A+B+C)	**D. Total Cost (A+B+C)**	**D. Total Cost (A+B+C)**	**D. Total Cost (A+B+C)**

When determining the number of households for next year, the increased number of households according to the current annual household growth rate should be added to the household number of the current year.

After determining the total annual cost, water tariff is calculated as follows:

A. Uniform Rate Method: In this method, uniform rate is charged, irrelevant to amount of water used by the users. This is calculated for household cost for water use per month. This method is applicable to a small scheme.

Monthly household water tariff rate =	$\frac{\text{Annual cost recovery + annual operation cost}}{\text{12 x no. of households}}$

B. Consumption Rate Method: In this method the water tariff is set according to the quantity of water consumed.

Per liter rate =	Annual cost recovery + annual operation cost / Annual water consumption in liters

Method for calculating annual water demand (annual water consumption):

(total beneficiary population) X (liters per capita per day) X 365

While determining the population for next year, the increased nos. population according to the current annual population growth rate should be added to the population of current year.

Example:

Data for calculating water tariff (*This data should be collected during the Step 1 of the WSP preparation, and recorded in the format 2*):

Total Scheme Cost	NPR 33,03,412
Project life	20 years
Estimated annual operation and maintenance cost	
2.5% of total project cost = 3,303,412 X 0.025 =	NPR 82,585
Annual salary and allowance expenses	NPR 140,000
Annual operation and management cost of WSUC	NPR 14,400
Population	4,833
Number of households	886
Annual household growth rate	2%
Annual population growth rate	2.04%
Water demand (liters per capita per day)	45 liters/capita/day
Annual Inflation Rate	7%

Cost Details	First Year	Second Year	Third Year	From the same method calculate for the other years
A. Scheme Recovery Cost	3,303,412 ÷ 20 = 165,170	165,170 x 1.07 = 176,732	176,732 x 1.07 = 189,103	
Total of A	165,170	176,732	189,103	
B. Annual Operation Cost				
1. Annual Maintenance cost	82,585	82,585 x 1.07 = 88,336	88,336 x 1.07 = 94,552	
2. Annual salary and allowance expenses	140,000	140,000 x 1.07 = 149,800	149,800 x 1.07 = 160,286	
3. Annual operation and management cost of WSUC	14,400	14,400 x 1.07 = 15,408	15,408 x 1.07 = 16,487	
Total of B	236,985	253,574	271,325	
Total A+ B	402,155	430,306	460,428	
C. Contingency (5% to 10% of A+B)	402,155 x 0.05 = 20,108	430,306 x 0.05 = 21,515	460,428 x 0.05 = 23,021	
D. Total Cost (A+B+C)	422,263	451,821	483,449	

Determining Water Tariff

A. Uniform Rate Method:

First year number of households= 886
Second year number of households= 886 x 1.02 = 904
Third year number of household= 904 x 1.02 = 922

$$\text{First year monthly tariff rate} = \frac{422{,}263}{886 \times 12} = 40$$

$$\text{Second year monthly tariff rate} = \frac{451{,}821}{904 \times 12} = 42$$

$$\text{Third year monthly tariff rate} = \frac{483{,}449}{922 \times 12} = 44$$

B. Consumption Rate Method:

To calculate the Water Tariff rate, from consumption rate method, water demand per person per liter per day is determined. Future population should be calculated by increasing the base year population by the population growth rate and adding it to the base year population.

Base year population = 4866
Second year population = 4833 x 1.024 = 4949
Third year population = 4949 x 1.024 = 5068

For the easy in calculation the liter is divided by 1000 to get the result in cubic meter.

$$\text{First year water tariff per cubic meter of water} = \frac{422{,}263}{\frac{4833 \times 45 \times 365}{1000}} = 5.32$$

$$\text{Second year water tariff per cubic meter of water} = \frac{451{,}821}{\frac{4949 \times 45 \times 365}{1000}} = 5.56$$

From the same way we can calculate for the third year and so on.