THE UNITED REPUBLIC OF TANZANIA

MINISTRY OF WATER

GUIDELINES FOR THE PREPARATION OF WATER SAFETY PLANS - RESILIENT TO CLIMATE CHANGE FOR RURAL WATER SUPPLY SERVICES

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ABREVIATIONS

CBOs	Community Based Organizations
CDOs	Community Development Officers
COWSOs	Community Owned Water Supply and Sanitation Organizations
CR-WSPs	Climate Resilient Water Safety Plans
CSOs	Civil Society Organizations
CWST	Council Water and Sanitation Team
DED	District Executive Director
DfiD	Department for International Development
DHO	District Health Officer
DRR	Disaster Risk Reduction
DWE	District Water Engineer
HWTS	Household Water Treatment and Safe Storage
IWA	International Water Association
LGAs	Local Government Authorities
MKUKUTA	Mkakati wa Kukuza Uchumi na Kupunguza Umaskini Tanzania
MoHSW	Ministry of Health and Social Welfare
NAWAPO	National Water Policy
NCDs	Non Communicable Diseases
NGOs	Non Governmental Organisations
PRT	Pressure Reducing Tank
RWH	Rain Water Harvesting
SCWS	Small Community Water Supplies
SOPs	Standard Operation Procedures
TWG	Technical Working Group
V&A	Vulnerability and Adaptation
VEO	Village Executive Officer
VIP	Ventilated Improved Pit
WAS	Water and Sewer
WASH	Water, Sanitation and Hygiene

WC	Water Closet
WEO	Ward Executive Officer
WHO	World Health Organisation
WSP	Water Safety Plan

DEFINITION OF TERMS

Climate:	Climate is an average weather and occurs over long time frames (e.g. 30 years)
Climate change:	A change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.
Climate variability:	Refers to variations in the mean state and other statistics of the climate on all spatial and temporal scales beyond that of individual weather events.
Climate scenario:	A plausible and often simplified representation of the future climate, based on an internally consistent set of climatologically relationships that has been constructed for explicit use in investigating the potential consequences of anthropogenic climate change, often serving as input to impact models.
Control measures:	Are activities or processes to prevent or reduce a hazardous event/hazard. The WSP process involves consideration of both existing control measures and new/proposed control measures (or improvements).
COWSOs	are legal entities at the community level who are entitled to make contracts with the private sector on behalf of the community
Critical limit:	Is a cutoff point that signifies when a control measure has failed or is working ineffectively and therefore emergency action is required
Hazard:	Is a biological, chemical or physical agent that has the potential to cause harm. Hazards are harmful micro-organisms (bacteria, parasite, protozoa, and/or virus), or chemicals (fluoride, arsenic, lead, etc) or physical (turbidity,) and/or lack of water that might affect health of the consumer or affect the water supply system.
Hazardous event:	is an event or situation that can introduce a hazard to the water supply system. They are unfavourable conditions, through which hazards enter into any stages of the water supply system such as heavy rainfall causing runoff entering the water source or treatment units with animal/human faeces. Collecting and

	storing water with dirty jerry can and unclean hand introduces pathogenic microorganisms (hazards),
Risk:	Is the likelihood that a hazardous event/hazard will occur combined with the severity of the consequences.
Sanitary survey:	Is an on-site inspection of water supply to identify actual and potential sources of hazards such as physical structure, operation of the system, and external environmental factors
Validation:	Refers to reviewing evidence to determine whether or not the existing control measures can effectively control the hazardous events/hazards. This must be done prior to risk assessment so that it considers how well hazardous event/hazard is currently controlled.
Verification:	Monitoring to confirm the effectiveness of the WSP as a whole and involving three elements: 1) compliance monitoring 2) Consumer satisfaction survey; and 3) internal/external WSP auditing.
Water safety plan:	A comprehensive risk assessment and risk management approach that encompasses all steps in the water supply, from catchment to consumer
Weather:	Is what is happening in the atmosphere at any given time is considered “weather” (including e.g. wind speed and direction, precipitation, barometric pressure, temperature, and relative humidity

FOREWORD

The Government of Tanzania instituted water sector reforms in 2002 as articulated in the National Water Policy, NAWAPO, (2002). The overall objective of the reforms/policy, as being coordinated by the Water Sector Development Programme, is to strengthen sector institutions for integrated water resources management and improve access to clean and safe water supply and sanitation services. There are a number of instruments which have been established since then in order to facilitate efficient and effective implementation of the reforms which include; the National Water Sector Development Strategy (2006 – 2015), Water Resources Management Act No. 11 of 2009, Water Supply and Sanitation Act No. 12 of 2009, Vision 2025; 5 yrs development plan; and MKUKUTA II.

Despite major efforts by the Government to ensure communities in rural areas have access to clean and safe water, the country is experiencing a number of challenges that include; pollution and degradation of water sources; inadequate treatments of water for domestic use; low awareness on household water treatment and safe storage, and weak water distribution infrastructure. Similarly, the impacts of climate change can manifest through a number of ways including increased average temperatures, higher freshwater temperatures, sea-level rise, more extreme precipitation, floods and increased drought in different areas causing tremendous pressure on the water supply systems and ecosystems at large.

Water Safety Plans (WSPs) will enable the operators and managers of the rural water organizations to know the system thoroughly, identify where and how problems could arise, put multiple barriers and management systems in place to stop the problems before they happen and making all parts of the system work properly so as to ensure safety of water intended for human consumption and other domestic uses in adequate quantity. The WSP will play as a vital tool for comprehensive risk assessment and risk management approach that will encompasse all steps in the water supply system from catchment to point of consumption.

It is my expectation that these Guidelines will create uniformity in approaches, for the development and implementation of Water Safety Plans and restore the state of the art for the availability of clean and safe water at all levels.

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Rweyemamu

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CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

It is evident that the water supply system in Tanzania especially in rural communities is facing water security risks in various aspects such as scarcity and quality, both of which affect health and other economic development. Similarly, even though technologies used for rural community managed water supplies are easier for the community to operate and manage, they are not capable to withstand the effects of climate change. Most of the rural water schemes are sited near riverbanks, or located at places prone to runoff/flood. If not well managed the situation could result to the contamination of water and thereby lead to increased prevalence of water and sanitation related diseases.

In effort to reduce rural water system's susceptibility to effects of climate variability and change; environmental challenges and other human activities so as to ensure continuous supply of safe water to rural communities, the Ministry of Water calls for Climate Resilient Water Safety Plan (WSP) to rural community managed water supplies. The WSP approach enables rural community water supply managers and operators/care takers to conduct a comprehensive risk assessment to water supplies and proactively manage the risks from catchment to point of consumption.

These Guidelines will be used by rural communities to prepare Water Safety Plans that will enable managers of the rural community water supplies to know the system thoroughly, identify where and how problems could arise, put multiple barriers and management systems in place to stop the problems before they happen and making all parts of the system work properly so as to ensure safety of water intended for human consumption.

1.2 Climate Change and Water Quality

Climate Change would possibly result to prolonged rainfall and thereby causing flood or otherwise lack of rainfall and higher temperatures leading to serious drought. The major water quality related issues that may impact heavily on community health include:

1. Increased concentration of pollutants when conditions are drier. This is of particular concern for groundwater sources that are already of low quality in areas where concentrations of arsenic, iron, manganese and fluoride are often problems.
2. Increased storm runoff can increase loading of pathogens, nutrients and suspended sediment.
3. Sea level rise that increases the salinity of coastal aquifers, in particular where groundwater recharge is also expected to decrease.
4. Algal blooms and increased risks from cyan toxins and natural organic matter in water sources as a result of higher water temperature, requiring additional or new treatment of drinking-water.

Table 1: **Potential Health Impacts of Climate Change and Variability**

Exposures affected by climate change	Potential health risks	Health impacts
Increased average temperatures	Accelerated microbial growth, survival, persistence, transmission, virulence of water-borne pathogens;	Increased risks of food- and water-borne diseases
Increasing drought	Lower water availability for washing, cooking and hygiene, increasing exposure to water-borne contamination. Decreased food security and increased risk of malnutrition, interacting with water-borne diseases. Lower food production in tropics; lower access to food due to reduced supply and higher prices; combined effects of under nutrition and infectious diseases; chronic effects of stunting and wasting in children	Increased burden of food- and water-borne disease. Increased risk of under-nutrition resulting from diminished food production in poor regions
More extreme precipitation events,	Lack of water for hygiene; flood damage to water and sanitation infrastructure, and contamination of water sources through overflow Very high rainfall can reduce mosquito and other vector populations (e.g. schistosomiasis) by flushing larvae from their habitat in pooled water	Increased risks of food- and water-borne diseases Decreased risk of vector-borne diseases
Higher freshwater temperatures (with increased concentration of nutrients such as phosphorus and other factors)	Shifting geographic and seasonal distributions of diseases e.g. vibrio cholera, schistosomia Increased formation of cyan bacterial blooms in freshwater	Increased risks of food- and water-borne diseases such as cholera and schistosomiasis, respectively Liver damage, tumor promoter, neurotoxicity (longer-term effects depending on toxin exposed to)
Sea-level rise	Coastal areas experiencing sea level rise may become uninhabitable and influence population displacement or force currently secure water sources out of use because of saline intrusion. Sea level rise that increases the salinity of coastal aquifers, in particular where groundwater recharge is also expected to decrease.	Increased risk of water-borne diseases, health impacts of high salt consumption on NCDs
More frequent and extreme heat events	Outdoor and unprotected workers obliged to work in physiologically unsafe conditions, or to lose income or livelihood opportunities	Consequences for health of lost work capacity and reduced labor productivity in vulnerable populations

1.3 Concepts of the Water Safety Plans (WSPs)

Water Safety Plans (WSPs) is a step by step comprehensive risk based assessment and risk management approach which involves traditional and scientific techniques in water supply from catchment to consumer to ensure safety of drinking water from catchment to point of consumption that proactively identifies sources of hazards and level of risks that affect adequacy and quality of the rural water supply service delivery systems.

Climate resilient water safety plans (CR-WSPs) access and manage risks to drinking water supply systems with special consideration to the current and anticipated impacts of climate change on the quality and quantity of the rural water supply systems. A WSP should be developed with the consideration of the following criteria:

i. It should be a teamwork task
ii. It should involve different background disciplines and levels of Professionals.
iii. It should involve understanding of the characteristics & dynamics of the catchments as well as the water supply systems
iv. It should have information and data to assess the risks and prioritizing them accordingly.
v. The assessment process has to consider the whole water system in totality (Water source, Treatment processes, Storage, Distribution systems & Household storage)

1.4 Objectives of these Guidelines

These Guidelines are designed to provide guidance to rural community on the preparation of Climate Resilient Water Safety Plans. Specifically, the Guidelines will aim to:

i. Provide guidance to rural communities in the steps involved in preparation of WSP

ii. Provide guidance on how COWSOs should integrate climate issues into CR - WSP

iii. Provide guidance to COWSOs in the implementation of CR - WSP

iv. Provide quick reference for authorities, academicians and all stakeholders in issues related to CR - WSPs

1.5 Rationale for these Guidelines

The Ministry of Water (2014) estimate that only 54.4% of the rural population has access to clean and safe water. The rest relies on water mainly from unsafe sources including hand dug and shallow wells. In addition to the unsafe water collected from shallow wells and surface water most households in rural communities lack ideal practices for household water treatment and safe storage. This situation has resulted to the increase in prevalence and mortalities caused by water and sanitation related diseases. The recent health and demographic surveys indicates that 17% of childhood deaths are associated with diarrhea. Above all, diarrhea disease remains the third leading cause of under-five child death in Tanzania (WHO 2004).

With increased trends of unreliable patterns of heavy rainfall and long periods of drought associated with climate change, it is expected that there will be increased pressure on the water supply systems posing serious threat in availability of safe water. Heavy rains that results to floods may cause contamination to sources of water due to runoff from either industrial, agricultural, mining or domestic activities. Furthermore, heavy rains could lead to the destruction of the whole water supply system infrastructure.

On the other hand, prolonged periods of drought could force communities to search for alternatives sources of water as the safe sources dry up.

It is also a fact that in recent years, many parts of the country's water supply infrastructure has been affected by effects of climate variability such as flush and river flooding due to increased rainfall that posed damage to water supply sources and infrastructures. This has been associated with gross contamination of drinking water which results in diarrheal disease outbreaks. There are also communities especially at the central part of the country and some areas of north eastern highlands suffer from the effects of prolonged droughts due to shortage of rainfall, evapo-transpiration, which result in lowering of ground water table and water bodies, water shortage and drying of shallow water sources and consequently people are forced to depend on unsafe water provided by water trucking.

In the face of such and other anticipated climate change impacts, there is a need to improve the climate resilience of water supply services to cater for the whole range of climate change risks, including extreme weather events, increasing resource stresses and ensuing water quality and quantity issues. A Water Safety Plan (WSP), which is a pro-active and comprehensive risk management approach to ensure the safety and security of drinking-water supplies, provides a valuable framework to address these issues. The WSP Manual (WHO 2009) notes: "there can be a tendency for the identification of hazards to be limited to thinking about those direct inputs to the water supply system impacting microbial and chemical parameters, as these are important in terms of compliance with water quality standards. However, the approach to ensure safe water must go much wider, with consideration of aspects such as potential for flood damage, sufficiency of source water and alternative supplies, availability and reliability of power supplies, the quality of treatment chemicals and materials, training programmes, the availability of trained staff, service reservoir cleaning, knowledge of the distribution system, security, emergency procedures, reliability of communication systems and availability of laboratory facilities all requiring risk assessment".

These Guidelines are therefore put in place to address issues of water safety with consideration of the impacts of climates. The Guidelines will assist COWSOs to identify hazards, hazardous events and the associated risks at every stage of the water supply system and thereafter put in place respective control measures.

1.6 Scope

These Guidelines are intended to be used by COWSOs and LGAs to ensure that communities are sustainably supplied with clean, safe and adequate water for consumption. Regional Secretariats and LGAs will work collaboratively in support services, monitoring and evaluation of the activities. Ministry of Water and MoHSW and other stakeholders will make decisions during planning and budgeting so as to support LGAs in planning for water safety and risk assessment interventions to support COWSOs in implementation of Water safety plans. Training institutions, academicians and other stakeholders will also benefit from these Guidelines as a reference material when addressing issues of Water Safety Plans**.**

The Guidelines highlight on the major steps involved in Water Safety Plans as well as the respective implementation procedures. Similarly, the Guidelines provide tools for implementation of different steps of the Water Safety Plans.

1.7 Integration of Climate Change into WSP

Planning for safe water supply in sufficient quantity in the long-term is set in the context of growing external uncertainties arising from changes in the climate and environment. The WSP offers a framework to manage these risks by considering the implications of climate variability and change risks at various steps points in the WSP process. This section sets out the key considerations aligned with the WSP approach

1. The WHO Guidelines for Drinking-water Quality (WHO 2011) recommends WSPs as a comprehensive risk management approach to most effectively ensure drinking-water safety. WSPs are at the heart of the Framework for Safe Drinking-water.

2. The WHO/IWA WSP Manual (WHO 2009) provides practical guidance to support WSP development and implementation for water supplies managed by a water utility or a similar entity.

The WSP steps addressed in this document are those that consider climate change to ensure sufficient management of climate-related risks through the WSP process.

CHAPTER TWO

2.0 STEPS/TASKS FOR THE PREPARATION OF WATER SAFETY PLANS (WSP)

WSPs for community managed water supplies have six interdependent steps/tasks which include: engagement of community and assembling of a WSP team; description of community water supply system; identification and assessment of hazards, hazardous events and risks; development and implementation of incremental improvement plans; monitoring control measures and verification of the WSP; and documenting, reviewing and improving all aspects of WSP implementation. The steps are summarized in the figure below.

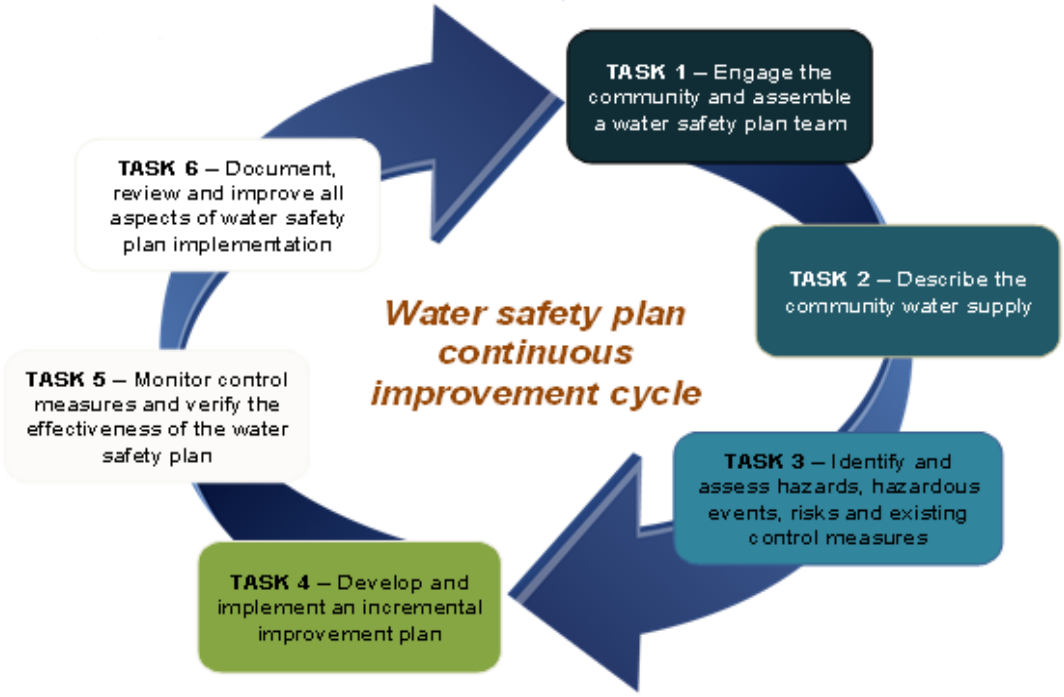

Figure 1: **Steps for WSP for rural water supply services (WHO)**

2.1 Task 1: Ensure Climate Vulnerability and Adaptation Assessment is conducted at Regional, Ecological or Climatic Zone Level.

Since most of the risks posed by climate variability and change in water resources will be similar in the same ecological or climatic zone, it is recommended to ensure that a vulnerability and adaptation assessment in relation to water is conducted at a higher level (e.g. regional, ecological or climatic). A group of experts will be selected at the selected level to conduct the vulnerability and adaptation assessment (V&A) and will include hydrologists, climatologists that will be in charge of performing climate and hydrology modeling and can also support with the development of risk maps.

Furthermore, a health vulnerability and adaptation assessment will also be conducted ideally at the same regional, climatic, ecological scale. The combination of results of both V&As (i.e. water and health) will provide the evidence required to inform the implementation of CR-WSPs at utility level.

2.2 Task 2: Community Engagement and Assembling the WSP Team

In order to have an effective WSP team, COWSOs responsible for rural community water supply should ensure the following:

2.2.1 Engage the Community

Community engagement involves:

i. Identification of key stakeholders and creation of awareness on WSP concept and benefits among the community.

ii. Consultation meetings to the community, community leaders, community workers, LGAs, religious organizations and other nongovernmental organizations to understand about WSP approach.

iii. Before arranging the stakeholder's consultation meeting, the COWSO members should work on the following:

   a. Identify key stakeholders and justify their importance (reasons why they should be consulted);

   b. Review the results of the V&A conducted at regional/ ecological or climatic zone level and organize evidences on the effects of climate variability (i.e. increased average temperature, increased drought, more extreme precipitation events, higher freshwater temperatures, and sea-level rise) on the community water supplies and associated health problems;

   c. Make preparation where and when to conduct the consultation meetings (arrange venue, schedule and necessary logistics);

   d. Convene the consultative meeting.

iv. During the stakeholders meeting, the COWSO members should:

   a. Define and explain to the stakeholders about the CR – WSPs and also create an in depth and clear understanding that WSPs is not a new program but is a tool designed to ensure water safety from catchment to point of consumption and to sustain services.

   b. Explain that WSPs approach is a means to achieve the national water quality standard specification, recommended water quantity, resilience of the supply system to climate change and therefore facilitate implementation of the government policy.

   c. Reveal that WSPs approach safeguards health of the community by ensuring water safety through removal of contamination risks and risk to the sustainability of the water supply system.

   d. Elaborate that WSPs is a means to show practical case that communities have capacity and resources to solve water safety problems, sustainability of the supply and that it opens opportunities for formal and informal community leaders to ignite and facilitate participation of the communities in the activities that contribute to and sustain their social and economic developments.

e. Show that WSPs create platform for improving partnership, cooperation and support network between WASH stakeholders and between neighboring communities.

2.2.2 Assemble a Water Safety Plan Team

A Water Safety Plan Team should comprise of community members; formal, informal and influential community leaders; and professionals with different expertise background on:

i. Community water supply schemes operation, maintenance and extension;

ii. Water quality/ environment/ health - standard specification; sampling; testing; analysis and sanitary surveys;

iii. Agricultural development and natural resource management;

iv. Community development and gender issues;

v. Water, Sanitation and Hygiene at household and institutional level (schools, health facilities and public places);

vi. Climatology, hydrology and hydrogeology

vii. Others should include: community government leaders; influential persons; religious leaders; NGOs; and CBOs

As specified above, the V&A will be usually conducted at higher level than the rural water facility level, so it may be decided that the inclusion of experts on climate and hydrology may not be required. The V&A conducted for water will provide the information required to fully understand the health risks posed by climate change as mediated by both water quantity and quality. The V&A assessment provides information required to fully understand the health risks posed by climate change as mediated by both water quality and quantity and of policies and programs that could increase resilience, taking into account the multiple determinants of climate—sensitive health outcomes; Hydrology modeling and climate modeling; Hydrology mapping and Regional forecasts of extreme weather events (e.g. droughts and floods).

2.2.3 Organize Capacity Building Training Program for WSP Team

There should be a TWG to build technical knowledge and skills to the new WSP Team on the steps of development and implementation of WSPs. The TWG comprising of a DWE, DHO and a facilitator for CR – WSP should make necessary preparation for the training such as:

i. Identify venue for theoretical and field exercise, and logistics.

ii. Inform the local administration (government and local leaders) that practical field exercise is conducted in a selected village/ selected villages.

iii. To make field work easier, involve responsible officer from the district water or health office.

iv. Training process should primarily be aimed at creating in-depth understanding on:

a. The national WASH and environment policies, strategies, national water quality standard specifications, and forming and leading team work.
b. Climate change/weather variability and its effects on drinking water supplies.
c. Concepts, principles and tasks of the climate resilient water safety plan.
d. How to describe water supply systems, identify hazards, hazardous events and to characterize risks and existing control measures.
e. How to develop and implement an incremental improvement plan,
f. How to monitor control measures, and verify effectiveness of the water safety plan.
g. How to document, review and improve all aspects of water safety plan implementation.

2.3 Task 3: Describe the Community Water Supply System

This step involves the identification and mapping of all community water supply systems. COWSOs should collect supporting information for the Community owned water supply systems in the area and describe the nature of human or anthropogenic activities that can pose a threat to contamination of water in the system. The figure below illustrates on how water system can be identified and mapped.

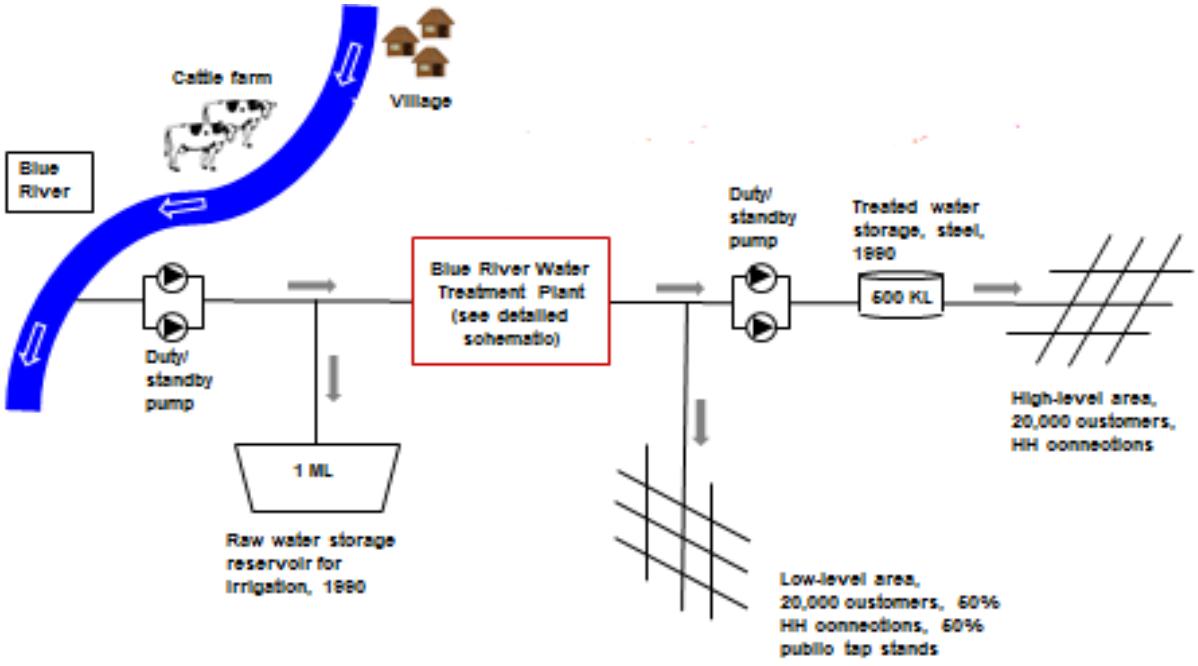

Figure 2: **Drawing describing the supply system**

2.3.1 General issues to be considered

In the process of describing the community water supply systems, COWSOs should have details of the following issues:

i. The changes in the water sources quality relating to weather or other conditions;

ii. The land uses in the catchment area (whether agricultural, mining, livestock e.t.c);
iii. The water treatment type starting from the water sources, distribution and storage of water;

iv. The staff status and skills currently responsible for operation and maintenance of the system and their education background including professional training they received;

v. The financial and human resources available for managing and operating water supply organizations (COWSOs);

vi. The management procedure which exists in operations and maintenance.

vii. The legal ownership of land used for the vital installations of the water supply system including the water source catchment area.

viii. The existing facilities of waste water disposal and solid wastes disposal including their locations in the villages.

ix. Legal status of the COWSO; tariff setting; amount of money collected, accounting and auditing procedures, and operation and maintenance costs

2.3.2 Issues to be considered in describing the catchment resources

In the provision of details on the catchment resources, community water supply organizations should consider the following:

i. The location, type and use of water sources (If the source is ground water; depth, discharge rate and depth of casing);

ii. Describe the impacts of climate variability and change (i.e. increased average temperature, increased drought, more extreme precipitation events, higher freshwater temperatures, and sea-level rise) on the source water quality and quantity such as reduced flow rate due to decreased precipitation and evaporation during hot dry seasons, and siltation/sedimentation due to runoff during rainy season. The WSP team uses information gathered in the V&A report conducted at regional, climatic or ecological zone level.

iii. The topographic features of the catchment land: plain, gorge, slope, erosion for possible danger;

iv. The ownership for the catchment land including agriculture, cattle grazing, mining, waste disposal, common defecation sites;

v. The current and future demand of water for users.

vi. The water source quality and sources of pollution due to different types of the social - economic development activities in the catchment area.

vii. The probable hazards or hazardous events from different sources in the catchment areas including organic, inorganic and chemical wastes.

viii. The current physical, microbiological and chemical qualities of the water.

ix. The changes of the source discharge rate during designing phase versus current rate and reliability of the source taking into consideration of population growth rate.

x. The condition of the intake structures such as possible intrusion of surface run off, access to animals and cracks.

xi. The condition of human and animal waste disposal.

Community water supply organization should also have information about spring water, hand dug and shallow wells, rain water harvesting that includes:-

i. Checking for runoff or flood ways leading towards the spring water.

ii. Checking for proper construction of the spring water intake structure and whether people wash clothes on the intake structure manhole cover or slab.

iii. Checking for presence of proper fencing, flood diversion ditches, and heavy traffic road crossing over water bearing spring catchment.

iv. Checking for water quality; physical, chemical and bacteriological.

v. Construction status of the well headwork.

vi. Presence of human and animal feces in the surrounding, latrine and waste disposal sites, farms, animals shed, fencing, pools of water on the well head.

vii. Water quality – physical, chemical and bacteriological.

Give detailed information on rain water harvesting such as: - Type of roofing material to prevent droppings from birds, rodents and insects; dust or debris on the rain water contact surfaces; presence of filtration and disinfection or chlorination practice

Furthermore, COWSOs should have information on the practices or knowledge of flushing away the first rainwater for 10 to 15 minutes before collecting rainwater; Cleanliness and proper cover of collection reservoir and pumps used to raise water to overhead tanks and Water collection practices of the households. The collection of information related to all the points included above, will allow to assess whether infrastructure is resilient to climate change

2.3.3 Issues to be considered in describing the reservoirs

In the provision of details on the reservoirs, community water supply organizations should consider the following:

i. The capacity, location and age of the reservoir.

ii. The designed inflow and out flow of the reservoirs.

2.3.4 Issues to be considered in describing the distribution systems:

In the provision of details on the distribution systems, community water supply organizations should consider the following:

i. The type, size, length, and age of pipe materials and accessories used.

ii. Where the pipes are laid and valve installed.

iii. Where pipes crosses the flood drainage, ditches, ponds, rivers, and the exposed parts.

iv. Where frequent leakages, breakages and supply interruption can occur.

v. Areas of possible water contamination such as valve chambers.

vi. The number of illegal connections and vandalisms discovered each year.

2.3.5 Issues to be considered in describing the household water treatment and safe storage (HWTS) practices:

In the provision of HWTS details, community water supply organizations should consider the following:

i. The type, size (volume) treatment and safe storage devices and practices.

ii. Water collection mechanisms including cleanliness of utensils;

iii. Human and animals waste disposal practices including child feaces.

iv. Supportive information about the community water supplies such as: Education and training of operation and maintenance workers; Tools and spare parts; Funds available for operation and maintenance; Record keeping and auditing documents.

2.4 Task 4: Identify the hazards, hazardous events and assess the risks

After completion of task 1, 2 and 3, the WSP team is required to make a comprehensive discussion and identify the situation that might threaten the safety and adequacy /quantity of the community water supplies, evaluate effectiveness of the existing control measures and assess level of associated risks to the quality and quantity of the drinking water sources.

For example: shallow community water supplies (hand dug wells, perennial springs) and open water sources (rivers, dams) are at high risk of drying due to high water demand by growing population and prolonged drought seasons in drought prone areas (semi-arid regions) of the country. In this case, COWSOs should identify potential hazards throughout the drinking water chain. The exercise should be done in such a way that, it identifies all potential hazards and hazardous events, evaluate existing measures, assess risks and their causes.

2.4.1 Identify the hazards and hazardous events

For each step in the water supply chain, COWSOs are required to identify hazards and hazardous events that could contaminate compromise or interrupt the water supply system. Usually these situations include mechanisms through which contaminants (hazards) could enter in the water supply system at source, distribution line, reservoir, distribution system, community distribution points and/or in the households.

Analysis of the hazardous events and hazards requires clear understanding:

1. The point where it happens in each process steps (points it enters in the water supply system);
2. The time when it happens (seasonality – during rainy or dry season);
3. The reason it happens (associated factors like human activities, water supply system itself, operation and maintenance capacity of the WAS); and/or the behavior of the water users); and
4. The frequency a hazardous event could happen and associated severity of its consequences.

2.4.2 Climate-related risks to water availability and reliability

The WSP manual describes the process for identifying hazards and hazardous events and assessing the levels of risk associated with each hazard. WSPs tend to focus on the hazardous events which impact on water quality. In a broader water resources context, drought related hazardous events, exacerbated by future climate change, can lead to scarcity and reliability risks. WSPs should consider the strategic risks posed by source water scarcity and the competing users of water in a catchment.

Reviewing the outputs from studies such as water resources assessments and basin management plans can be used to identify the longer-term risks to water supply systems. These may include urban development causing increasing water scarcity or pollution as well as future climate change altering water availability amongst others. Where these assessments are available, the WSP team should refer to them as part of the risk assessment process. This may include the following elements:

i. Assessing the reliability of source yields within years, arising from seasonal variability, and between years arising from drought events;
ii. Compiling information on the other abstractors of water in the catchment and their patterns of abstraction under normal and drought conditions;
iii. Identifying trends in land use, pollution discharge, urban development, industrial development, population dynamics and any other factors which may lead to increased competition for water, or reduced water quality at key water sources; and
iv. Considering changes in water availability and reliability under different climate change scenarios to highlight potential future risks, as determined by the results of the assessment conducted at climatic/ ecological/ regional level.

2.4.3 Climate-related risks to water supply infrastructure

From a DRR perspective, it is essential to consider a range of potential hazardous events that the area might experience. In order to explore the hazardous events and their potential impacts on water safety, civil contingency planners may assist in developing credible hazardous event scenarios for the specific location.

Water supply systems are exposed to a range of climate related hazardous events which can impact on the effective operation and overall structural integrity or water supply system assets. This can range from flooding of treatment works and auxiliary systems such as power supplies, damage of pipe work due to flooding, scour and erosion damage at rivers and coastal areas,

Damage to infrastructure will often occur as part of wider disaster events which will cause widespread disruption to power and transport networks which are largely outside the control of the water supplier. In

these cases, the assessment of related hazardous events beyond the water system itself will be required in order to gain a full picture of the risks to which water supplies are exposed.

2.4.4 Climate-related risks to water quality

The effects of climate change can cause problems in water supplies. In general, the types of hazards that are more likely to occur at more hazardous levels within existing water supplies as a result of climate change are those that are exacerbated by warmer, drier conditions combined with more intense precipitation events. Historically, these types of hazards and hazardous events have included factors such as:

i. Pathogens, e.g. *Cryptosporidium* spp. oocysts, along with particles, e.g. topsoil in runoff, being driven into source waters in higher concentrations due to increased precipitation intensities following prolonged dry periods, or fire damaged forests, with reduced dilution due to lower storage levels.
ii. Phytoplankton, e.g. toxigenic cyanobacteria, proliferating to higher levels in the slower flowing, lower turnover, warmer conditions within uncovered water source and reservoirs.
iii. Opportunistic pathogens, e.g. *Naegleria fowleri*, proliferating to higher levels in the slower flowing, warmer water with disinfectant residual within closed water storages and distribution systems.
iv. Chemicals found in many groundwater systems (e.g. arsenic and fluoride), as well as chemicals in wastewater discharges, increasing in concentration due to less dilution and reaching levels of concern.

One of the predicted consequences of climate change is increased periods of water shortage in many parts of the world, and, new water supplies are being tapped in many areas, sometimes for the first time. (In other contexts, water flows might be higher, more variable or subject to more intense precipitation events). Traditional water sources that have been used for many years are likely to be well-understood with the important hazards, hazardous events and control measures recognized and managed. However, there may often be no local experience with new water supplies and issues relating to new supplies will be context specific. Water management agencies may be unfamiliar with the very different water qualities and challenges involved with new sources. For instance:

i. Water suppliers familiar with surface water that are forced to bring on groundwater, or vice versa. Surface water supplies rarely contain metals at problem concentrations, but ground waters often do. Similarly, ground waters typically have fairly stable water quality whereas surface water quality can be highly variable.
ii. Water suppliers familiar with sourcing water from large reservoirs that are forced to bring on river water sources, or vice versa. Some river water supplies rarely contain cyan toxins at problem concentrations, but reservoir waters often do. Similarly, reservoir waters typically have fairly stable water quality whereas river water quality can be highly variable.
iii. Water suppliers familiar with relatively clean water that are forced to bring on more contaminated water sources. Water from undeveloped catchments rarely contains hazards at problem concentrations, whereas water sourced from developed catchments often does.
iv. Innovative water management arrangements may be implemented that introduce new types of hazards and hazardous events. For instance, there may be an increased reliance on recycled water in agricultural and urban settings which might present increased risks of water-related disease if cross-connected into drinking-water supplies.

Table 2: **Analysis of hazards and hazardous events**

Stage	Hazardous events	Nature of hazard	Control Measures of hazardous events	Risk level	Additional control Measures if needed.
Catchment/Source	Open defecation around water sources: runoff washes feces and enters in to the water source	Microbial	No control measure	High	Building flood diversion ditch; Health education
	Flood/ Heavy rain damage and consequently runoff washed animal and human feces and contaminate water sources ,	Microbial, Physical (turbidity)	Protection of water sources, treating drinking water and safely storing it at household level	High	Maintaining vegetation and grass; Build flood protection dike uphill of the borehole and rehabilitate the well and repair infrastructures
	Drought resulted in lowering of the ground water table and as a result hand dug and shallow well dried,	Microbial, Physical (turbidity)	No control measure	High	Ensure proper conservation and protection of water sources; Replacement of the hand dug and shallow wells and infrastructures with more drought tolerant/resilient deep boreholes
	Hand pump broken due to continuous pumping and lack of greasing of moveable parts (lack of regular preventive maintenance)	Operational/ physical	No control measure	Medium	Regular inspection and maintenance of the water supply infrastructures
Treatment plant)	Malfunctioning of treatment plant, inadequate dosage and power rationing	physical and chemical	Proactively checking treatment plant conditions and promptly rectifying abnormalities observed. Frequent check residue dosage	Medium	
Storage/ reservior	Poor storage facilities	Microbial and turbidity	Boiling of water	Medium	Use of safe water storage facilities Jerry-cane
Distribution	Busting and untimely repair of damaged pipes Illegal and improper connections	Chemical and microbial	Proactively checking conditions of distribution systems and reacting timely to observed situations. Undertake connections inventory from time to time.	High	
Household (point of use)	Poor storage facilities	Microbial and turbidity	Boiling of water	Medium	Use of safe water storage facilities Jerry-cane

COWSOs are required to:

1. Analyze and explore the linkage between occurrence of the hazardous event and possible hazards likely to enter into drinking water supplies;

2. Identify and validate the existing control measures and associated level of risks to health of the water users.

For example:

A runoff due to heavy rainfall in a rural community washes fecal matter and enters in the water source. The water source is contaminated by fecal pathogens (bacteria, which is hazard), and the likelihood of the diarrheal disease breakout is high among communities that are collecting water for drinking and domestic use from that borehole. COWSOs should identify and document all existing and likely future hazards, hazardous events and risks related to environmental, climate and operational issues as follows.

1. During identification of environmental related hazards: COWSOs should consider the following hazards: Agricultural chemicals, industrial/mining pollutants, agricultural microbes, land degradation, wastewater pollution, urbanisation, overgrazing, and deforestation

2. During identification of climate related hazards: COWSOs should identify all water related hazards associated by climatic factors such as drought (intensity and frequencies), floods (intensity and frequencies) and extreme rainfall, River flood, soil erosion, landslides, severe storms and or sea level rise

3. During the identification of operational related hazards: COWSOs should identify all water supply related hazards throughout the water supply chain i.e. water sources, water storage, water distribution lines and handling of drinking water by customers

COWSOs should as much as possible identify all hazardous events based on the following incidences:

i. Contamination of water sources, which may be due to agricultural chemicals, Industrial pollution, River flood, extreme rainfall, soil erosion;

ii. Drastic increase of water demand, which may be due to urbanization;

iii. Drying of potential water sources, which may be due to catchments and land degradation, droughts;

iv. Raising of water salinity due to sea level rise, severe and prolonged droughts and or geological formation;

v. Destruction of water supply infrastructure, which may be due to landslides, vandalism, floods and destructive agricultural practices.

2.4.5 Identify existing control measures and evaluate their effectiveness

WSP team should evaluate effectiveness of existing control measures; whether it provides adequate protection to water supply system from contamination. Effectiveness of the existing control measures put in

place at source, reservoir, distribution system, distribution points and in the household should be assessed based on the following measurements.

i. Preventing contaminants from entering the source of water;

ii. Removing the contaminants from the water;

iii. Inactivation /killing the hazards (pathogens);

iv. Preventing recontamination of water during distribution, storage and handling

N.B. Control measures are required to reduce both experienced hazards (risks) and the anticipated future hazards related to climate, environmental or operational climate.

Hence the WSP team must evaluate effectiveness of existing control measures; to comprehend whether, they provide adequate protection to water supply system from various hazard categories.

Evaluation of the effectiveness of the control measures should involve:

i. Assessing what activities have already been initiated to protect water sources at community level, and how they could be strengthened;

ii. Identifying activities initiated as part of a disaster risk management or could highlight initiatives that already have an impact on community water supply systems;

iii. Review of the resources that are available to the community and its information needs.

iv. Putting control measures at source, reservoir, distribution system, distribution points and in the household for effectiveness.

The evaluation of existing control measures should summarize all key information throughout the entire water supply chain for each COWSOs as shown in table 1 below.

Table 3: **Example of identified hazardous events paired with hazard and condition of existing control measures at the catchment/ source and households**

Stage	Hazardous events	Nature of hazard	Control Measures of hazardous events	Risk level	Additional control Measures if needed.
Catchment/Source	Open defecation around water sources: runoff washes feces and enters in to the water source	Microbial	No control measure	High	Building flood diversion ditch; Health education
	Flood/ Heavy rain damage and consequently runoff washed animal and human feces and contaminate water sources	Microbial, Physical (turbidity)	Protection of water sources, treating drinking water and safety storing it at household level	High	Maintaining vegetation and grass; Build flood protection dike uphill of the borehole and rehabilitate the well and repair infrastructures
	Drought resulted in lowering of the ground water table and as a result hand dug and shallow well dried	Microbial, Physical (turbidity)	No control measure	High	Ensure proper conservation and protection of water sources; Replacement of the hand dug and shallow wells and infrastructures with more drought tolerant/resilient deep boreholes
	Hand pump broken due to continuous pumping and lack of greasing of moveable parts (lack of regular preventive maintenance)	Operational/ physical	No control measure	Medium	Regular inspection and maintenance of the water supply infrastructures
Household (point of use)	Poor storage facilities	Microbial and turbidity	Boiling of water	Medium	Use of safe water storage facilities Jerry-cane

2.4.6 Assessment of risks associated with each identified hazards

i. COWSOs and WSP teams should be aware that, assessment of risks of both identified hazards and hazardous events is essential exercise to provide forward thinking for water risk management plan measures.

ii. To conduct risk assessment, COWSOs may decide to apply either the descriptive method or ranking method or a combination of the two methods. Hence COWSOs should notice that, basically there are two common methods which integrate climate issues to assess water safety risks, the descriptive and ranking methods.

iii. The descriptive risk assessment method is the easiest method to determine risk level, prioritize and decide actions. This method in most cases depends on expert judgement of COWSOs team/CR-WSP team (See Table 2 for more clarity)

Table 4: **Descriptive risk assessment method**

Risk Level	**Meaning**	**Notes**
High or significant	Clearly a priority	Actions need to be taken to minimize the risk. Proposed actions should be documented in the improvement plan and implemented based on priorities and available resources.
Medium	Medium priority	Currently no impact on drinking water safety, but requires attention in operation and/or possible improvement in the medium and long term to continue minimizing risk.
Low or insignificant	Clearly not a priority	Actions may be taken but not a priority, or no action is needed at this time. The risk should be revisited in the future as part of the WSP review process.

Source: Adapted from the SCWS WSP Manual

iv. The Risk Ranking method is more complex in most cases and depends on probability of the hazardous event to happen and associated severity of its consequences. COWSOs/WSP team should be well-informed that application of Risk Ranking Method depends very much on establishment of Risk Score, which is habitually the product of likelihood and consequences i.e. **Risk = Likelihood x Consequence.**

Table 5: **Illustration of prioritizing actions using combined risk description and risk ranking approaches**

Risk Ranking	Meaning	Description
High	Requires urgent attention /Action must be taken urgently	COWSOs must take action urgently to minimize the risk of hazards and hazardous events related to climate, environment and operational. COWSOs should document possible options (as part of risk management improvement plan) and be implemented based on available resources.
Medium	Requires attention	COWSOs may need to take actions to minimize the risk because the likelihood of a hazard occurring is low. In most case, the control measures in place are effective but the likely consequences are major (e.g. microbial, chemical contaminant risks). COWSOs team is required to pay special attention to maintaining the control measures and their appropriate operational monitoring to ensure that the likelihood remains low.
Low	Undoubtedly not a priority	COWSOs may need to take actions but currently not necessary. COWSOs team should revisit the risk in the future as part of CR-WSP review process.

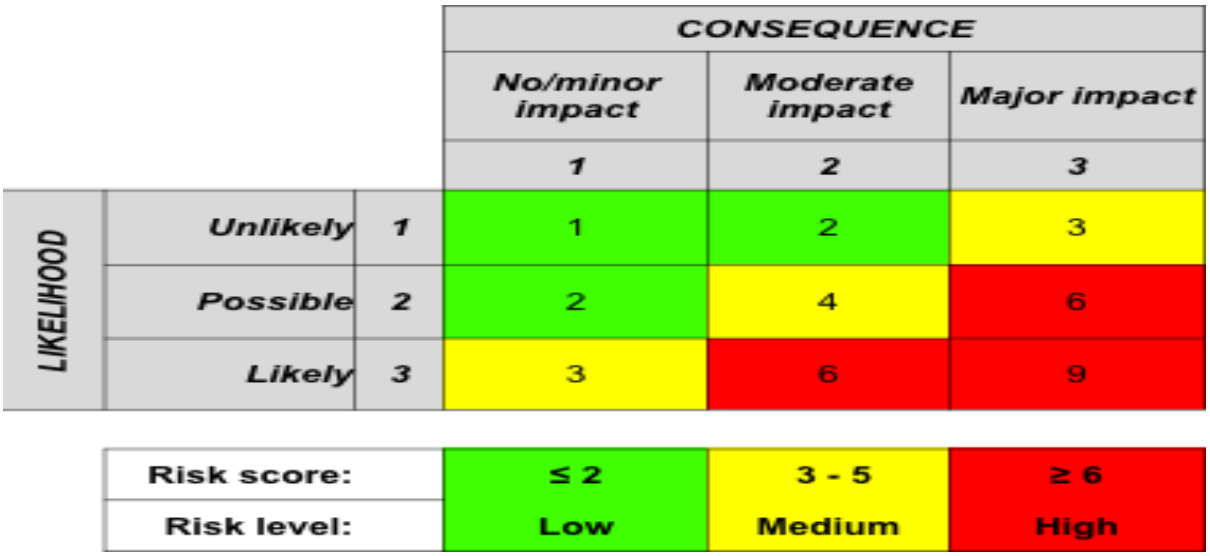

Figure 3: **Risk ranking method**

Table 6: **Description of the likelihood of the risk and its consequences (severity) and scores assigned to each level Severity or Consequence**

		Insignificant or no impact - Rating: 1	Minor compliance impact - Rating: 2	Moderate aesthetic impact - Rating: 3	Major regulatory impact Rating: 4	Catastrophic public health impact - Rating: 5
Likelihood or frequency	**Almost certain/ Once a day - Rating: 5**	5	10	15	20	**25**
	Likely / Once a week - Rating: 4	4	8	12	16	20
	Moderate / Once a month - Rating: 3	3	6	9	12	15
	Unlikely / Once a year - Rating: 2	2	4	6	8	10
	Rare / Once every 5 years - Rating: 1	1	2	3	4	5
	Risk Score	**< 6**	**6 - 9**	**10 -15**	**> 15**	
	Risk Rating	**Low**	**Medium**	**High**		**Very High**

2.5 Task 5: Develop and implement an incremental improvement plan

To develop an incremental improvement plan, COWSOs should consider the following:

iii. The hazardous events and hazards that threaten the water safety;

iv. Control measures in place, their effectiveness, the risks and what needs more controls;

v. Things to be done to address the risks that require additional controls.

vi. Specific action to be undertaken as an additional control; responsible party; due date; budget and resource constraints.

Table 7: **Example of an improvement plan**

SN	Specific improvement action	Arising from (hazardous event)	Responsible party	Budget (USD)	Due date	Status
1	Purchase 10 specialized plastic trench liners and 5 trench dewatering pumps, develop SOP and train staff on new procedures	Risk of physical and microbial contamination from pipeline repair practices	Mr. Y	5,000	Dec, 2015	Not yet started

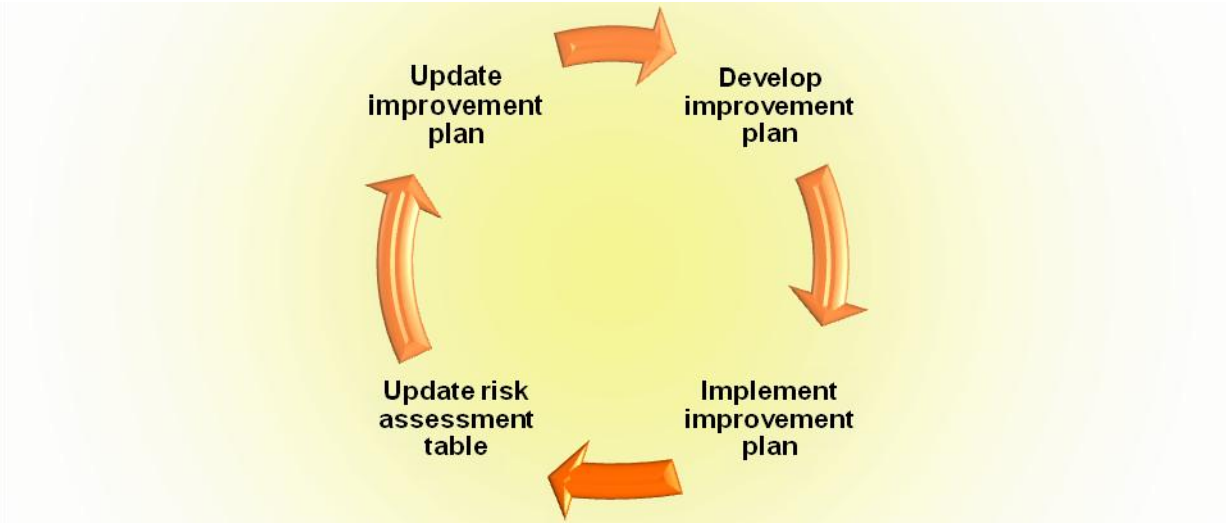

Figure 4: **WSP improvement and implementation cycle**

2.6 Task 6: Monitor control measures and verification of effectiveness of WSP.

The main purpose of monitoring control measures is to provide guidance on how to confirm whether the community managed water supply system is operating properly and the designed water safety plan is providing adequate safety to the drinking water and protecting health of the community.

Table 8: **Examples of hazards and hazardous events that may be exacerbated by climate change and accompanying potential control measures to reduce the level of risk. Note that this table is neither exhaustive nor universal**

Examples of climate change impacts	Examples of hazards	Examples of hazardous events	Examples of control measures to mitigate risks
Enteric pathogens			
Increased temperatures Reduced runoff volumes Increased precipitation intensities Reduced reservoir turnover and depths	Faecal-oral pathogens from faecal waste in source waters and catchments including viruses, protozoa and bacteria e.g. norovirus, *Cryptosporidium parvum* and *Campylobacter jejuni.*	Occurring at higher concentrations in treated water due to: • Increased release of pathogens due to more intense precipitation causing wastewater containment, treatment and management systems to become less effective • Increased release of pathogens due to more intense precipitation causing greater transport of manure from grazing animals • Decreased dilution, sedimentation and attenuation in source waters due to increased precipitation intensity and increased stratification in storages • Increased transfer of pathogens through treatment systems due to more intense precipitation and reduced storage volumes causing drinking-water treatment systems to become less effective • Selection of less safe alternative sources due to limited water resource availability in safer normal sources • Increased use of source waters for polluting activities due to reduced availability of alternative waters • Cross contamination from damaged sewage systems or flooding of sewer pump stations • Surface water ingress into septic tanks, after flooding events leading to overflow of effluent into streams and rivers • Contaminated surface water entering well heads after large run-off events • Increased lateral flow in soils, after large rainfall events) may increases transport of contaminants, particularly in shallow aquifers	Source controls: • Minimise sewage and manure runoff from catchment, particularly from human and intensive juvenile stock animal sources • Increase riparian area integrity and vegetation cover • Introduce or enhance wet weather event storage and management capacity of wastewater management systems • Increase setback distance and improved buffering from watercourse to points of faecal matter deposition or storage of effluent • Develop a long term drought management plan • Keep storages as full as possible to maximise detention times • Protect storage and catchment from activities that could introduce pathogens e.g. recreation, grazing in direct proximity to water sources • Reduce impervious surface areas in water catchments to smooth out inflows • Capping unused bores and ensuring current wells are appropriately sealed from surface run-off • For deep wells ensure casing exceeds well below the level of shallow aquifers Treatment controls: • Enhance or introduce additional treatment to handle increased pathogen challenge during peak events • Maintain or improve turbidity levels during treatment, particularly during peak events

Examples of climate change impacts	Examples of hazards	Examples of hazardous events	Examples of control measures to mitigate risks
Microorganisms proliferating within water storage and distribution systems			
Increased temperatures Reduced water availability	Opportunistic pathogens e.g. *Legionella* spp.	Occurring at higher densities more often within distribution system due to: • Increased water temperature due to environmental warming • Greater difficulty maintaining disinfectant residual due to increase in water temperature • Greater difficulty maintaining disinfectant residual due to reduced water turnover if water use restrictions are in place to respond to reduced water availability • Greater difficulty maintaining disinfectant residual due to decrease in source, and therefore, treated water quality	Source controls: • Reduce disinfectant demand through optimising source selection to minimise organic matter in water • Abstract source water from cooler depths • Increase riparian shade plantings around storages Treatment controls: • Reduce disinfectant demand through enhancing coagulation • Increase disinfectant residual concentrations at point of primary disinfection • Introduce or increase secondary booster disinfection • Change to disinfectant with reduced residual decay (e.g. to chloramine from chlorine, but noting the greater difficulty in managing chloramine residuals in many contexts) Distribution system controls: • Reduce treated water service reservoir operating levels to reduce hydraulic residence times • Design or modify system to reduce residence times within pipes • Design or modify system to minimise length of shallow or surface pipes (if practical) • Coat exposed pipes and tank roofs with white paint or make from reflective materials and avoid dark colours Point of use controls: • Avoid storing water in containers in direct sunlight • Coat exposed pipes and tank roofs with white paint or make from reflective materials and avoid dark colours • Refrigerate stored water
	Total coliforms and associated compliance issues		
	Biofilms and heterotrophic plate count bacteria and associated management issues		
	Ammonia oxidising bacteria and associated difficulty maintaining chloramine residual		
	Actinomycetes and associated taste and odour compounds e.g. geosmin		
Problematic source water algae and bacteria			
Increased temperatures Reduced runoff volumes Increased precipitation intensities Reduced reservoir turnover and depths	Cyanobacteria and associated cyanotoxins, e.g. microcystin, and taste and odour compounds, e.g. geosmin.	Occurring at higher densities more often within source water reservoir due to: • Increased water temperature • Increased hydraulic residence time due to more prolonged periods of drought • Increased nutrient loads due to increased precipitation intensity	Source controls: • Reduce nutrient loads into storages • Establish wetlands and riparian buffer zones to retain nutrients from runoff and minimise soil erosion • Where possible, use selective depth abstraction to source water from reservoir depths that minimise
	Diatoms and associated taste and odour, e.g. *Asterionella* spp., compounds and filter blocking diatoms, e.g.		

Examples of climate change impacts	Examples of hazards	Examples of hazardous events	Examples of control measures to mitigate risks
	Synedra spp. Benthic cyanobacteria and associated cyanotoxins, e.g. saxitoxins, and taste and odour compounds, e.g. geosmin. Benthic actinomycetes and associated taste and odour compounds, e.g. geosmin.	• Increased nutrient concentrations due to reduced dilution, particularly from point sources • Stronger stratification • Changed biological niche leading to changes in the dominant species present to types not previously considered or experienced within the context	concentrations of hazards • Increase riparian shade plantings around storages • Operate storages and flows to maximise turnover if low turnover is a key underlying problem • Keep storages above levels that could lead to significant benthic influence on upper depths if problem arises at lower strata • Introduce artificial mixing to reduce stratification and oxidise nutrients • Dose algaecides pre-emptively to keep concentrations below problem levels • Protect storage from activities that could damage macrophytes, e.g. recreation, thereby helping to prevent a shift from aquatic macrophytes to planktonic dominance • Reduce impervious surface areas in water catchments to reduce inflow rates • Cover small storages where the risk is significant Treatment controls: • Cease pre-oxidation before filtration to avoid killing cells and releasing toxins and taste and odour compounds • Increase primary disinfection after filtration to inactivate toxins • Optimise coagulation and filtration to remove algal cells • Change to disinfectant with capability of removing toxins and taste and odour compounds e.g. ozonation • Introduce ability to remove toxins and taste and odour compounds, e.g. powdered activated carbon or granular activated carbon Point of use controls: • Store water in darkness
Problematic plants			
Increased temperatures Reduced runoff volumes Increased precipitation intensity Reduced reservoir turnover and depths	Aquatic weeds and associated loss of utility of reservoir, e.g. *Cabomba*	Occurring at higher densities more often within source water reservoir due to: • Increased light penetration due to decreased turbidity, resulting from less run-off • Increased water temperature • Increased hydraulic residence time due to more prolonged periods of drought • Increased nutrient loads due to	Source controls: • Minimise nutrient runoff, particularly phosphorus, from the catchment • Establish wetlands in key catchment locations to retain nutrients • Mechanically harvest weeds from water • Kill weeds using herbicides safe for use in drinking-water • Increase riparian shade plantings around

Examples of climate change impacts	Examples of hazards	Examples of hazardous events	Examples of control measures to mitigate risks
		increased precipitation intensity • Increased nutrient concentrations due to reduced dilution, particularly from point sources • Stronger stratification • Changed biological niche leading to changes in the dominant species present to types not previously considered or experienced within the context	storages • Dose herbicides to keep concentrations below problem levels • Protect storage from activities that could introduce problem water weeds e.g. water-based recreation
Chemical toxicants			
Increased temperatures Reduced runoff volumes Increased precipitation intensities Reduced reservoir turnover and depths	Agricultural chemicals, e.g. nitrate.	Occurring at higher concentrations in treated water due to: • Decreased dilution in source waters due to reduced runoff • Increased intensity of agriculture in areas that are still viable due to drought-related reductions in total land area available for agriculture • Change to potentially more contaminated water due to increased abstraction and less inflow leading to change of contributing water sources • Selection of less safe alternative sources due to limited water resource availability in safer normal sources • Increased nutrient loads in source waters after large runoff events • Contamination of groundwater due to infiltration of pollutants with large rainfall events • Increased lateral flow in soils after large rainfall events may increase transport of contaminants, particularly in shallow aquifers	Source controls: • Minimise agrochemical runoff from catchment or recharge area • Minimise the use of high risk agrochemicals in recharge areas • Limit high intensity agricultural activities in key catchment and recharge areas • Abstract water from deeper or better confined aquifers • Capping unused bores and ensuring current wells are appropriately sealed from surface run-off • For deep wells ensure casing exceeds well below the level of shallow aquifers Treatment controls: • Introduce reverse osmosis treatment
	Chemicals from geology in ground water, e.g. arsenic and fluoride.	Occurring at higher concentrations in treated water due to: • Decreased dilution in source waters due to reduced inflows or recharge during more prolonged periods of drought • Change to potentially more contaminated water due to increased or over abstraction and less inflow leading to change of contributing water sources • Selection of less safe alternative sources due to limited water resource availability in safer normal sources	Source controls: • Abstract water from less contaminated sources • Avoid over abstraction that may change contributing source waters to more contaminated ones • Use multiple sources to dilute specific pollutants Treatment controls: • Optimise existing treatment to remove chemicals e.g. coagulation optimisation • Introduce enhanced treatment e.g. pre-oxidation, ion exchange, chemical adsorption or reverse osmosis

Examples of climate change impacts	Examples of hazards	Examples of hazardous events	Examples of control measures to mitigate risks
	Disinfection by-products, e.g. haloacetic acids	Occurring at higher concentrations in treated water due to: • Decreased dilution of organic precursors in source waters due to reduced inflows or recharge during more prolonged periods of drought • Increased organic matter from phytoplankton due to reduced river flow and increased nutrients concentrations • Increased disinfectant concentrations to maintain residuals under hotter, lower flow conditions	Source controls: • Minimise nutrient runoff, particularly phosphorus, from the catchment • Establish wetlands in key catchment locations to retain nutrients • Replace vegetation that contributes high levels of organic runoff with less problematic vegetation • Introduce artificial mixing to reduce stratification and oxidise nutrients • Protect storage from activities that could introduce organic matter e.g. water-based recreation Treatment controls: • Optimise existing treatment to remove precursors e.g. coagulation optimisation • Introduce enhanced treatment e.g. pre-oxidation, ion exchange, chemical adsorption or reverse osmosis • Introduce better optimised disinfection strategies, such as using booster disinfection rather than excessive primary disinfection • Move to using primary disinfectants with reduced disinfectant by-product formation potential, e.g. UV or ozone Distribution system controls: • Reduce treated water service reservoir operating levels to reduce hydraulic residence times • Move to using residual disinfectants with lower disinfectant by-product formation potential, such as using chloramines rather than free chlorine for maintaining residual
	Metals released from sediments, e.g. manganese.	Occurring at higher concentrations more often within source water reservoir due to: • Reduced dilution from reduced overall rainfall quantity • Stronger stratification and reduced dissolved oxygen penetration due to increased temperature • The formation of acid sulphate soils, due to the exposure and re-wetting of sediments	Source controls: • Manage river and wetland flow regimes to minimise the formation of acid sulphate soils • Abstract source water from depths that minimise concentrations of hazards • Operate storages and flows to maximise turnover • Keep storages above levels that could lead to significant benthic influence on upper depths • Introduce artificial mixing to reduce stratification and oxidise metals

Examples of climate change impacts	Examples of hazards	Examples of hazardous events	Examples of control measures to mitigate risks
			Treatment controls: • Optimise existing treatment to remove metals e.g. coagulation optimisation • Introduce enhanced treatment e.g. aeration, pre-oxidation, ion exchange, chemical adsorption or reverse osmosis
Physical hazards			
Sea level rise due to increased temperatures Reduced runoff volumes Increased precipitation intensities	Salinity	Saline ingress into coastal estuaries and ground waters from due to increased sea levels and/or over abstraction of freshwaters influenced by saline groundwater Increases in evaporation and decreasing recharge may increase the salinity of some groundwater resources Decreased run-off in the headwaters of catchments leading to reduced dilution downstream, where saline inputs are more significant	• Maintain critical dilution flows in river and streams • Minimise high saline loads from specific sources entering rivers and streams (for example irrigation drainage or wetland discharge) • In controlled river systems, manage flows to minimise the concentration of highly saline water • Maintain or improve landscape vegetation to reduce shallow groundwater salinisation • Control abstraction rates to prevent saline ingress • Recharge aquifers with wastewater to keep back saline ingress
	Turbidity	Occurring at higher concentrations in treated water due to: • Increased intensity of agriculture in areas that are still viable due to drought-related reductions in total land area available for agriculture • Increased turbidity due to more intense precipitation events causing greater erosion of agricultural lands, stream banks and loads from urban stormwater	• Minimise sediment loads from agricultural and urban stormwater • Stabilise stream bed and banks to minimise erosion • Establish wetlands in key catchment locations to retain nutrients • Increase riparian area integrity and vegetation cover
General			
Increased temperatures Reduced runoff volumes Increased precipitation intensities Reduced reservoir turnover and depths	Water quality hazards that are present in new water sources	A hazard becomes problematic due to a new water source being used to augment a drinking-water supply or a new water source being used in place of an existing water source (refer above as examples of hazards for which this is a potential hazardous event)	• Carefully consider all hazards that might be relevant to the new water source • Undertake baseline water quality testing of the new water source • Review capability of existing treatment systems against the treatment requirements of the new water source and augment the treatment if required • Operate the water source assuming the worst-case for its quality in the absence of knowledge about that quality until new knowledge has amassed
	Water quality hazards that cause unforeseen incidents	A hazard becomes problematic that was not foreseen and is only revealed after adverse consequences have occurred or are about to occur	• Place emphasis on assessing emerging or future risks • Maintain a water quality incident and emergency management plan

Examples of climate change impacts	Examples of hazards	Examples of hazardous events	Examples of control measures to mitigate risks
			• Prepare specific contingency plans for foreseeable hazardous scenarios • Introduce available to use alternative sources • Increase treated water storage capacity to allow avoidance of problem periods • Set up systems to enable rapid community alerts regarding boil water alerts and water consumption avoidance advisories and orders
	Water quality hazards that are present due to new water management arrangements	A hazard becomes problematic due to a new water management arrangement that can lead to new water-related exposures or cross-connections between alternative non-potable water and potable water	• Carefully consider all hazards that might be relevant to the alternative water management arrangements • Ensure treatment systems adequately reduce hazard concentrations in the alternative water to allow for both the intended and inadvertent but inevitable uses of, and exposures too, that water • Implement rigorous systems to prevent excessive exposures beyond those intended to the alternative non-potable water supply • Implement rigorous systems to prevent cross-connections or inadvertent tap-ins that could cause the potable water supply to become contaminated by the alternative non-potable water supply • Operate the alternative water source assuming the worst-case for its quality in the absence of knowledge about that quality until new knowledge has amassed
	Water quality hazards that arise due to effects on infrastructure	A hazard becomes problematic due to a failure of water supply systems resulting from for instance • heat-related power failures and loss of pumping and treatment systems • floods overwhelming treatment systems and assets in general • heat-related asset failures such as increased rate of pipe bursts due to heat and drought-related ground movement • heat-related impacts on water treatment chemicals such as loss of potency of sodium hypochlorite solution • drying landscape leads to cracking of river banks and degradation of bores	• Install backup systems for critical infrastructure and develop backup water supply options where possible to help in the event of system failure • Develop systems to provide safe water in the event of system failure • Store critical chemicals and materials away from excessive heat • Select materials and chemicals that can withstand increased temperatures • Install robust assets and use installation procedures that protect assets to protect from heat-related stresses, ground movements and flood events

2.6.1 Operational Monitoring

Operational monitoring is an ongoing observation or inspection to assess whether the water supply system is operating properly using observation checklists. It is a regular activity to check whether control measures are able to remove and/or reduce potential risks of contamination, and important to timely detect water quality problems so that corrective actions can be taken before supplying water to the community. It is usually based on simple observations and tests such as turbidity or structural integrity.

Effective monitoring programmes should rely on establishing: What will be monitored; how it will be monitored; timing and frequency of monitoring; where it will be monitored? Who will do the monitoring? Who will do the analysis; and who will receive the results for action.

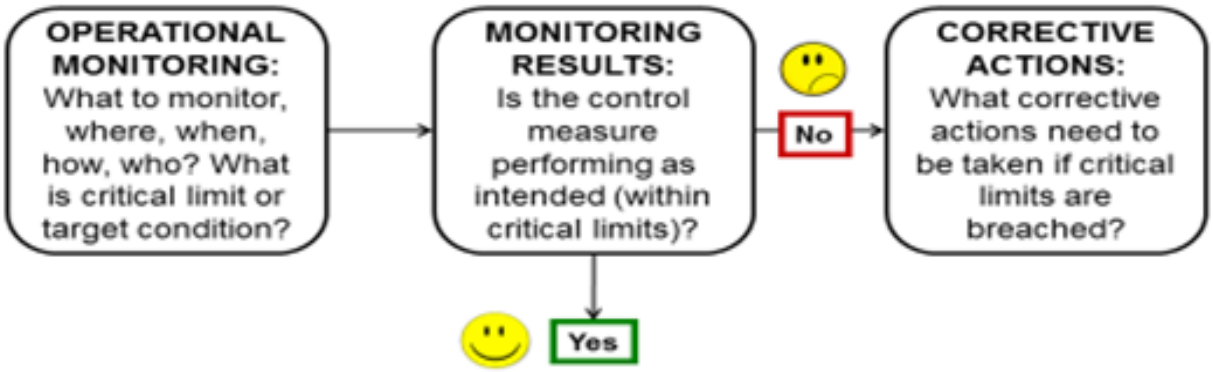

Figure 5: **Operational Monitoring features**

Guidelines for monitoring of control measures

In order to efficiently and effectively monitor control measures Community Water Organizations should:

1. **Prepare and operationalize monitoring programmes.** Community Water Organization shall put in place operational monitoring program that aims to ensure periodic inspection of water supplies as well as collection and testing of water samples at critical points.

2. **Identify possible areas in the water flow system (if any) that could result to water contamination (Critical Control Points).** Determine the existing control measure already in place at the Critical Control Points, and conduct operation monitoring by observations/inspections to ensure that the control measures are effective in the prevention of water contamination.

3. **Periodically collect and test water samples at critical control points to check for microbial, chemical and physical hazards.** Measures for monitoring control of pathogenic and chemical hazards should include those that relate to source protection and those that relate to engineered assets, such as

well-head protection, drinking-water treatment plants, disinfection plants, storage reservoirs and backflow protection.

2.6.2 Verification of the effectiveness of WSP

Verification is an action taken to confirm water quality targets are being achieved, water supply systems are operating properly, and water safety plan is functioning. Verification is based on water quality testing, internal and external auditing of the adequacy of the WSP, and checking of the consumer satisfaction. The purpose of the verification is to confirm that the water supply system is capable of consistently supplying safe drinking water and that the water safety plan is working effectively.

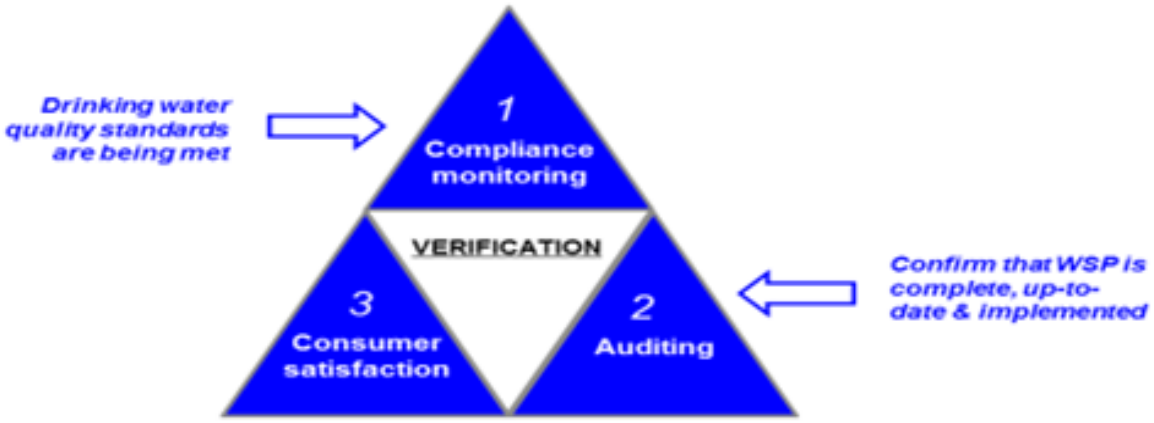

Figure 6**: Elements of Verification**

1. **Compliance Monitoring:** Compliance monitoring is usually based on the water quality testing for faecal indicator organisms and harmful chemicals such as fluoride, nitrate, and Arsenic; and the test results are checked against national drinking water quality standards.

2. **Auditing:** is important to maintain quality of WSP implementation. Internally, WSP implementation reviews can be made by respective CWST or responsible personnel. WSPs implementation reviews are also conducted by independent team of professionals who have good understanding about water supply systems, water safety plan and of the drinking water quality. For example, teams from LGAs, Basins, or Regional. The internal audit team assesses whether hazardous events are fully removed, risks are averted, whether appropriate control measures are identified for each risk, and appropriate operational monitoring procedures are put in place, critical limits are also set to monitor proper implementation of the control measures, and whether verification monitoring is conducted regularly.

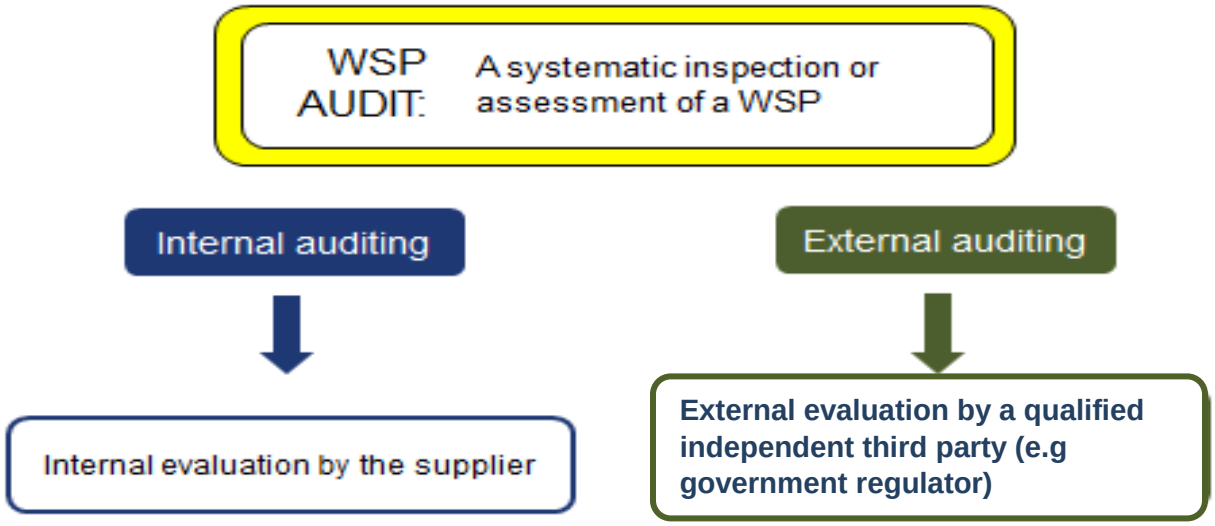

Figure 7: **Types of WSP Audits**

3. **Water Users' Satisfaction:** Verification process also encompasses assessment of water users' satisfaction with the quality/safety, quantity/adequacy, reliability, continuity, and cost of the drinking water and is important indicator whether water supply system is properly operating. Water users might have compliance on taste, color or odor of the water and they may divert to alternative unsafe water sources if their voice is not heard. Therefore, water users' satisfaction surveys should be conducted on a regular basis to get feedback on the quality of the drinking water.

2.7 Task7: Document review and improvement of all aspects of WSP implementation

Water safety plan includes establishment of clear management procedures to document actions taken when the water supply system is operating under normal condition (standard operation procedures- SOPs) and when the system is operating in incident situation (corrective actions) when critical limits are surpassed. Sometimes, incident situation such as flood and/or drought

may occur and create loss of control of the system, and could result in damage of the water supply infrastructure, drying and/or gross contamination.

Therefore, assessment of past trends of drought and floods is important to develop emergency preparedness and response plan and the standard operation procedures (SOPs) on how to operate the system during unanticipated disaster (emergency situation such as flood and drought), identification of the specific activities to be carried out by WASH committee and local artisans both under normal conditions and during emergency situation. The following are examples of standard operation procedures (working manuals) important for community managed rural water supply systems.

2.7.1 Operational procedures under normal conditions

i. Prepare/update operational manual that is used for operation and maintenance of rural water supply schemes, water sampling, quality testing and surveillance, disinfection, and household water treatment and safe storage practices, WASH committee and board management guidelines

ii. Prepare/update procedure for record keeping and reporting (list of reportable key parameters, failure reporting forms, users' claim form, etc)

iii. Develop system of communication between stakeholders particularly on sharing of compliance and monitoring results

2.7.2 Management procedures to deal with incidents

i. In addition to climate and weather information collected from the nearest meteorological stations, WSP team organizes community/expertise consultation workshop and identify trends of climatic changes that occurred during the past years/decades (based on the histories and experiences of the elders or on meteorological data, make prediction for possible impacts on the water supply system and establish baseline for future monitoring

ii. Prepare/update Clear description of actions required in the events of deviations from the critical limits

iii. Depending on the type and complexity of emergency situation, develop/update the response action which could vary from;

   a. Modification of treatment of existing sources, or temporary use of alternative sources with appropriate water treatment, or water tracking during worst water scarcity.

   b. Use of alternative water sources with household water treatment and safe storage practices in case of gross damage and contamination with existing water supply schemes.

iv. Properly document these emergency response actions in the emergency management procedures.

v. In addition, address the following issues in the emergency response procedure;

a. Prepare response and monitoring actions,

b. Identify responsibilities of internal and external stakeholders,

c. Develop/update communication strategies (rules for internal information sharing/exchange mechanism, with the regulatory and with media and the public),

vi. Develop/update user manual for distribution of emergency supplies, surveillance procedures, etc

2.7.3 Development of the WSP supporting activities

Development and availing of the standard operational procedures (user manuals) for implementation of WSP under normal condition and during incident condition is not sufficient by itself. Thus, there should be activities that support the WSP team, WASH committees, and local artisans and system care takers to develop necessary knowledge, skills, and commitment to develop and implement water safety plan approach, and capacity to manage water supply systems to deliver safe water supply.

Therefore, start supporting programs from simple actions;

i. Organize in-service training for laboratory professionals/analysts on quality control/calibration of testing equipment, and on water quality testing and sanitary inspection.

ii. Organize refresher training for local artisans, water and sanitation committee member on management of small community water supplies, operation and maintenance, and on preventive maintenance of the rural water supply schemes.

iii. Strengthen hygiene and sanitation promotion interventions to reduce contamination risk at source, in the distribution systems and at household level

iv. Identify potential areas of water sources and the supply systems that are likely to be affected or damaged by possible disasters (flood) and prepare necessary protective/preventive measures including training of operators, and sensitization of communities.

v. Provision of the ward health offices with rapid water quality testing kits

2.7.4 Regularly review the WSP

It is expected from the WSP team to periodically meet to review and learn from WSP implementation experiences and new procedures. Reviewing the WSPs could be done whenever there are significant changes in community water supply systems such as flooding, and/or policy changes on the land use and changing of the water supply system equipment to climate resilient technologies (example, diesel pumps to solar pumps, iron pipes to uPVC pipes, etc.) or supply expansion. In addition, reviews are important to address improvement plan that need consorted actions of different stakeholders and to strategize fund raising mechanisms.

WSP review process starts from task-1 and stepwise goes through all tasks and update system description, identify whether there exists new hazards and hazardous events, unaddressed risks, new control measures

and /or corrective actions if existing control measures are inadequate to remove risks, and to revise the improvement plan and implementation timelines. WSP review may include reorganization of the management of the rural water supply system, salary structure of the WASH board, roles and responsibilities and standard operation procedures.

WSP reviews should be done following emergency incidents such as flooding and droughts.

The need for regular review of the WSPs depends on the following situations;

i. Urgent review of WSPs when critical changes or problems occurred in the water supply systems (e.g. contamination exceeding critical limits) and to make operational/physical audits and take corrective measures

ii. Quarterly to assess progresses made on implementation of quick wins and solve ambiguity/confusions related to WSP implementation, which is carried out by COWSO

iii. Annually to identify successes, challenges and learn from experiences and update the WSP

iv. Biennial to review the whole processes of WSP implementation, outputs, and its effectiveness from the viewpoints of ensuring water safety and meeting health based targets.

Furthermore, the impacts of climate change on long-term plans should be considered. Some control measures in the implementation/ upgrade plan will manage existing risks over short time scales and can be periodically reviewed and adjusted when WSPs are reviewed. Other measures, such as capital infrastructure upgrades and new supply sources, may be much longer lived. Considering climate change and other risks associated with rising demand and pollution loading will be important in these long-lived aspects of improvement and upgrade plans. Old infrastructure assets require substantial capital investment and will likely be operated for many decades. As a general approach, adaptation strategies for water system infrastructure may require actions such as: designing adaptable infrastructure; building in safety factors to infrastructure accommodating uncertainty in future climate; utilizing a range of options to achieve an outcome (e.g. diversifying the use of water sources); and supporting infrastructure with non-structural measures such as tariffs and information.

CHAPTER THREE

3.0 IMPLEMENTATION SET UP OF WSP

Table 9**: WSP team members roles and duties**

No	Team members	Expected duties of the team members	Remarks
1	LGA leaders DED	Play a decisive role in creating favorable political environment for WSPs development processes and their implementation. Make decisions on catchment demarcation, social safeguarding, mobilization of community resources (labor, material and cash) during WSPs implementation and provide administrative and legal solutions to community concerns related to water uses, vandalism, sabotage, illegal connections and maintaining peoples motivation Lead annual WSP implementation reviews.	WSPs team leader
	Ward leaders (WEO/ VEO)	Play a decisive role in creating favorable political environment for WSPs development processes and their implementation. Make decisions on catchment demarcation, social safeguarding, mobilization of community resources (labor, material and cash) during WSPs implementation and provide administrative and legal solutions to community concerns related to water uses, vandalism, sabotage, illegal connections and maintaining peoples motivation Lead annual WSP implementation reviews.	WSPs team member
2	District Water Engineer	Make decision on the allocation of right technical resources (artisans, material, financial resources) during planning and implementation of WSPs. Provide copies of records and reports on the water supply schemes layout maps; type and size of materials; life period, leakage and wastage rate; catchment delineation, equipment and spare parts for operation and maintenance. Actively engage in the identification of hazards and risk levels, setting of priority control measures and corrective actions Play leadership role during implementation of control measures and corrective action/improvement plan, operational monitoring, and participate in the semi- annual and annual WSP implementation reviews	WSPs team member
3	COWSO members	Provide information during system description of the overall rural water supply schemes in the area,	WSPs team

No	Team members	Expected duties of the team members	Remarks
		Provide data on frequency of system breakage, type of the schemes, life period, size, length, yield, and materials of the system, Provide information on leakage and wastage rate if the scheme is motorized deep borehole or gravity springs with distribution system, specifications of equipment and spare parts for operation and maintenance, on the major cause for supply interruptions, Actively engage in the identification of hazards and risk levels, setting of the priority control measures and corrective actions Responsible for implementation of the control measures and corrective action/improvement plans, operational monitoring and take part in the semi- annual and annual WSP implementation reviews	member
4	Water supply operators	Provide information for system description specific to the managed water schemes, data on frequency of breakage, type of the scheme, yield, age, down time, specification of equipment and spare parts for operation, repair and maintenance, and major cause for supply interruptions, Actively engage in identification of hazards and risk levels, and setting of the priority control measures and corrective actions Responsible for implementation of the control measures, corrective action/improvement plans, operational monitoring and in the WSP implementation reviews	WSPs team member
5	Water quality and environmental health officer	Determine baseline level of the physicochemical and microbiological quality status of the community managed water supply schemes at source, storage, distribution points, and at the point of consumption Periodically monitor critical water quality parameter during implementation and advice the WSP team to operational monitoring/inspection when critical limits are surpassed Provide expertise support on the treatment/disinfection of the drinking water when need arises Description of the socio-economic dynamics of the community and health status of the catchment population Identification of behavioral and environmental health related hazards, hazard events, and determination of risk levels from catchment to the point of consumption Actively engage in identification of the control measures and corrective/improvement actions Provide data on the coverage and status of household hygiene and sanitation services and its utilization, open defecation practices, household water storage and handling practices, solid and liquid waste disposal, challenges to sustain the household and community sanitation infrastructures such as due flood and termite	WSP team member

No	Team members	Expected duties of the team members	Remarks
		problem, water logging, soil condition, e.t.c Provide data on the number, operation and management status of household owned hand dug wells, and seasonal variation of the well productivity Actively engage in identification of hazards, hazard events, and determination of the risk levels, and identification of priority control and corrective actions for each community managed water supply schemes, during fetching, transportation and at point of consumption Responsible for implementation of control measures, corrective actions, and improvement actions particularly on promotion of improved hygiene and sanitation behaviors, ensuring safe water handling practices, promotion of hand hygiene at critical times and provide support on household water treatment and safe storage practices during emergency situation Actively engage in operational monitoring and conduct regular inspection to water supply schemes and periodic household and community contamination risk assessments and take corrective action with WSP team, Responsible for implementation of WSP plan particularly on the removal of hazard events related to hygiene and sanitation behaviors and environmental health, and engage in the semi- annual and annual WSP implementation reviews	
6	Agriculture and natural resource management worker	Identify sources and types of pollution in the catchment of the water source due to various socio-economic activities (agriculture, local cottage industry, etc) Actively engage in identification of potential hazards, hazard events, and determination of risk levels, Actively engage in identification of the control measures and corrective/improvement actions Responsible for implementation of WSP plan particularly on the removal of hazard events in the catchment and demarcation of micro-watershed, soil and water conservation activities such as development of recharge ponds and terracing in the upstream of the water source, plantation of shallow rooted plants and flood control Actively engage in the semi- annual and annual WSP implementation reviews	WSPs team member
8	School representative	Provide data of the school water supply including age, type, yield, operation and maintenance status, Actively engage in identification of hazards, hazard events, and determination of the risk levels, and identification of priority control and corrective actions for both school water supply and community managed schemes Responsible for implementation of WSPs particularly in the improvement of school hygiene and sanitation, specific control and corrective actions to school water supply, awareness creation and mobilization of the students and school communities on concepts and benefits of WSPs approach, promotion of safe water chain	WSPs team member

No	Team members	Expected duties of the team members	Remarks
		in the school and surrounding communities Actively engage in the semi- annual and annual WSP implementation reviews	
9	Child and Women's Affair /(CDOs)	Provide information on observed and perceived health and social impacts of unsafe water consumption specific to women and children, travel and physical burden of women to collect water from long distances when nearest water sources dry due to drought or damaged by floods. Actively engage in identification of hazards, hazard events, and determination of the risk levels, and identification of priority control and corrective actions for each community managed water supply schemes, during fetching, transportation and at point of consumption Mobilize women/health development groups on improvement of household hygiene and sanitation conditions, and household safe water storage practices, and cleaning of the surroundings of the water points Represent the water users and lead implementation of corrective actions and improvement plans expected from the households/women in their catchment areas and households by mobilizing gender balanced team of leaders Actively engage in operational monitoring from catchment to point of consumption and take part in the semi-annual and annual WSP implementation reviews	WSPs team member
10	Religious Leaders	Provide data on church/mosque managed water sources and water supply such as age, type, depth, length, size, operation and repair status, and safety of the water. Involve in identification of hazards, hazard events, and determination of risks and implementation of corrective measure for all water supply schemes in the catchments and religious institutions. Educate their religious followers and children on the importance safeguarding water from sources to the point of consumption Mobilize resource (labour, materials, funds) from their followers for the implementation of WSP and application of hazard corrective actions Establish norms and Influence sanitation behaviors of the water users and support the community to	WSPs team member

No	Team members	Expected duties of the team members	Remarks
		discipline antisocial behaviors such as vandalism, sabotage and illegal connections Work with local administrative bodies in solving any upstream and downstream community concerns, catchment demarcation, etc. Actively take part in operational monitoring and in the semi- annual and annual WSP implementation reviews	
11	CSOs	Provide technical, financial and logistic support to the WSP team during system description, system layout mapping, hazard identification, risk analysis and identification of the priority control measures Provide program management support through organizing training for the WSP team on the concepts, development and implementation of the water safety plans, adaptation/preparation or updating of the standard operational manuals (SOPs) and translation of SOPs in to local languages, sensitization of operation and maintenance staff, technical advice on operational and verification monitoring and researches - SUMMARISE Support on organizing and facilitation of the semi- annual and annual WSPs implementation reviews, and on documentation of best practices, challenges, lessons learned. Facilitate establishment of networks and information exchange between WSPs team in the neighboring communities and best performing WSP teams somewhere else	WSPs team member

3.1 Tools for inspection and evaluation of COWSO Performance

3.1.1 Tool for inspection of catchment area

1. Name of COWSO:
2. Name of catchment areas
3. Name of village allocated:
4. Date of inspection:

Table 10: **Tools for inspection and evaluation of COWSO Performance**

S/N	Items to be inspected and checked	Points to score	Scored points
1	Demarcation of the water source catchment area by the water basin	20	
2	Water source protection & conservation-records of trees planted in each year as a mitigation and adaptation to impacts of climate change	17	
3	Documentation of the status of catchment area with regard to seasonal variation of water levels; • Quantity (water) flows • Sedimentations • Environmental flows	20	
4	Protection of water source from erosion of banks and siltation caused by heavy rains/ floods	15	
5	Plans for water resources and environmental watershed sustainability	10	
6	Records drought and floods and availability of responses contingency plan • (Experience of recurrence of floods or drought) • Adaptation options e.g. rain water harvesting (RWH)	10	
7	Local climate sensitive early warning system for protection of catchment area.	5	
8	Measurements of meteorological parameters (precipitation; wind speed; temperature)	3	
	Total Score (%)	**100**	

3.1.2 Tools for inspection of intake cum chlorination

1. Name of COWSO:
2. Name of intake cum chlorination:
3. Year of construction:
4. Name of village allocated:
5. Date of inspection:

Table 11: **Tools for inspection of intake cum chlorination**

S/N	Items to be inspected and checked	Points to score	Scored points
1	Demarcation of the water source catchment area and right of occupancy or land title for the intake catchments area.	10	
2	Water source protection & conservation-records of trees planted in each year as a mitigation and adaptation to impacts of climate change	20	
3	Cleanness of the intake chamber and water. The functioning of the fittings installed in the intake chamber (**8**)	10	
4	Cleanness of the strainer	5	
5	Rust on the bolts and nuts of the flanges	5	
6	Leakage from the intake structures	10	
7	Rust on the outlet and over flow pipes	10	
8	Cutting of grasses and bushes surrounding the intake catchment area	10	
9	The conditions of interception ditches (floods diversion furrow)	10	
10	Chemical storage room	5	
11	Watchman's Hut (**2**) Toilet:- VIP or WC (**3**)	5	
	Total Score (%)	**100**	

3.1.3 Tools for inspection of intake

1. Name of COWSO:
2. Name intake:
3. Name of village allocated:
4. Year of construction:
5. Date of inspection

Table 12: **Tools for inspection of intake**

S/N	Items to be inspected and checked	Points to score	Scored points
1	Demarcation of the intake catchments area and right of occupancy or land title for the intake catchment area.	10	
2	Water source protection & conservation-records of trees planted in each year as a mitigation and adaptation to impacts of climate change	20	
3	Cleanness of the intake chamber and water. The functioning of the fittings installed. Inside the chamber.	10	
4	Cleanness of the strainer	10	
5	Rust on the bolts and nuts of the fittings and flanges	10	
6	Rust on the outlet and over flow pipes	10	
7	Leakage from the intake structures	10	
8	The conditions of interception ditches (floods diversion furrow)	10	
9	Cutting of grasses and bushes surrounding the intake	10	
	Total Score (%)	**100**	

3.1.4 Tools for inspection of storage tank

1. Name of COWSO:
2. Name of storage tank:
3. Name of village allocated:
4. Year of construction:
5. Date of inspection:

Table 13: **Tools for inspection of storage tank**

S/N	Items to be inspected and checked	Points to score	Scored points
1	Cleanness of tank inside including stored water	10	
2	Cleanness of strainer	10	
3	The working condition of the floating valve (**5**) Rust on the floating valve rod and floating ball (**5**)	10	
4	The condition of the storage tank manhole cover (**6**) including its frame (**4**)	10	
5	Leakage from the storage tank structure; Micro (**-4**) Leakage (**-5**) Serious Leakage (**-8**)	10	
6	The appearance of the storage tank:-clean and good	10	
7	The cleanness of the surrounding area of the storage tank	10	
8	The condition of the storage tank fence and gate (Temporary fence with temporary gate (**10**) points; resilient to adverse weather conditions (20) points	20	
9	If the pipe line attendant has the annual schedule for cleaning the storage tank and also actual cleaning dairy	10	
	Total Score in (%)	**100**	

3.1.5 Tools for inspection of Storage Tank cum chlorination

1. Name of COWSO:
2. Name of storage tank Cum chlorination:
3. Year of construction:
4. Date of inspection:

Table 14: **Tools for inspection of Storage Tank cum chlorination**

S/N	Items to be inspected or checked	Points to score	Scored points
1	Cleanness of tank inside including stored water	10	
2	Cleanness of strainer	10	
3	The working condition of the floating valve- (**5**) Rust on the floating valve rod and floating ball (**5)**	10	
4	The condition of the storage tank manhole cover (**6**) including its frame (**4**)	10	
5	Leakage from the storage tank structure; Micro (**-4**) Leakage (**-5**) Serious Leakage (**-8**)	10	
6	The appearance of the storage tank:-clean and good	10	
7	The cleanness of the surrounding area of the storage tank	10	
8	The condition of the storage tank fence and gate (Temporary fence with temporary gate (**-10**) points; resilient to adverse weather conditions (**10**) points)	10	
9	If the pipe line attendant has the annual schedule for cleaning the storage tank and also actual cleaning dairy	10	
10	Chemical storage hut (**4**) Watchman's hut (**2**) Toilet (**4**)	10	
	Total Score (%)	**100**	

3.1.6 Tools for inspection and evaluation of pressure reducing tank

1. Name of COWSO:
2. Name of Pressure reducing tank:
3. Name of village allocated
4. Year of Construction:
5. Date of Inspection :

Table 15: **Tools for inspection and evaluation of pressure reducing tank**

S/N	Items to be inspected or checked	Points to score	Scored points
1	Cleanness of PRT inside including stored water (5) Cleanness of PRT valve chamber plus fittings (5)	10	
2	Cleanness of PRT strainer	10	
3	The working condition of the floating valve- (**5**) Rust on the floating valve rod and floating ball (**5)**	10	
4	The condition of the PRT tank manhole cover (**6**) including its frame (**4**)	10	
5	Leakage from the PRT structure; Micro(**-4**) Leakage (**-5**) Serious Leakage (**-8)**	10	
6	The appearance of the PRT:-clean and good	10	
7	The cleanness of the surrounding area of the storage tank	10	
8	The condition of the PRT fence and gate Temporary fence with temporary gate (**-15)** points	20	
9	If the pipe line attendant has the annual schedule for cleaning the PRT and also actual cleaning dairy	10	
	Total Score (%)	**100**	

3.1.7 Tools for inspection of evaluation systems

1. Name of COWSO:
2. Name of chamber with water meters, valves, sluice valves, wash out, air valves e.t.c:
3. Name of village allocated:
4. Year of construction:
5. Date of inspection:

Table 16: **Tools for inspection of evaluation systems**

S/N	Items to be inspected and checked	Points to score	Scored points
1	Cleanness of the floor inside the chamber	5	
2	Cleanness of fittings inside the chamber Functioning of the fittings installed inside the chamber (**8**)	10	
3	Cleanness of either water meter or valve (**10**) and its working condition (**40**)	50	
4	The condition of valve chamber cover (**12**) including its frame (**8**)	20	
5	The cleanness of surrounding area of the chamber been inspected	5	
6	Abbreviations of the items installed inside the chamber or marker poles for showing where valves have been installed.	10	
	Total Score (%)	**100**	

3.1.8 Tools for inspection of public tap

1. Name of COWSO:
2. Name of Public tap or number:
3. Village allocated:
4. Year of construction:
5. Date of inspection:

Table 17: **Tools for inspection of public tap**

S/N	Items to be inspected and checked	Points to score	Scored points
1	Cleanness of the Public tap floor slab	10	
2	Cleanness of the Public tap body	10	
3	Condition of the Public tap fence (Temporary (**5**) or permanent fence(**10**)	10	
4	The condition of Public tap gate (with permanent gate (**10**) Temporary gate (**4**)	10	
5	Cleanness inside the Public tap body (**2**) and if the PT offers 24hrs service (**8**)	10	
6	If there is a pit latrine near the Public tap (**-10**) or if people are washing at the public tap surrounding area **(-10**)	10	
7	- Condition of Public tap cover and frame (**7**) - Schedule of daily cleaning of public tap (**7**) - Cost of water sells written on the PT body and PT Number (**7**) - Record of daily water sells **(7)** - Records of monthly meter readings (**7**) - Cleanness of water collecting utensils.(**5**)	40	

	Total Score (%)		

3.2 Tools for inspection of office building

1. Name of entity:
2. Name of Office Building:
3. Year of construction:
4. Date of inspection:

Table 18: **Tools for inspection of office building**

S/N	Items to be inspected or checked	Points to score	Scored points
1	Office sign board (**5**) and condition of the office yard fence (temporary **(-3**) or permanent (**5**)	10	
2	**Condition of the office building outside:-** Attractive and in good condition (**10**) Bad appearance and in poor condition (**-5**)	10	
3	Trees planted surrounding the office yard (**10**) and records of trees planted each year (**10**)	20	
4	Tree nurseries for reforestation, and a forestation and conservation of water sources.	10	
5	Cleanness of entity material store **(5)** and proper arrangement. of the store **(5)**	10	
6	Cleanness and condition of the ventilated improved pit latrine (**5**) or W.C for the field workers –Attractive and in good condition with hand washing basin and soap (**5**).	10	
7	Cleanness of the office floor, wall and ceiling (**5)** The arrangement of the office including documents (**5**)	10	
8	Cleanness of the office kitchen (**5**) and arrangement (**5**)	10	
9	Cleanness of the office W.C lavatory (**5**).Condition of flashing system (**5)**	10	
	Total Score	**100**	