iDE Guidelines for Planning, Design, Construction and Operation of Multiple Use Water Systems (MUS)

Field-Level Implementation Guidelines

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Abbreviations

BSP	:	Biogas Sector Partnership
CBO	:	Community Based Organization
CC	:	Climate Change
CCA	:	Climate Change Adaptation
DADO	:	District Agriculture Development Office
DDC	:	District Development Committee
FCT	:	Ferro Cement Tank
FCL	:	Ferro Cement Lining
ft	:	Feet
GDP	:	Gross Domestic Product
GESI	:	Gender Equality and Social Inclusion
GI	:	Galvanized Iron
GSM	:	Gram per square meter
HDPE	:	High Density polyethylene
HP	:	Horse Power
iDE	:	International Development Enterprises
INGO	:	International Non-Government Organization
IWRM	:	Integrated Water Resource Management
LAPA	:	Local Adaptation Plans of Action
MIT	:	Micro Irrigation Technology
MTJ	:	Modified Thai Jar
MUS	:	Multiple Use Water Systems
NAPA	:	National Adaptation Programme of Action
NEWAH	:	Nepal Water for Health
NGO	:	Non-Government Organization
ODF	:	Open Defecation Free
PoU	:	Point of Use
R & M	:	Repair and Maintenance
RVWRMP	:	Rural Village Water Resource Management Project.
UNDP	:	United Nations Development Programme
VDC	:	Village Development Committee
VLO	:	Village Level Organization
WASH	:	Water Sanitation and Hygiene
WCF	:	Ward Citizen Forum

Glossary

Domestic use of water: Water consumption for domestic needs like: drinking, cooking, cleaning and sanitation, etc.

Productive use of water: Water consumption for water-based enterprises like: irrigation of crops, commercial livestock farming, agro-processing, and fisheries.

MUS: Piped water supply system designed to meet both domestic and productive use or systems determined by the community and translated into MUS by design for multiple uses.

Project: Activities including planning, construction and operation phases of MUS.

Users group: Beneficiary group who owns a MUS and responsible for its operation and management. The group might include a representative from all beneficiary households.

Executive Committee: A core team selected from users group for planning, preparation, operation and monitoring of MUS.

Construction Committee: A small committee selected from the users group to carry out all procurement and construction work of MUS.

Support Agency: The organization playing the role of facilitation and coordination in the community for the planning and implementation of MUS.

Stakeholders: Organization or individuals who support or have interest or a stake in the project.

Smallholder farmers: Marginal farmers cultivating small plots of land, typically vulnerable to climate change.

Funding agency: Organization or authority who financially supports a MUS project.

Village Level Organization: Organization working in community development at the local level, such as Village Development Committee (VDC) or Community Based Organization (CBOs) including Civil Citizens forum, club, or mothers group.

Offtake: Irrigation tap stand for use with micro-irrigation technology (MIT) on small farm plots.

Chapter 1: Introduction

1.1 Background

Nepal is a predominantly rural, mountainous and agricultural country where about 70% or rural people depend on agriculture for their livelihood. It is the poorest country in Asia after Afghanistan and ranks in the lowest 20% on the Human Development Index. Nepal is ranked 102 out of 148 countries on the UNDP's Gender Inequality Index and it has higher than average levels of inequality (across life expectancy, education and income) in South Asia[1]. Agriculture contributes around 34% in total gross domestic product (GDP). Therefore, agriculture is an important sector for any attempt to increase income, reduce poverty and uplift living standard. The average rainfall in Nepal ranges from 1500-2500mm, however, 80% of its rain falls in three monsoon months, meaning that for 9 months of the year water is scarce. Only 18% of the land is irrigated year-round. Most poor and disadvantaged people depend on monsoon water for irrigating agricultural land. Spring and ground water are typically sources for drinking water and other household uses in mountain and terai districts, respectively.

The Climate Change Risk Atlas 2010 ranks Nepal as the fourth most vulnerable country in the world[2]. Every year more than 1 million people are directly impacted by climate-induced disaster such as drought, landslides and floods in the mid-west and far-west regions of Nepal. Climate change projections for Nepal indicate that there will be significant warming, particularly at higher elevations, leading to reductions in snow and ice coverage. Climate variability and the frequency of extreme weather events, including floods and droughts, are expected to intensify due to an increase in precipitation during the wet season. Similarly, declining spring water sources are having visible impacts, resulting in reduced water availability for drinking and irrigation. Women and girls are disproportionately affected by reduced water availabilituy as they typically bear responsibility for water collection and agricultural labor. The reduction of agriculture production increases food insecurity and has adverse impacts on the health of women and children.

The varying impact of climate change in different communities, and communities' diverse adaptive capacities, demand different adaptation approaches across geographic regions. Poor women, indigenous peoples, socially excluded communities and low-income households are the most vulnerable populations needing climate change adaption.

Water and agriculture are major sectors facing multiple problems caused by climate change and its impact on temperature and rainfall patterns. Water use practices among rural and peri-urban households can be

1 UNDP Annual Report ,2012
2 WB, ADB and DARA reports (2010). Maplecroft Climate Change Risk Report 2009/10

broadly categorized as domestic, such as drinking, cooking, cleaning and sanitation, or productive, such as irrigating agricultural fields, livestock raising, and other water-based enterprises. Productive activities make a major contribution to rural communities for income generation and food security. The gradual reduction of water sources has increased the importance of effective and efficient water management practices. Therefore, MUS is an important approach to tackle these issues.

1.2 Nepal Climate Change Support Programme

The Nepal Climate Change Support Programme (NCCSP) is a national climate change (CC) intervention programme from the government of Nepal for implementing the recommendations of the National Adaptation Programme of Action (NAPA). The programme is supported by UK AID/ DFID, the European Union and the United Nations Development Programme (UNDP). It is being implemented by the Ministry of Science, Technology and Environment – MoSTE . The goal of NCCSP is *to ensure that Nepal's poorest and most vulnerable people are able to adapt well to the effects of climate change*. The key objectives are to enhance the capacity of government (particularly MoSTE and Ministry of Federal Affairs and Local Development – MoFALD) and non-government organizations to implement Nepal's climate change policy (2011) and execute the most urgent and immediate adaptation actions in order to increase the resilience of vulnerable and poor people of Nepal. The principal components of the programme are improving governance, empowering women and other disadvantaged groups, and ecosystem sustainability. These approaches are designed to ensure that climate change adaptation is integrated into the local development process through local government, private sector and community based organizations (CBOs). The programme is being implemented in 14 districts of Nepal — 3 in the far-west (Achham, Bajura, Kailali) and 11 in the mid-west (Bardiya, Dolpa, Humla, Jumla, Mugu, Dailekh, Jajarkot, Kalikot, Dang, Rolpa and Rukum).

1.3 What is MUS?

Communities traditionally use water for multiple purposes, collecting it from multiple sources without established norms. This unplanned distribution of water for multiple domestic and productive uses has the potential to cause social conflicts and other problems. Water service providers typically do not consider the needs of smallholder productive users when they plan domestic water supply systems. This limits the economic benefits of water supply systems and affects their sustainability[3] .

[3] G.C., Raj Kumar (2010). An Evaluation of Multiple Use Water Systems in Mid-hills of Nepal. A Case Study of Phulbari Multiple Use Water Systems in IDE's Project Area of Shyangja District. M.Sc. Internship Report. Wageningen University, the Netherlands.

MUS is a participatory approach that takes the multiple domestic and productive needs of water users who take water from multiple sources as the starting point for planning, designing and delivering water services—moving beyond conventional barriers between the domestic and productive sectors[4]. MUS meet people's domestic and productive needs while making the most efficient use of water resources—taking into account different water sources and their quality, quantity, reliability and distance from point of use. The MUS planned and designed in Nepal normally employ a piped system approach to meet both domestic and productive needs. This is the established and recognized iDE-led approach in Nepal. MUS are a way of using scarce water more effectively and efficiently compared to traditional drinking-water systems.

The MUS approach falls within the framework of Integrated Water Resource Management (IWRM). This involves planning, finance and management of integrated water services to meet the multiple water and livelihood needs of users[5]. The approach emerged in the early 2000s when professionals from the water sub-sectors, in particular the domestic water, sanitation and hygiene (WASH) sector and the irrigation sector, began to see the untapped potential of providing water beyond the confines of conventional single-use mandates. The MUS approach encompasses new infrastructure development and rehabilitation as well as water governance. MUS apply innovative and cutting-edge approaches and interventions to improve efficiency and effectiveness through low-cost and technology combinations. Local knowledge, skills and practices are duly considered and combined in this approach where appropriate. This is illustrated below in the chapters on social mobilization and capacity building training on MUS.

Globally, the entry point for MUS is classified into three categories[6]:

Domestic-plus: under this entry point, domestic water supply systems are developed in such a way that service is provided at a higher level than the minimum requirements, so that on top of water for domestic uses, users have access to water for productive uses; service providers widen their mandates but maintain the (implicit) priority for domestic uses around homesteads.

Irrigation-plus: under this entry point, irrigation systems are developed or redeveloped in such a way that non-irrigation uses – both productive and domestic – can be accommodated; service providers widen their mandates, but maintain the (implicit) priority for productive uses, for instance on fields.

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[4] Marieke Adank, Barbara van Koppen, and Stef Smits, on behalf of the MUS Group (Feb 2012): Guidelines for Planning and Providing
Multiple-Use Water Services

[5] Faal, J., Nicol, A. and Tucker, J. 2009. Multiple-Use water Service (MUS): Cost-effective waterinvestments to reduce poverty and address all the MDGs. RiPPLE briefing Paper No 1,June 2009. Addis Ababa: WaterAid Ethiopia.

[6] Marieke Adank, Barbara van Koppen, and Stef Smits, on behalf of the MUS Group (Feb 2012): Guidelines for Planning and Providing Multiple-Use Water Services

Community-driven MUS by design: this entry point takes communities and their own prioritization of water use from multiple sources as a starting point for improvement, and offers technology choices designed for multiple uses.

1.4 How is MUS different from existing water supply systems?

MUS is superior to conventional single use water systems because it is designed for both domestic and productive uses. Communities with single-use designed systems tend to rely on them for both uses, regardless of the original intent. As a purpose-built solution (by design or by community-driven design), MUS is more efficient and reduces costs for communities served by traditional drinking water systems. In addition, water supply systems designed for a single use such as drinking/domestic use or irrigation may not be able to supply water other than for a defined purpose without resulting in damaged hardware or harm to community relationships during periods of limited water supply. A single water supply system designed for multiple uses can reduce existing social stress by satisfying many competing community needs including domestic use, irrigation, livestock, fisheries and other end uses.

MUS offers three main advantages compared to single-use water service delivery models: 1) more livelihood improvement, 2) more environmental sustainability, and 3) strengthened integrated water resource management (IWRM).[7]

The major differences between single-use and multiple-use systems include:

Single Use system	Multiple Use System
• System is designed for single use	• System is designed for multiple uses
• Water demand is projected for single need	• Water demand is projected for multiple needs
• Potential conflict around the use and allocation of water for competing demands	• No or reduced conflict as water demand is already incorporated while designing system
• No or limited focus on livelihood improvement of vulnerable communities	• Fully focused on livelihood improvement of vulnerable communities
• Less supportive of integrated management of water resources	• A tool for integrated water resource management
• Focus on using available water only for single purpose with conventional practices	• Designed to use available water resources optimally, with inclusion of effective and efficient water application technologies

[7] Marieke Adank, Barbara van Koppen, and Stef Smits, on behalf of the MUS Group (Feb 2012): Guidelines for Planning and Providing Multiple-Use Water Services.

• Designed for single use with little or no attention to improving climate change resilience	• Specific focus on addressing climate change impacts due to water stresses, supporting diverse livelihoods as well as household needs
• Additional financial resources may be required for maintaining operation and/or a maintenance fund	• Sustainable arrangement for O & M funds built into design process; additional income generated through productive activities such as high value crop production

1.5 Characteristics of MUS delivery

MUS are designed to deliver a minimum quantity of water at a minimum recommended level of quality. Quantity is the amount of water required to meet specific needs, whereas quality is based on a safe threshold for use according to a defined purpose. Accessibility and reliability of the services are also important parameters. Accessibility is based on the distance to and location of water services, as well as water rights related to use of water and the time and effort required to access services. When water service is available consistently at the appropriate time for a desired purpose, it is a reliable service. These four characteristics—quantity, quality, accessibility and reliability—are determined by[8]:

- **Water availability at source:** Location of water source (accessibility), quantity and quality of water sources and continuous availability of water (reliability)
- **Infrastructure**: Water services are available from the infrastructure and will determine the quantity, quality, accessibility and reliability of the services.
- **Institutional arrangements**: The provision of governance on water services helps to determine quantity, quality, accessibility and reliability.
- **Financial arrangements**: This is the funding arrangement required to convert water resources into water services and recovery mechanism, including maintenance and repair.

1.6 Features of MUS

The main features of MUS are:

- Access to water supply for multiple needs from single system
- Water demand for domestic and productive needs are incorporated in design of the system
- Sustainability of system ensured by involving vulnerable communities directly in the planning process and in construction and management

[8] Marieke Adank, Barbara van Koppen, and Stef Smits, on behalf of the MUS Group (Feb 2012): Guidelines for Planning and Providing Multiple-Use Water Services

- Provides economic improvement opportunity for rural and vulnerable communities from water-based enterprises
- Productive utilization of small water resources
- Reduced drudgery for water collection mainly by women and girls
- Low construction and maintenance cost through integration of simple and low cost technologies
- Improved community resilience to climate change through effective and efficient utilization of water of small scale water resources
- High level of community participation and mobilization

1.7 MUS in Nepal

MUS is not a new concept in Nepal. In rural communities of Nepal, people are already using available water for multiple purposes: drinking, cooking, washing, bathing, irrigating fields, livestock, etc. Drinking water supply systems designed to meet drinking and domestic water needs are currently being used to fulfill these multiple water needs. In 2003, iDE Nepal initiated purpose-built MUS “by design” in Nepal, designed to supply sufficient water for both domestic and irrigation needs. Since that time, the MUS approach has been formally recognized, with international and national development organizations considering MUS as a prominent development activity to enhance rural livelihoods.

In addition to iDE’s ongoing work in this area, Winrock International, Water Aid, Practical Action Nepal, Nepal Water for Health (NEWHA), Biogas Sector Partnership Nepal (BSP) Rural Village Water Resource Management Project (RVWRMP), Non-Conventional Irrigation Technology Project (NITP)/ Department of Irrigation (DOI) and other organizations have promoted the MUS approach. Different organizational priorities have resulted in different designs: Water Aid and NEWHA are promoting MUS for improving WASH, for instance, whereas iDE and Practical Action are focusing on water supply for both domestic and irrigation use employing micro-irrigation technologies (MIT). RVWRMP has multiple activities focusing on MUS, such as domestic-plus-irrigation, micro-hydro plus irrigation, and drinking plus WASH. BSP is promoting MUS utilizing rainwater harvesting. Almost all MUS are community-owned systems. Most of these installed systems are concentrated in hill districts of the western, mid-western and far-western development regions. In 2012, iDE Nepal piloted a small Solar MUS in Rupandehi for the first time in the Terai. Some organizations have taken a technology-focused approach to MUS, whereas some have focused on management. The decline of small water sources in recent years has resulted in greater need for better water resource planning and development in rural communities, and NCCSP has consequently taken up the MUS approach, with pilot tests planned in the mountains, hills and terai.

1.8 MUS and climate change

Climate change is a global problem and Nepal is particularly vulnerable to its adverse impacts. National Adaptation Plan of Action (NAPA) guidelines report that Nepal is going to face multi-faceted problems in water and agriculture sectors due to climate change. It is already affecting temperature and rainfall patterns. Uncertain and irregular monsoon rains are causing reductions in spring and ground water sources. The water table is decreasing annually, requiring more investment in resources to fetch water from tube wells. Many small spring sources are drying up in the hills and mountains. This reduction of water flow and volume both in springs and ground water sources has a direct impact on poor rural communities that depend on agriculture. Most are dependent on rain-fed irrigation systems for seasonal agriculture production. Decreased water supply affects livelihoods, personal hygiene, sanitation and the health of women and children in these communities.

MUS is a low-cost solution to counter the negative impacts of climate change on poor and vulnerable communities. A properly planned, managed and regulated water distribution system, integrated with water efficient technologies (for example micro-irrigation) can enable farmers to produce high value crops like off-season vegetables to increase and diversify incomes. In the face of increasing scarcity, a regular supply of clean water in a community can directly address issues of personal hygiene, health and sanitation.

Chapter 2: MUS Design

MUS are designed considering different factors such as water sources and geographical setting, water availability and available technology. MUS can be built as new schemes or rehabilitation/upgrades of existing water supply systems. Broadly, the design of MUS requires two main considerations:

- Available water sources and geographical setting
- Water flow at source

2.1 Water sources and geographical setting

Gravity-fed systems are the most economical and are appropriate whenever the community is located below the water source. When the community is located above the source, a solar or grid-powered pump solution is needed. MUS design depends on the nature of available water sources in different geographical locations. Appropriate systems for these sources are listed below.

Water Sources	Delivery System	Application	Feasible Geographical Location	Ownership
spring water	gravity fed	domestic with drinking, productive	mountain, hill	community
stream/ river water	gravity fed, lift system	domestic without drinking, productive	mountain, hill, terai	community
ground water/ lake water/ pond	lift system	domestic sometimes with drinking, productive	terai, hill, mountain	community, individual
rain water	gravity fed	domestic without drinking, productive	mountain, hill	community, individual

2.2 Water availability

Water availability at sources can be classified as sufficient, moderate or scarce. Based on these categories, MUS may have the following designs:

- Single tank flow system
- Double tank flow system
- Multiple tank/ intermittent flow system

Single Tank Flow System

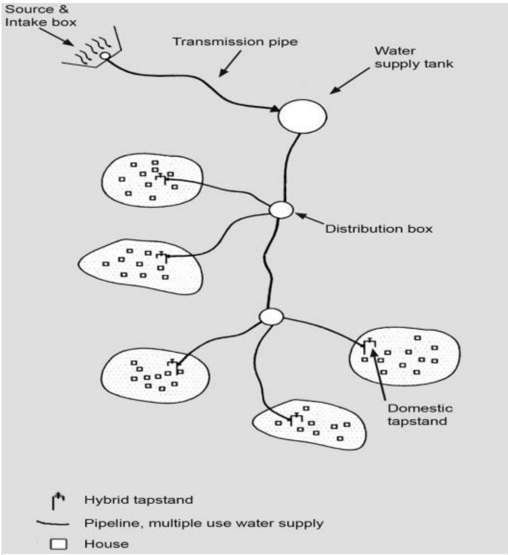
If water availability is more than 1.5 times the assessed demand, a single flow MUS system may be used. Water supply can be maintained throughout the day without regulating/controlling water flow in the system. This system is also called a regular flow system. This type of MUS can be built from spring or stream/river sources where gravity feed is possible. This type of MUS has single water storage tank and a single distribution pipe line from which both domestic and productive water is distributed.

Double Tank Flow System

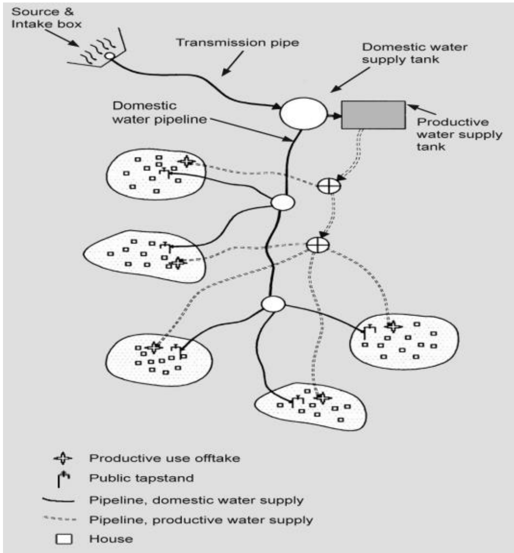
In case water availability is not sufficient throughout the year, a two tank and two separate line MUS system is built to ensure regular domestic water supply even in the dry season. Where the water flow is greater than the assessed need but less than 1.5 times the demand, such a system is recommended. This type of MUS have two separate water storage tanks – one for domestic and another for productive (irrigation) uses. The domestic use tank is filled directly from the source water, while the irrigation tank is filled with the overflow from the domestic tank. The distribution is made from two separate pipelines. Domestic outlets/ tap stands are located near houses, and irrigation tap stands are located in the irrigation fields of landowners. This type of MUS can be built using water from a spring, stream/river or pond/lake source and uses both gravity fed and water lifting systems.

Multiple Tank System

When a water source supplies just enough to meet designed demand, a multiple tank system design is followed. This is also called an intermittent flow system. This is similar to a single flow system with a single large tank and distribution pipeline, supplemented with individual household storage tanks, but with water distribution controlled throughout the year. Based on a community developed schedule, household tanks are typically filled on a turn-by-turn basis. This type of system can be designed for rainwater harvesting, spring, ground water, and stream/river sources. Gravity fed and water lifting methods can be used. In an intermittent flow system individual households typically have a storage tank for better control and management of water.



MUS layout for single tank or intermittent flow system



MUS layout with double tank flow system

(Source: iDE)

2.3 MUS selection criteria

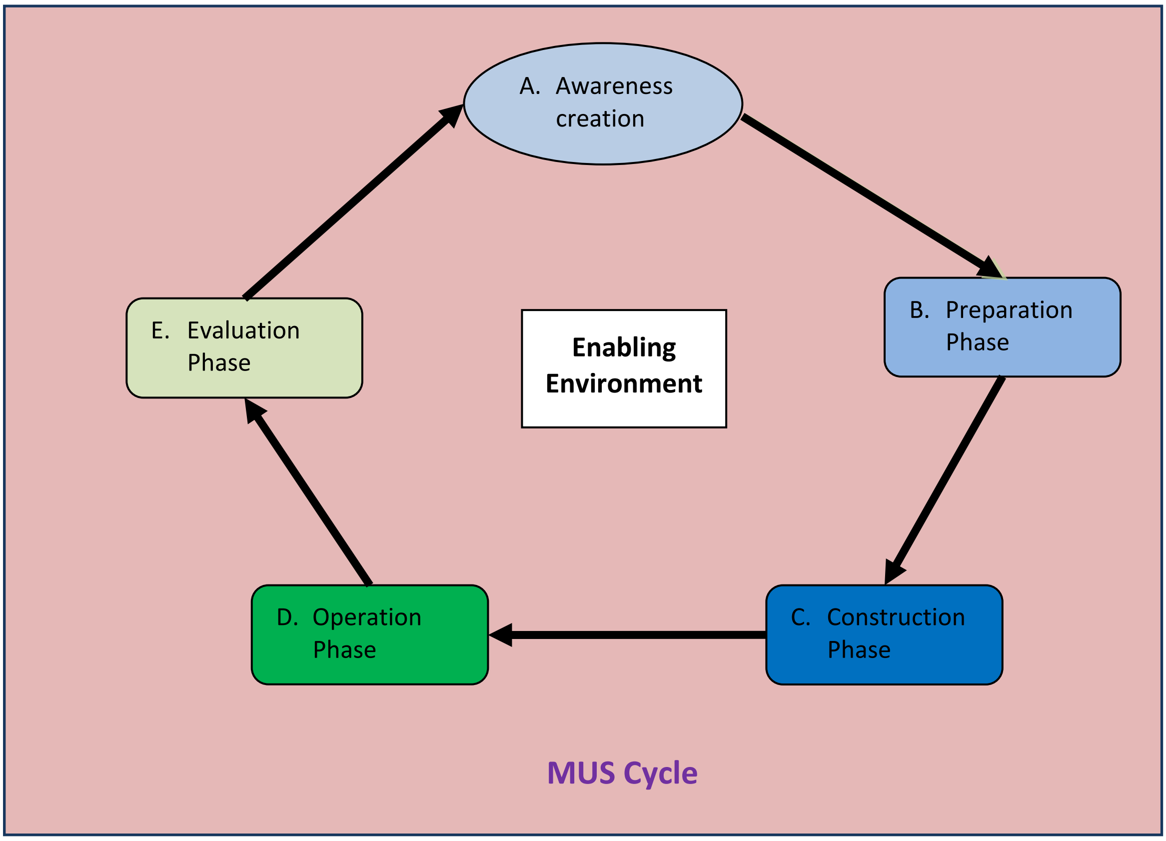
The following criteria should be met for successful development of a new MUS:

- Water discharge should be above 0.1 liter per second
- Water should be sufficient to meet 45 liters per day per person for domestic use and 640 liters per household per day for productive use
- The number of beneficiary households in a cluster should be 15 to 80
- Community should be willing and commited to contribute cash, labour and local materials
- Community should be willing to form an inclusive management committee
- Distance between water source and community should be less than 4 km for gravity-fed system and less than 100s meter for lift system in the hills; water table for groundwater system in the terai should be less than 100 feet
- All beneficiaries should be ready to contribute to operation and maintenance costs on a monthly basis, as decided by the users committee
- Community should be willing to adopt water-efficient application technologies for productive activities, such as micro irrigation technologies (e.g. drip, sprinkler irrigation system)

Chapter 3: MUS Planning and Implementation Process

3.1 Overview of MUS planning and implementation

MUS planning is a key factor for sustainable operation of water services. MUS planning will guide development of a streamlined process for design, construction, operation and evaluation. The MUS cycle shown below represents a set of activity and implementation planning steps for water service development. The MUS process is briefly examined below.



A. **Awareness Creation:** This phase informs people about the MUS approach. This helps potential beneficiaries to understand what a MUS is and how it differs from existing systems, how a MUS may benefit the community, the role of different stakeholders, service levels and the importance of MUS in the context of climate change. Support agencies like NGOs and CBOs play a major role in community mobilization to ensure that users understand their role and ensure their participation in the next phase.

B. **Preparation Phase:** This phase includes all preconstruction activities, such as: users committee formation, preparation of a MUS constitution (including a provision for a paid care taker, repair and maintenance fund mechanism, long term management and operation strategies), opening a bank account, action plan development, prefeasibility, engineering survey, design and cost estimation, related project appraisal, financial resource management and agreement with service providers. The community will lead these processes and activities with support/facilitation from a support agency. The support agency is responsible for the survey, design and cost estimate for the system. Local NGOs/CBOs are trained to undertake survey and design activities.

C. **Construction Phase:** This phase starts with collection of local materials and purchase of external materials. Construction starts from the intake, transmission pipe line, storage tank, and distribution pipe line followed by tap stands. Finally, all structures are tested. Responsibilities of stakeholders are defined according to an agreement signed during the preparation phase. It is common for the community to lead collection/procurement of materials and construction and monitoring, whereas the support agency provides external materials.

D. **Operation Phase:** After completion of MUS construction, the community develops operational guidelines including provision of repair and maintenance funds. According to the MUS constitution developed in the preparation phase, they will nominate/hire a caretaker for smooth functioning and to ensure consistent operation of the MUS. Training of different types is also a key to the MUS process. The major trainings, provided by the support agency, include operation and maintenance, record keeping, source protection, micro-watershed management, use of micro-irrigation technologies, high-value crop production, and market linkages. Users committees are trained as part of this MUS process.

E. **Evaluation Phase:** Regular monitoring of the system operation and functionality of water system is done by the MUS community/users committee as per the operational guidelines. Performance evaluation is carried out by both the community and the support agency. The support agency's evaluation is based both on performance of the system and functioning of the users committee.

Enabling Environment: Different stakeholders are involved in the MUS process. The community leads the MUS process, and the support agency facilitates each phase of the MUS process, backstopped by the key stakeholders involved. Linkages, coordination and partnership between the state and non-state actors/ stakeholders at the local level create an enabling environment for MUS. DDC, VDC and DADO are the key state authorities on MUS, whereas the I/NGOs are the major relevant non-state agency actors. State actors create the platform and thus an enabling environment for MUS at the district level.

The table below shows the role of different actors in MUS process.

SN	Activity	Users group	Executive Committee	Construction Committee	Support Agency	VLO	Funding Agency
A	Awareness/ Orientation on MUS	SR	NR	NR	MR	NR	NR

SN	Activity	Users group	Executive Committee	Construction Committee	Support Agency	VLO	Funding Agency
B	Preparation phase						
B.1	Users committee formation	MR	NR	NR	MR	SR	NR
B.2	Pre-feasibility study	SR	MR	NR	MR	SR	NR
B.3	Engineering survey	SR	SR	NR	MR	SR	NR
B.4	Detailed design and cost Estimation	SR	SR	NR	MR	NR	NR
B.5	Project appraisal	MR	MR	NR	MR	SR	NR
B.6	Financial resource management	SR	MR	NR	MR	SR	NR
B.7	Agreement with service provider and support agency	SR	MR	NR	MR	SR	MR
B.8	First public audit	MR	MR	NR	MR	SR	SR
B.9	Formation of Construction Committee/ sub committees	SR	MR	NR	MR	SR	SR
C	Construction Phase						
C.1	Material collection/ procurement	SR	MR	MR	SR	NR	SR
C.2	Construction	MR	MR	MR	SR	SR	SR
C.3	2nd/ Midterm public audit	MR	MR	MR	SR	SR	SR
C.4	Testing	SR	MR	MR	MR	SR	NR
D	Operation Phase						
D.1	Final public audit and project completion	MR	MR	MR	SR	SR	SR
D.2	Operational guideline preparation and operator selection	MR	MR	NR	SR	SR	NR
D.3	Capacity building	MR	MR	NR	MR	SR	SR
E	Evaluation Phase						
E.1	Performance evaluation	SR	SR	NR	MR	MR	MR

MR: main role, NR: no role, SR: supporting role

3.2 Awareness Creation / project initiation

The support agency organizes orientation on different aspects of MUS. This phase is critically important for community sensitization on MUS. The community is instructed in the MUS process to help them understand the multiple uses and benefits and to make them aware of ways in which MUS can help the community to adapt to the effects of climate change. Based on the orientation and willingness of the community, the MUS implementation process is initiated.

3.3 Preparation Phase

3.3.1 Users group formation

A community meeting is organized and a users committee is formed. The community selects the executive body based on the criteria describe in Chapter 4 - Social Mobilization Process. The executive body of the users group is inclusive in nature. This executive body is responsible for carrying out all activities in consultation with members of the users group. The support agency facilitates the community meetings. During this phase, the users group adopts a MUS constitution that includes guidelines on provision of a caretaker, maintenance and repair funds, and other management tasks. A sample User's Group Constitution that may require modification to fit the particular needs of each community is attached in Annex II, Format 4.

The user's committee will be responsible for:

1. Assisting the technical team during the engineering survey
2. Mobilizing user households to provide labor for scheme construction
3. Keeping records of the materials, income/expenditures and labor contribution
4. Supervision of the construction work
5. Nominating the water operator and the caretakers
6. Resolving social or technical issues related to the project

3.3.2 Prefeasibility study

With technical support from the support agency, the MUS Executive Committee will carry out a prefeasibility study of all potential sources. See Annex II, Format 1. The following information will be essential to guide this process:

1. Water flow at each source
2. Possible sitea for intake, reservoir tanks and tap stands.
3. Community willingness to contribute (cash and kind)
4. Social aspects of water sources: water conflict, source ownership etc.
5. Availability of local materials.
6. Feasibility for high value crops
7. Indigenous practices of water storage and utilization practices

A technical team (from the support agency) will assess preliminary information from the prefeasibility study and identify the most appropriate options. Based on the prefeasibility results, the water users group may decide on and make recommendations for a further detailed engineering survey.

3.3.3 Detailed engineering survey

The support agency will perform a detailed engineering survey upon the formal request of the users committee. The Executive Committee itself or an individual assigned by the Executive Committee will support the survey team. The survey team must be equipped with basic survey equipment as described below, such as an Abney level, measuring tap (minimum length 30 m), altimeter, stop watch, and five liter buckets. The following tasks and information should be performed/obtained in the detailed survey.

1. Locate existing water sources
2. Water discharge measurement (best period is April-May)
3. Calculate tentative water demand for domestic, productive and institutional need
4. Water quality testing
5. Identify possible areas of community contribution
6. Locate command area
7. Establish pipeline alignments
8. Ratification of identified location of intake, reservoir tank and tap stands
9. Elevation of strategic points: intake, reservoir tank, tap stand, etc.
10. Preparation of layout maps
11. Identify market areas and distance to reach markets

The technical team will prepare a detailed survey report based on the data collected. The detailed engineering survey mainly consists of determining elevations and alignments (also called “Reduced Levels” or RLs) of points along the proposed pipeline alignment and the proposed sites for the tank, tap-stands, off-takes and other system structures. The survey work begins from the source and works down towards the outlets (tap-stands and off-takes). Water discharge is measured and reassessed to determine if the volume available matches need. The location of the structures and main points along the alignment are marked on the spot with wooden pegs and clearly mentioned in the field book.

The detailed survey report consists of a project layout map showing the positions of prominent places such as the school, VDC office, religious places like temples, house locations and their elevations. The location of MUS infrastructure such as the intake, sedimentation tanks, reservoir tank(s), tap-stand posts, and off-takes, which were tentatively chosen during the prefeasibility study are ratified during the survey.

For small water systems an Abney level survey is commonly employed. However, there may be the need for conducting an auto level or theodolite survey for relatively complex and large systems.

Abney Level Survey

The instruments required for this type of survey include an Abney level, compass, range rods, measuring tape, and an altimeter.

The Abney level is the most widely used instrument to determine elevations in rural gravity flow water supply systems because it can be used in places with rolling or steep slopes and can give the accuracy of vertical angles up to 20 minutes. The survey conducted by the Abney level should be supplemented by leveling machines or the theodolite if the area is relatively flat.

Surveying Procedure.

1. In the ranging rod of the objective a prominent level mark is made equal to the eye level of the surveyor. This altimeter reading is set as the benchmark elevation
2. The vertical angle is measured by sighting the level mark
3. Using the compass, the horizontal angle is measured
4. The slope length is measured with the measuring tape
5. To determine the rise or fall from the surveyor's station, the following formula is used:

   $h = \pm (l \times \sin A)$
6. Elevations are computed by adding or subtracting the elevation of the previous station
7. Elevations are verified by the altimeter for every 20-metre difference of level.

Automatic level (Auto-level) Survey

This is the most accurate instrument to determine level differences. This is used in places of flat topography and areas where the highest accuracy is desired. Since MUS in Nepal has generally been implemented in the hills where the land is sloped, its use for MUS has been limited. However, it is used in critical sections where the slopes have to be measured very accurately. Compared to the Abney level survey, the auto-level survey is time consuming and labor intensive.

Theodolite Survey

Just like the auto-level survey, the use of the Theodolite survey is also not generally necessary in the hill areas. However, when needed, it is sometimes used to verify levels determined by the Abney level.

3.3.4 Detailed design and cost estimate

The detailed design and cost estimate is prepared base on the information collected from the engineering survey. The detail design and cost estimation report should have the following information.

1. Salient features
2. Water demand calculation: domestic, productive and institutional
3. Sizing of reservoir tank
4. Hydraulic/pipe line design
5. Cost estimation and rate analysis of different components
6. List of material required and purchase orders
7. Detail engineering drawing

3.3.5 Project appraisal

Detailed design and cost estimation is discussed with the users committee. In this meeting, the users committee and community should be well informed on the design criteria, technologies, and cost involved in the MUS. The committee will approve the design and cost estimation after incorporation of their feedback.

3.3.6 Financial resource management

The users committee takes the lead to generate matching funds/leverage for MUS construction. The support agency shall facilitate and link the users committee to potential donors to support construction. The agreement with stakeholders and users committee is made after reaching an understanding on resource sharing.

3.3.7 Agreement with stakeholders and first public audit

A public meeting is organized at the community level in the presence of the support agency and concerned stakeholders who agree to be part of the MUS construction. A formal agreement is developed with the users committee, support agency and funding partners. In this agreement, the role and responsibilities of all stakeholders should be clearly defined. The first public audit is to be carried out during this period, in which details of MUS construction including cost, materials and process are shared and discussed. The details of the public audit are described in Chapter 4. In the same meeting, a work plan is discussed and prepared. The support agency should help facilitate the public audit by the users committee.

3.3.8 Formation of Construction Committee and sub-committees

In the same public meeting, the users committee takes a lead role to form a Construction Committee and different sub-committees. All name lists of the committee and sub-committee members are listed in the meeting minutes developed for this public audit. The Construction Committee is responsible for overall management of construction whereas the sub-committees are responsible to carry out specific duties they are assigned. These sub-committees might include:

- Human Resource Mobilization sub-committee
- Account Sub-committee
- Procurement sub-committee
- Monitoring sub-committee

The support agency facilitates the formation of these committees. Details on formation of the Construction Committee and sub-committees are described in Chapter 4.

3.3.9 Preparation of Work-plan

Following the approval and agreement for the MUS scheme construction at the user committee meeting described above a detailed work plan for construction is prepared and signed by the representatives of the user committee, the support agency and other supporting organizations.

3.3.10 Collection of Fund for O&M and Micro-irrigation

Before the commencement of construction, a portion of the operation and maintenance (O&M) fund may be collected from beneficiaries. Depending on the size of the scheme, the upfront O&M cash deposit may range from Rs. 500 – 1000 per stand-post/off-take. It is suggested that at least 75% of the total beneficiary households should have committed to purchasing micro irrigation technology (MIT) – a drip or sprinkler kit. It is also suggested that every MIT user deposit a third to a half of the MIT system cost during the O&M cost collection stage. The user committee keeps the records of these deposits for transparency of contribution.

3.4 Construction Phase

3.4.1 Material collection/ procurement

The material management sub-committee is entrusted with the procurement and collection of materials. Materials are divided in two groups: local material, which includes stone, sand, gravel, clay, bamboo etc., and non-local (or external) materials, which include cement, iron rod, pipes and fittings, and mold/formwork. Timber can be local or external material depending on its cost and availability. The material management committee will collect local material and purchase external material maintaining the quality prescribed in the design report. The Construction Committee will develop procurement guidelines for maintaining transparency. The support agency must facilitate development of procurement guidelines. The construction materials and tools can generally be separated into two categories - manufactured and local. The main items under each category are given in the following table.

Manufactured Materials	**Local Materials**
Cement	Sand
Steel rods	Stone
Pipes	Gravel
Pipe and fittings	Dirt
CGI Sheet	Bamboo
Chicken wire mesh	

Manufactured Tools	**Local Tools**
Wrenches	Ladder
Dies	Buckets
Shovels	Ropes
Baskets	
Pigs	
Formworks / Jute bags	

3.4.2 Agreement between User Committee and the Contractor / Mason

In order to carry out construction the user committee, with assistance from the support agency, selects a contractor or lead mason and negotiates a contract. The contract states the clear responsibilities of each party, payment and work schedules. The representative of the support agency provides assistance in work schedule preparation and acts as witness to the agreement.

3.4.3 Construction of structures and pipelines

MUS are constructed with integration of different structures at different levels such as intake, reservoir tank, pipelines and water outlets. These are further linked to water application technologies such as micro-irrigation. These structures are installed under the leadership of the community with quality control from the support agency and concerned stakeholders.

Intake:

This is a structure built to capture water at the source. Depending on the type and quality of water sources, different types of intake can be constructed. The intake can have a single or double chamber. The size and design of the intake chamber is determined by the technical staff of the support agency. The intake helps to protect water contamination from runoff water and animals. It should be provided with a proper air valve and wash out and by covered by a concrete slab. It should also be protected by a fence.

Pipelines:

The pipeline has two main functions: transmission and distribution. Pipeline excavation work is done by the community with mobilization of beneficiary households by the technical staff of the support agency. First, the transmission pipe is laid, followed by the distribution pipes. The pipeline must be buried at least 90 cm below ground except in hard rock areas, and the excavation width varies from 40-60 cm. High-density Polyethylene pipe (HDPE) of Nepal standard is commonly used. In sections involving exposed sites and hard rock areas, galvanized iron (GI) pipe is used.

Reservoir tanks / storage tanks:

To maintain regular flow of the water supply, a reservoir tank/ storage tank is needed where the yield of water sources does not consistently match demand. The tank helps to regulate supply of water. Water demand in a community is typically high during morning and evening hours, while supply from water sources is typically the same throughout the day. Depending on the application of water for domestic and productive uses, different types of tanks may be used. Closed tanks can be used for both purposes, whereas open tanks can be used for productive use only.

For seasonally regulated systems both the Modified Thai Jar (MTJ) and Ferro-cement lined tank (FCL) are used for water storage. However, for continuous flow and year round controlled systems only the MTJ model is used. In such cases, more than one jar may be needed to meet the required storage volume. The necessary tank size is determined during the design phase and is dependent on the supply and demand of water at different times of the day. After calculating the volume of storage, the nearest larger standard size is chosen.

The tank site should be both technically and socially acceptable. It should be built on stable ground not prone to landslides and flooding and there should be good drainage of any overflow. Often, communities are proud of their tanks, so the tank location must be fixed in close consultation with the beneficiary households. It is recommended to build the tank as close to the village as possible to ensure better care in operation and maintenance. Suitable fencing has to be provided around the tanks for their protection.

Technical staff from the support agency will determine the size of the tank based on the water demand for domestic and productive use. Location of tanks is typically identified at the time of the feasibility study, and technical staff of the support agency lays out the tank at the time of construction. The tank location should be free from any type of community conflict. The storage tank should have overflow, wash out and an air vent. For a double tank system, overflow from the domestic water storage tank is collected in a productive water storage tank. It is better to construct reservoir tanks near the community to ensure their safety.

Water outlets:

An outlet is designed to deliver water for end-use application such domestic use and micro-irrigation use. Two types of water outlets are commonly used: 1) a drinking water tap stands and 2) an irrigation tap stands. Drinking water tap stands are designed to serve 4-6 households, whereas irrigation tap stands are typically installed at the center of a field to cover up to 2,000 m^2 (4 ropani) of land, depending on the type of crop, season, and type of micro-irrigation technologies used. Flow regulating valves are used to control water in each tap to maintain equal distribution. User committees determine the location of tap stands in consultation with technical staff of the support agency. The location should be free from any type of social conflict. The following basic criteria should be met for choosing outlets:

- Maximize equity in distance to households/ farms
- Stable ground
- Accessibility
- Drainage provision
- Social conflict free land or written permission from land owner if is located at individual lands

3.4.4 Second / midterm public audit

The users committee should organize at least one public audit during the construction phase. After the committee receives an advance from funding agencies/supporting partners and procurement of construction material, the public audit helps the Construction Committee to maintain transparency and to be more accountable on the project. The public audit can occur a few times (more than one) depending on the work in progress. For all public audits, the Construction Committee should invite the support agency and funding partners. Details of the public audit process are described in Chapter 4.

3.4.5 Testing

After the completion of the MUS, structure testing is carried out by technical staff of the support agency jointly with the executive body of the users committee. The following tests are performed:

- Discharge measurement of inlet point of storage tank and outlets. Discharge of outlet can be fixed by adjusting flow regulating valve
- Entire pipe line and structure joint observation to check leak points and make repairs as necessary
- Filling water in each structures and allowing it to run for a few days intermittently. After careful observation and making sure that system operates successfully, the pipe lines and structures are backfilled.

3.5 Operation Phase

3.5.1 Completion and final public audit

The Construction Committee organizes a mass meeting of beneficiaries in coordination with the users committee to report on the completion of the project. Before this process, the Construction Committee organizes a final public audit in the presence of all stakeholders and support agencies. After completion of the public audit and sharing of the completion report, the Construction Committee shares the detailed project report with the users committee. The support agency facilitates the public audit, completion ceremony and preparation of project report.

3.5.2 Operation and maintenance of system

The users committee will perform the following tasks upon completion of the project.

Selection of operator/caretaker:

The Executive Committee of the users committee selects a system operator/caretaker for daily operation of the system and for MUS care. The operator is responsible for controlling outlet flow, repair and maintenance of the system on a daily basis. The operator should be accountable to the users committee.

The operator is responsible to collect water fees as decided by the users committee. The users committee should prepare a water distribution schedule and provide it to the operator, who is responsible for maintaining the schedule afterwards. The users committee should establish the operator's fee and set the agreement in writing.

The criteria for operator selection is:

- Should be from among beneficiary households
- Should have knowledge of pumping and masonry work; priority should be given to people with formal training in such skills
- Should have permanent residence in the same community
- Should be literate
- Should be trusted by the community

Capacity building training:

The capacity building is important for sustainable operation of the MUS. The training and orientation is to be provided during the preparation and operation phases. Training is recommended in the following areas.

- Awareness creation
- GESI, public audit, right base approach
- Small scale watershed management and climate change impacts
- Bookkeeping/accounting
- Scheme operation and maintenance training
- Installation and operation of micro-irrigation technology

Details of various trainings are listed in Chapter 7.

3.6 Monitoring and Evaluation Phase

Quality work is important for future operation of the MUS. Monitoring is an important tool for quality control and should be carried out beginning with the preparation phase. The Executive Committee has an important role in monitoring work in progress internally. It is also recommended that funds be allocated for external monitoring at the time of project design.

Internal Monitoring System:

This is the monitoring mechanism to be conducted by the community itself. The users committee will form the monitoring committee. The monitoring committee is entrusted with checking the procurement process, bookkeeping system, quality of materials, work in progress, etc. The monitoring committee should not be members of the executive body and should be respected members of the community. The internal monitoring must be carried out on a regular basis.

External Monitoring System:

External monitoring is carried out by the support agency and funding partners. VDC representation in external monitoring will help develop ownership of the MUS project by the VDC and local bodies. This type of monitoring system is performed on an interval basis. It is facilitated by the support agency.

Evaluation:

The functionality of the MUS must be evaluated periodically both internally and externally. The internal evaluation is to be carried out by the users committee itself. Internal evaluation has to be carried out at least twice a year. The evaluation will analyze the achievements, success and failure factors of the MUS, i.e., whether or not the MUS delivers the results as designed. The support agency does the external evaluation. External evaluation includes socio-economic and institutional factors. External evaluation should be carried out at least once in the first year of operation and later depending upon availability of funds and need.

3.7 Water Quality and Safety

A Water Quality and Safety plan should be prepared for every MUS. This plan should be a holistic guideline for water quality standards, water resource protection and related measures.

Source protection on MUS:

MUS require clean spring sources. The design and construction of a MUS must account for preventing contamination. Protective measures at the intake is critically important for MUS for source protection. Intake design depends upon the type of sources from which water is tapped. It should be placed as far from landslide ares and geographically unstable areas as possible. Proper drainage must be provided surrounding the intake to prevent the source contamination. In majority of the cases intakes are a stone masonry structure constructed from locally available materials. A wing wall with boulder packing is provided around the intake as per the site condition. The intake is constructed in manner that will allow accesses for regular inspection, cleaning and operation. A strainer to prevent external materials from entering the system should be provided at the outlet pipe. A washout pipe should also be provided for cleaning/ flushing the intake and an overflow pipe is provided for spill over water. Both the overflow and washout pipe should be extended away from the intake structure to a suitable location. Access to the intake tank roof/ slab cover is required so that accumulated sediment and debris from screening can be removed. Two photos of a MUS intake works are provided below.

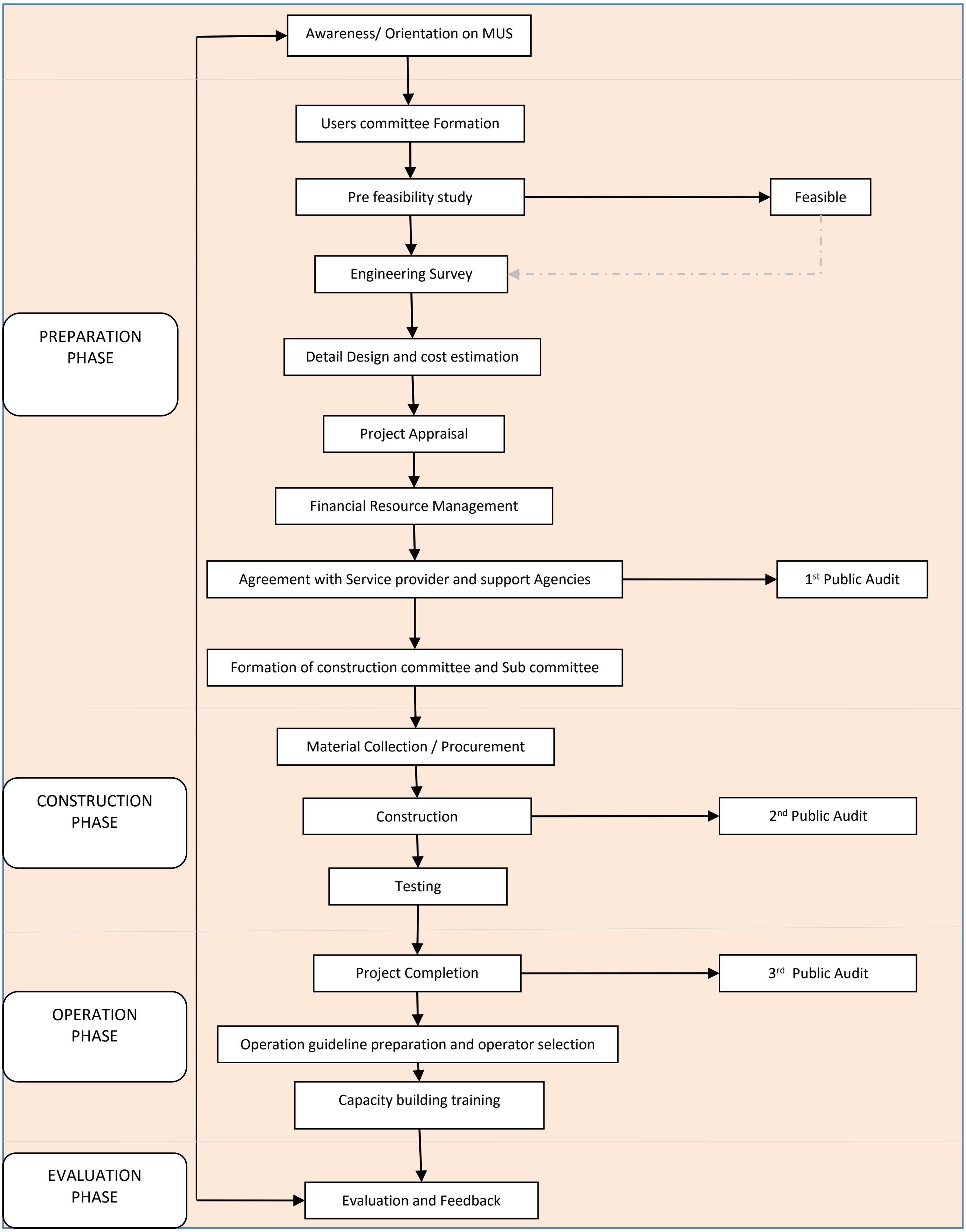

Protection principles (site specific):

1. No latrines are located within 30m upstream or downstream of a spring.
2. After opening up the area around the spring, the spring is protected with loose gravels/ stones and then a soil cover behind the small retaining wall.
3. The area around the spring should be fenced to prevent access by animals to prevent contamination.
4. If MUS does not fully utilize spring sources (leaving the environmental flow) overflow, water should be directed to an area outside the protection zone where the animals can take water, particularly in pastoral areas.
5. Constructing a cut off drain above the spring prevents contaminated water from entering or mixing with the spring water.
6. The spring box is cleaned out periodically. A paid care taker is trained for the correct maintenance of the spring inlet/ system.

Water Quality Testing for MUS:

iDE Nepal has recently initiated to test for water quality parameters using a simple, portable and low cost method developed by ENPHO. A junior technician or a person who has received simple training can perform the test. The cost of the quality test kit is about Rs. 20,000. Nine different water quality indicators (Temperature, Chlorine, Chloride, Ammonia, Ph, Iron, Hardness, Nitrate and Phosphate) are tested for. With the exception of the Coliform test which takes 48 hours, testing for the other indicators takes only about 30 minutes. This simple test kit provide only an approximate estimation of water quality, but this test method is considered an appropriate and practical method for rural water supply schemes that use safe and clean springs. Laboratory analyses are required for more accurate results. A detailed water safely plan/ framework developed by WHO is the most reliable guide for water safety plans and water quality standards, source protection and related measures. In certain situations, a plan that follows the WHO guidelines may be appropriate.

Flow Chart of MUS Implementation Process



Chapter 4: Social mobilization

Social mobilization is a process of empowering poor, women and excluded communities for inclusive social, cultural, economic and political development at individual, community and institutional levels. It is a method of creating positive change in livelihoods, literacy and community issues and helps to reduce conflict within and outside the community. Two types of social mobilization approaches[9,10] are generally practiced:

- **Transactional Approach:** This approach brings together members of the community in a group, which is then supported by a social mobilizer of the support agency. This group is responsible for delivering services and mobilizing financial and human resources. This approach uses analytical tools for group formation, which are a vehicle for service delivery, asset creation, savings & credit and skill creation etc.
- **Transformational Approach:** This approach focuses on empowering all citizens to engage with the state, building their capacity to express their views to influence policy and development programs and to make local government and service providers accountable to citizens. This approach helps citizens to understand their social, economic and political situation through their own analysis.

The Transactional Approach to social mobilization is followed for MUS, and the support agency has a crucial role in its implementation.

4.1 Users Group Formation

Community members are joined under the umbrella of a users group in order to lead implementation in planning, preparation, construction and operation of MUS. The support agency facilitates a public meeting within a community of beneficiaries, and all beneficiaries are considered members of the users group. The users group selects an Executive Committee to oversee regular tasks. The criteria for formation of the Executive Committee include:

- There should be 7 to 9 total member of the Executive Committee, including a Chairperson, Vice Chairperson, Secretary, Treasurer and 3 to 5 members.
- The committee should have at least 50% representation from women in the community.
- Women should be appointed in two key positions:

[9] LGCDP, 2009, Social mobilization Guideline

[10] Rural Reconstruction Nepal, 2012. Social Mobilization in Practices, Ways of Empowering People for Enhancing Development Effectiveness, Reflections from Community Support Programme (CSP-II)

    - One should be chosen as Chairperson or Secretary,
    - And one should be Vice Chairperson or Treasurer
- The committee should be inclusive and reflect diverse ethnicities and marginalized social groups within the beneficiaries' community.

The Executive Committee is responsible for calling 4 meetings of the users group each year. During the meeting, the Executive Committee presents reports on income and expenditures, problems and concerns. The users group ratifies the reports from the Executive Committee and provides advice to help them to overcome problems and ensure a clear future direction. The roles and responsibilities of the user group, the Executive Committee and the various sub-committees should be described in detail in the User Group Constitution.

4.2 Construction Committee and sub-committee formation

A Construction Committee and various sub-committees are formed by the users group and the Executive Committee after initiation of the preparation phase. These might include:

- Construction Committee
- Human Resource Mobilization Sub-committee
- Account Sub-committee
- Procurement Sub-committee
- Monitoring Sub-committee

Construction Committee: The Construction Committee prepares an enabling environment for MUS construction and leads the process. The users group can decide to allow the Executive Committee to function as the Construction Committee, or to form a separate Construction Committee. The formation of the Construction Committee should follow the committee formation criteria as described in Users Group Formation, above. When the Construction Committee is distinct from the Executive Committee, this Construction Committee should be accountable to the users group and Executive Committee.

Human Resource Mobilization Sub-committee: This sub-committee mobilizes users for project work, both paid and unpaid labor. It should be formed under the coordination of one member from Executive Committee. This committee is formed at a public meeting of the users group and should have at least 3 members. Two members should be from among the beneficiaries.

Account Sub-committee: This sub-committee is entrusted to maintain the records of income and expenditures of ongoing construction work. This committee keeps all records of payment made for materials, skilled and unskilled labor as well as income and funding support received from different partners. This committee works in close coordination with the procurement and human resource mobilization sub-committees. The Account Sub-committee is coordinated by the Treasurer of the Construction Committee and as 3 members. The remaining two members are selected from the users group.

Procurement Sub-committee: This sub-committee is mandated to procure and manage local and external material, ensuring the regular supply of materials needed for construction work. It may maintain the records of all materials purchased and used on MUS construction. The committee should have 3 to 5 members, as decided at a meeting of the users group and should be led by a representative of the Construction Committee.

Monitoring Sub-committee: This sub-committee is responsible for internal monitoring of work in progress and provides feedback to the Executive Committe. The committee verifies progress against the work plan and makes suggestions for improvement. This committee should have at least three members and have representation from respected and trusted people in the community as well as the Coordinator of the Ward Citizen Forum (WCF) of the VDC. This committee can also play an advisory role.

Except for the Monitoring Sub-committee, all other sub-committees are accountable to the Construction Committee. Each sub-committee should be inclusive and have 50% participation by women. All of these committees submit their reports during a public audit. The support agency facilitates the formation of the Construction Committee and sub committees.

4.3 Preparations of operational guidelines and source registration

The Executive Committee of the MUS users group is entrusted with preparation of operational guidelines. The guidelines help the MUS to run systematically and sustainably. The support agency provides input into the operational guidelines. The guidelines should cover the following details:

- Background
- Objectives
- Function of users group
- Membership and its criteria
- Formation process of Executive Committee
- Roles and responsibility of Executive Committee
- Formation process of sub-committees and their roles and responsibilities
- Establishment of operation and maintenance fund
- Operating system of MUS

- Fee and penalty system
- Half-yearly and annual meeting

As per the privilege rules, the Executive Committee is responsible to register the water source with the relevant authorities (VDC, DDC) before MUS construction and operation.

4.4 Public audit

MUS public audits are the process of assessing the effectiveness of the MUS construction and operation. This approach enhances the transparency and accountability of the development intervention. It ensures that marginalized and excluded communities are empowered, resulting in active participation of members in planning, implementation and operation of the MUS project. The Executive Committee is responsible for organization of public audits; the support agency facilitates organization of public audits in a timely manner.[11]

During MUS construction and project implementation, public audits are carried out in three stages:

First Public Audit:

The first public audit is conducted at the time of agreement with all the stakeholders. All members of the users group, other stakeholders and VDC representatives are invited. The objectives of the first public audit are:

- To inform the users and stakeholders about the project
- To share information about the implementation process and working modalities
- To share information on estimated costs and the roles of different stakeholders, and on the agreement to be signed with the stakeholders and funding partners
- To prepare an work plan.

Midterm/ Second Public Audit:

This public audit is organized at the mid-point of the work in progress. The Executive Committee has a crucial role in organizing the public audit. The Executive Committee or Construction Committee (if different from the Executive Committee) presents a progress report on income, expenditures, material stock details, and progress against the work plan in this meeting. This public audit is very important and should be made participatory and interactive. All stakeholders and funding partners are invited. The objectives of this audit are:

- To present progress made during the period

[11] Rural Reconstruction Nepal, 2012: Public Audit: Ways of Enhancing Development Effectiveness, Reflections from Community Support Programme (CSP-II)

- To inform stakeholders about funds received and expenditures made
- To share information about material procurement process and quantity
- To interact with stakeholders about problems and issues faced, and to find solutions in a collaborative manner and collect feedback for improvement.

Final Public Audit:

This public audit is carried out after the completion of the MUS project, when the Construction Committee transfers all operational tasks to the users group. All stakeholders, including VDC representatives and key persons from the VDC are invited. The final public audit is organized:

- To present the final progress report
- To present final figures for actual funds received and expenditures made
- To discuss lessons learned during the process
- To discuss the sustainability of the project and continued operation of the MUS.

The Executive Committee organizes public audit event, and the support agency facilitates it. The Construction Committee is responsible for presentation of all reports, agreement documents, income and expenditure details, information about the procurement process, and installation of the project information board at the project site.

4.5 Operation and maintenance fund

The effective and sustainable operation of MUS is only possible once it is properly managed and operated by the users committee. An operation and maintenance fund is established to ensure its sustainability. The users group must decide on the size and nature of this fund, including the amount to be collected on a monthly basis. This fund should be maintained and managed separately by the Executive Committee in a bank or other institution as decided by the users group. The fund can be used to pay monthly wages of a system operator/caretaker and to repair the MUS as needed. All details of income and expenditures are presented during a regular users group meeting on a quarterly basis. The users group may decide to establish seed money to set up the repair and maintenance fund prior to the inception of construction work on the MUS.

Chapter 5: MUS / Technology Combination

5.1 Technology

MUS are water systems designed to meet both domestic and productive requirements of users based upon need and demand. The systems begin with source protection at the intake of the spring. Water is conveyed by gravity through plastic pipe to water collection tanks near the target village. MUS support livelihood improvement of communities vulnerable to climate change, therefore low-cost MUS options may be a particularly useful strategy to meet the needs and requirements of smallholder farmers. Infrastructure and technology described below are environmentally friendly and have not been observed to have significant adverse impact on the environment. MUS infrastructure includes intake, reservoir tank, water outlets and application technologies.

5.1.1 Intake

Intake is a structure constructed to tap water at the source. It protects source water from surface runoff contamination, deters animals encroaching and protects the source from erosion and damage. Two types of intakes are commonly used based on quality/turbidity of water:

- **Single Chamber:** Where source water is comparatively clean, single-chamber designs are the most economical and simplest option. A screen filter is fixed inside the chamber where it meets transmission pipelines. The size of the chamber is determined according to water availability at the source(s).
- **Double Chamber:** A double-chamber intake is used where water is turbid or has debris. In the first chamber, debris settles, and filtered water flows to the second chamber and then from there to the reservoir tank.

The intake is built from stone/brick masonry. Appropriate plastering should be done on both faces, inside and outside of the chamber, with RCC cover. Intakes should be provided with washout and air vents for smooth water flow and must be cleaned periodically.

Technical staff from the support agency should design the intake. The Construction Committee is responsible for the construction as suggested by the support agency. Quality monitoring is the responsibility of the support agency.

5.1.2 Pipelines

In the transmission section of the system, pipelines are used to bring water from the source to the reservoir tank. The distribution section distributes water from the reservoir tank to the water outlets. Two different types of pipe are used depending on project requirements: High Density Polyethylene pipe (HDPE) and Galvanized Iron pipe (GI Pipe). HDPE pipes are commonly used in rural water supply systems. A pipe trench of 90 cm depth and 40-60 cm width has to be excavated for laying pipe, which is in standard sizes of 63, 50, 40, 32, 25 or 20 mm. These pipes are available in 10, 6 and 4 Kg/m^2 pressure, meaning that the pipe can withstand pressure head up to 100, 60 and 40 meters respectively. HDPE pipe should be buried at least 90 cm below ground level for protection. GI pipe are used in exposed areas such as over hard rock and at water outlets. The GI Pipe is also available in three qualities: light, medium and heavy, based on weight, and different colors are marked on the surface of pipe: yellow (light), blue (medium) and red (heavy). At minimum, medium quality pipe should be used for MUS.

Technical staff from the support agency must carry out a level survey for determining level of ground and distance. The technical staff from the support agency is responsible for carrying out the survey, hydraulic design and recommends the sizes of pipe to be used at different stages.

5.1.3 Reservoir tanks/storage tanks

The Reservoir tank, also known as storage tank, is the main structural component of the MUS. The storage tank is used for water storage and distribution. There are different types of storage tanks used for MUS construction. Some storage tanks are used for both domestic and productive use, and some can be used only for productive use. The domestic-use storage tank is covered to prevent external contamination. The different storage tanks that can be used in MUS are discussed below.

Modified Thai Jar (MTJ)

This is a jar-type storage tank designed by iDE Nepal. The tank is available in three different sizes: 1,000, 1,500 and 3,000 liters. The 1,000 and 1,500 liter MTJ is appropriate for individual use, whereas the 3,000 liter jar is for community use. Drinking water can be stored in a MTJ. The technology is simple, but trained, skilled masons and iron molds are needed for the construction. The construction cost ranges from Rs 7 to 8 per liter.

Thai Jar

Ferro-Cement Tank (FCT)

Ferro-Cement Tank is a semi-underground tank designed by DWSS. The tanks may be constructed in sizes ranging from 1,000 to 20,000 liters. The tank is simple in construction, but a skilled, trained mason is needed. Larger capacity tanks above 10,000 liters can be used for both domestic and irrigation use. The cost-per-liter capacity ranges from Rs 7 to 9.

Ferro Cement Tank

Ferro Cement Lining (FCL) Tank

Ferro-Cement Lining (FCL) Tank

This is an underground tank constructed using ferro-cement technology. The FCL is designed by iDE Nepal and can have 6,000 or 10,000 liters storage capacity. Such tanks can be constructed up to 20,000 liters, but these must be designed separately. The tank is open and useful only for productive uses (irrigation). A trained skilled mason is needed for the construction. The per-liter cost of the tank ranges from Rs. 5 to 8.

Plastic Pond

The plastic pond is a low-cost productive (irrigation) use option. A wide range of water storage capacity ponds can be constructed. The minimum economical size is 10,000 liters, but they can go up to 100,000 liters or even larger. Silpaulin plastic, minimum 250 GSM, is recommended for the plastic pond. The life of the plastic is expected to be at least 5 years, but this largely depends on the safety/ treatment process followed in preparation of the pond. It can be locally constructed by users after a very basic orientation in the construction process. Such a pond is used to store rain, stream/river and spring water. The construction cost of a plastic pond ranges from Rs. 3 to 5 per liter capacity. Water can be accessed through an outlet or by siphoning.

High Density Polyethylene (HDPE) Tank

HDPE tanks are manufactured by industry and are used for storing water at the individual and community level. These tanks are available in different storage capacities such as 500, 1,000, 1,500, 2,000, 5,000 or

10,000 liters. The smaller tanks are for domestic use, whereas 10,000 liter tanks can be used for both domestic and productive uses. The cost ranges from Rs. 10 to 12 per liter. These are easy to use and install.

HDPE

Cement Tank

Cement Tank

This tank can be constructed using a stone or brick wall, cement-plastered from inside. The size of the tank is based on the water demand. Both closed and open type tanks can be constructed using this technique, with closed tanks used for drinking water supply and open tanks for productive use. The cost of tank depends on the raw material, transportation and geographic location.

The table below shows each of these tanks and its possible application.

Tank	Available Capacity (liters)	Application	Ownership	Location	Water Source	Delivery system	Technical support requirement
Modified Thai jar	1000, 1500, 3000	Domestic	Individual, community	Terai, Hill, Mountain	Spring water, Stream/river, Rain water, ground water	Gravity fed, Lift system	Skilled mason for construction, Technical staff for monitoring
Ferro-cement Tank	1000 – 20000	Domestic, Above 6000 liter - domestic and productive	Individual, community	Terai, Hill and Mountain	Spring water, Stream/river, Rain water, ground water	Gravity fed, Lifting system	Skilled mason for construction, Technical staff for monitoring
FCL	6000 and 10000	Productive	Individual, community	Hill and mountain	Spring water, Stream/river, Rain water, ground water	Gravity fed, Lift system	Skilled mason for construction, Technical staff for monitoring

Plastic Pond	10000 liter and above	Productive	Individual, community	Terai, Hill and mountain	Spring water, Stream/river, Rain water, ground water	Gravity fed, Lift system	Self construction with basic orientation
HDPE Tank	500, 1000, 1500, 2000, 5000, 10000 liters	Domestic use, 10000 liter – domestic and productive	Individual, community	Terai, Hill and mountain	Spring water, Stream/river, Rain water, ground water	Gravity fed, Lift system	Self installation with support from semi skilled mason.
Cement Tank	Design Base	Domestic, productive	Community, Individual	Hill, Mountain	Spring, stream, river, rain water	Gravity fed, lift system	Skilled mason with technical support from support agency.

These tanks should never be left empty; at least 1/4 of the tank should always be submerged, otherwise cracks will form in MTJ, FCT and FCL tanks, plastic will be damaged and the life of the tank will be reduced. Each tank should have a provision for an air vent and washout. All tanks should be cleaned periodically.

5.1.4 Water outlets

Different types of water outlets and tap stands are installed for domestic and productive purposes. Domestic tap stands are shared by 3-5 households, as determined based on the distance of the households to the tap. Irrigation taps, shared by 3-4 households., are designed for MIT use in small farm plots and irrigate about 2,000 square meters of land. Where a farm plot is near the houses, a domestic tap can supply water for micro-irrigation use. Such a provision is arranged in a multi-tank intermittent flow system MUS. The cost of a domestic tap stand ranges from Rs. 8,000 to Rs. 12,000 and irrigation outlets range from Rs. 5,000 to Rs 8,000.

The photographs below show the different types of tap stand.

Irrigation Offtake

Domestic Tap Stand


Drinking Water Tap Stand

5.1.5 Micro-irrigation and water lifting technology

Micro irrigation technology (MIT), primarily drip systems and sprinklers, are utilized for end-use application with MUS to irrigate small vegetable plots. These MIT enable MUS users to use limited water effectively and efficiently for agricultural production.

Drip Irrigation System

Drip irrigation is an efficient and effective irrigation technology suitable for water-scarce areas and for use on porous soil or unleveled land, where conventional irrigation is not possible. This technique applies water slowly over time directly to the root zone of plants. The available sizes of drip systems range from 90 to 2,000 square meters. Larger sizes may also be constructed. During watering, 90 m^2 drip irrigation system consumes a minimum of 200 liters of water per hour. Drip installation technology is relatively simple and can be installed after a short orientation by end-users. The benefits of drip irrigation system include the following:

- More crops irrigated with less water
- Time and labor savings
- Reduced weed growth
- Simple technology to install, operate and maintain
- Low investment with high returns
- Feasible for all types of land and soil
- Possibility of fertilizer application with irrigation water

Sprinkler Irrigation System

Sprinkler irrigation is a method of irrigation by which water is sprayed on the land surface in the form of artificial rain. To create the precipitation, water under pressure is ejected through the nozzle of a device called a sprinkler. Sprinkler irrigation systems are available in various designs and irrigation capacities. A wide range of sprinklers are available in the market. A single sprinkler head can irrigate a minimum of 25 m^2 of land at a time and consume 70 liters of water per hour.

Benefits of sprinkler irrigation, compared to traditional methods, include:

- Simple to install, operate and maintain
- Achieves more irrigation coverage with less water application due to light precipitation
- Effectively reduces problems of soil erosion and plant damage
- Low-cost and durable
- Effective on flat or sloped land

5.1.6 Different lifting MUS applications

Lifting MUS are planned for and designed when water sources are located below the community. The primary lifting options for MUS are electric pump, solar pump and Hydraulic Ram pump. The selection of each of these technologies is determined according to the water demand, available water at the source, available budget, energy access and availability and community preference.

Electric Pump

Electric pump is a water lifting technology available in a wide range of power supply systems from 0.5 HP and above. Different model pumps are available, including Centrifugal pump, Jet pump, Submersible pump etc. These pumps have different lifting capacities and characteristics. The electric pump is feasible where water lifts from underground sources, ponds, streams/rivers or springs and where there is an electric power supply. The 0.5 HP electric pump with a ½" outlet can deliver 40 liters of water per minute and lift up to 30 meters. The discharge is varies in capacity and height to delivery. The multi-stage lifting option should be utilized when the head is above 100 m. Technical support from the support agency is necessary for design of the water lifting system.

Electric Pump

Solar Pump

Solar pump is a water lifting device using photovoltaic (PV) solar-powered electricity. This pump is appropriate where solar panels receive abundant solar light in most months of the year. It is a reliable water pumping system, requiring a high initial investment of Rs. 15,000 to 20,000 per meter of lifting. During monsoon and cloudy days, flow from the pump is reduced but sufficient to meet domestic need. The capacity of a solar pump is determined based on water need and lift height. The technology is appropriate for mountains and hills where water sources are available below the community. It can lift water from any type of surface water source.

Hydraulic Ram Pump

The Hydraulic Ram pump (Hydram) is an environmentally friendly water lifting technology. This pump does not need external energy to operate. It uses the energy from water flowing downhill, with a drop of a few meters sufficient to lift water to a greater height. The pump can deliver 1000 to 100,000 liters of water per day up to 200 m above the source. This type of pump can be used for filling a MUS storage tank from different water sources. The lifted and stored water can be used for domestic purposes, irrigation and income generation activities. The technology is simple and inexpensive to install and maintain and requires no regular operating cost.

Hydraulic Ram

Solar Lift System

The table below shows the application of micro-irrigation and water lifting technologies.

Micro-Irrigation Technology

Technology	Ownership	Location	Water Feeding System
Drip Irrigation system	Individual	Mountain, Hill, Terai	Gravity fed, Pressurized
Sprinkler system	Individual	Mountain, Hill, Terai	Gravity fed, Pressurized

Water Lifting Technology

Technology	Ownership	Location	Water Source	Application	Remarks
Electric Pump	Individual, community	Terai, hill, mountain	Groundwater Spring, stream/ river, pond	Domestic and productive	Drip and sprinkler irrigation directly coupled with electric pump and can be used for irrigation in terai
Solar Pump	Community	Hill, Mountain	Stream/ river, Spring	Domestic and productive	
Hydraulic Ram Pump	Community	Hill , Mountain	Stream/ river, Spring	Productive and domestic	Except drinking

Chapter 6: Cross-Sector Linkage of MUS

6.1 MUS and commercial agriculture

A key benefit of the MUS approach is the increased income from agriculture and other water-based household enterprises. The increased income enables MUS users to raise funds to compensate a paid manager and maintain a reserve fund for maintenance and eventual system replacement. The increased income also gives strong incentives for users to maintain proper management of the system.

In order for MUS households to increase income from commercial agriculture, they need good access to agricultural value chains for inputs and technologies; similarly, marginal rural agriculture systems benefit from regular and reliable access to water for irrigation. Therefore, either MUS should be located where commercial agriculture value chains are present, or concurrent agriculture development programs should link value chains to MUS development. It is also important that MUS households receive agricultural training on high-value commercial crops utilizing micro irrigation technologies for water efficiency.

Agricultural value chains include local access to input supply systems that market appropriate agricultural inputs (seed, fertilizers, IPM products) and equipment (micro/drip irrigation, greenhouses, etc.). This may be through community-based sales agents that also provide information, training and backstopping to their customers along with the sales of inputs and equipment. MUS communities also need good access to markets, and in an ideal situation, there is a rural agricultural collection center located close to the MUS community.

Collection centers provide access to markets for smallholders and also provide important services including development of cropping calendars with detailed recommendations for climate smart agriculture utilizing the expertise of the government agriculture extension services, the private sector, and traders to identify commodities that are in demand.

Collection centers managed by member elected marketing and planning committees (MPCs) are also in a position to assess overtime the impacts of climate change and to seek out technical solutions with government, private sector, and development stakeholders. Collection centers also facilitate access to government services and expertise like plant protection, facilitate access to credit and insurance for members, and reduce the transaction costs of reaching smallholders with information they need.

There are strong synergies between collection centers and MUS. MUS increase the volume of production and enable production through the dry season, making collection centers profitable and sustainable year round. Collection centers can also play a key role in identifying and assisting to organize members to develop MUS systems.

6.2 Micro-irrigation, agriculture & rural markets

Development of small water resources for smallholder farmers does not have significant impact on the livelihood of poor unless they are linked with appropriate irrigation tools and market access to sell produce. Farmers with water access from MUS are recommended to use micro-irrigation technology in order to enable farmers to increase vegetable production and income. Trainings on micro-irrigation use for high-value vegetable production enable farmers to profitably grow both seasonal and off season vegetables. MUS beneficiaries frequently belong to marginal groups with low income and resources and may be especially vulnerable to the shocks and stresses of climate change. Capacity building training on market driven vegetable production, including linkage to rural markets through vegetable collection centers, helps to increase the long-term sustainability of MUS.

6.3 Water supply, sanitation, health and hygiene (WASH)

Access to safe drinking water and sanitation are considered basic human needs and are fundamental to health improvement, growth and development. A large proportion of people in Nepal lack access to these vital services. According to reports, only 75% of the population has access to safe drinking water from an improved water supply. Women spend significant amounts of time and effort carrying water for domestic purposes, which deprives them of time for other activities.[12]

By increasing water access for each household to meet their daily multiple water needs, MUS can have a substantial impact on WASH and support the national total sanitation campaign. Improved and reliable water access helps to meet five basic criteria for total sanitation: using a clean toilet, proper hand washing

[12] GC, Raj Kumar (2013), iDE Nepal, A Project Completion Report for SOLAR MUS I.

practices, access to safe drinking water, maintaining personal hygiene, and liquid and solid waste management. Access to clean drinking water reduces water-borne diseases, and MUS for domestic use delivers tested, clean water directly to the community. In addition, MUS reduces water fetching time for women, girls and children.

6.4 Health and nutrition

MUS are designed to provide sufficient water to allow vegetable production in a home garden or for commercial production. Vegetable production increases farmers' regular consumption of nutrient-dense vegetables, and dietary diversity is associated with better maternal nutrition and household food security. MUS is, therefore, expected to have a positive impact on health, particularly for pregnant women, girls and children. Availability of clean water directly reduces incidence of water-borne disease such as diarrhea, dysentery, typhoid, jaundice etc., resulting in a reduction in medical expenses. Lower rates of water-borne disease are also associated with improved nutritional outcomes due to reduced enteric dysfunction.

Chapter 7: Capacity building training on MUS

Before and after implementation of a MUS project, different orientations and trainings should be provided to users groups and committee members on sustainable operation of MUS. The support agency will have a key role in providing the recommended trainings listed below.

Training Details	Target group	Duration	Training Period
MUS Orientation	Users group members	½ day	Prior to preparation phase
Gender equality and social Inclusion	Users group members	2 days	Prior to preparation phase
Public audit	Executive and Construction Committee's members	1 day	Preparation phase
Book/account keeping	Executive and Construction Committee's members	½ - 1 day	Preparation phase
Scheme operation and maintenance	MUS operators and masons	2 days	Operation phase
Small watershed management	Users group members	1 days	Operation phase
Micro-irrigation installation and operation	Users group members	1 day	Operation phase
Group management and leadership development	Users group members	1 day	Operation phase
Sanitation and health	Users group members	½ - 1 day	Operation phase
On- and off-season vegetable farming*	Users group members	5 days	Operation phase

* Seasonal and off-season vegetable farming training should be provided on a modular basis for nursery raising, production technology, composting, post-harvest processing, and marketing.

Chapter 8: Mainstreaming of MUS in WUMP, LAPA and Local Level Planning

A Water Use Master Plan (WUMP) is an integrated water resource development plan at the VDC level. This participatory process involves identifying, planning and utilization of water sources. In WUMP, the nature of each water source and its possible uses are identified jointly with community and VDC personnel. The WUMP categorizes water sources into single and multiple uses. MUS should be developed according to recommendations of the WUMP. For this to occur the support agency must coordinate with VDC and relevant stakeholders.

A number of VDCs across different development regions have already prepared a Local Adaptation Plan of Action (LAPA), and some are in progress. LAPA helps vulnerable communities, women and children to prepare a plan of action to develop adaptive capacity against the effects of climate change. During the preparation phase of LAPA, communities should be made aware of the MUS approach and its benefits in improving incomes and livelihoods. MUS can be incorporated in LAPA plans in order to address multiple water needs in terai, hill and mountain districts. It is widely reported that water sources are declining due to climate change impacts. Therefore, MUS is instrumental in tackling reduced water availability through improved water resources management.

The local level planning process requires participatory planning for VDC-level development activities. VDC's must complete planning activities as described in the Local Self Governance Act (LSGA). Only those activities recommended as a result of the planning process can be implemented or supported from development agencies. MUS seeking government support/funds must, therefore, go through the local level planning process. Likewise, MUS incorporated in WUMP and LAPA must also be endorsed by the DDC council. Mainstreaming of MUS in order to improve community resilience is necessary in these different planning processes to achieve wider scale-up of MUS across Nepal.

Annex I - References

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Annex II - Different Formats

Format - 1

Nepal Climate Change Support Programme (NCCSP)

Pre-Feasibility Study

Please tick or explain briefly

Proposed Scheme Name:

Scheme System	☐ Gravity	☐ Pressure
Scheme Type	☐ New	☐ Rehabilitation

1. General Information

1.1 Location

District

VDC, Ward

Village

1.2 Access

Roadhead (km)

Nearest market (km)

1.3 Labor availability	**Yes/No**	**If no, mention the place where it can be found**	**Rate (NPR)**
Skilled labor			
Unskilled labor			
Other			

1.4 Availability of construction material	**Yes/No**	**Place**	**Distance (km)**	**Rate (if needs to purchase)**
Sand				
Stone				
Aggregate				
Bamboo				
Wood				

Mud		Local	1	

2. Beneficiaries and Command area

2.1 Number of households/ Populations

SN	Caste/Ethnicity	HHs	Population		
			Male	Female	Total
1					
2					
3					
4					
	Total				

2.2 Public organizations (School, health post, ..) ____________________

2.3 Total command area (Ropani) ____________________

2.4 Command area for irrigation (Ropani) ____________________

3. Source Information

3.1 Name of the source ____________________

3.2 Type of source ____________________

3.3 Source yield (lps) ____________________

3.4 Safe yield (lps) ____________________

3.5 Date of measurement ____________________

3.6 Water quality ____________________

3.7 Source ownership (pvt/public) ____________________

3.8 Present use of source ____________________

3.9 Source catchment ____________________

3.10 Source disputes (if any) ____________________

4. Water Demand Information

4.1 Per capita daily demand (lpd) ____________________

4.2 Other institutional demand (ltr) ____________________

5. Source of Income

SN	Particulars	Household	Remarks

1	Agriculture / Livestock		
2	Wages labor		
3	Service/ Pension		
4	Remittance		
5	Other		
	Total		

6. Food Sufficiency

SN	Sufficiency period	Household	Remarks
1	Less than 3 months		
2	3 – 6 months		
3	6-12 months		
4	Food Secure		
	Total		

7. Consumption of Fresh Vegetable

SN	Consumption Period	Household	Remarks
1	Less than 3 months		
2	3 – 6 months		
3	6 -12 months		
4	Throughout year		
	Total		

8. Land Holding (High value cash crops)

SN	Area	Household	Remarks
1	Less than 1 Ropani		
2	1 – 3 Ropani		
3	3 – 5 Ropani		
4	5 Ropani and Above		
	Landless		
	Total		

9. Education

SN	Level	Household	Remarks
1	Illiterate		
2	Primary		
3	Secondary		
4	Graduate		
	Total		

Signature: _________ Surveyed by: Date: =

Format – 2

Nepal Climate Change Support Programme (NCCSP)

Field Survey Format

Source Name:

Scheme Name: **Discharge:** ________________________________

Location: **Date:**

Station		Ground Distance (m)	Vertical Angle (deg)	Vertical Height (m)	Reduced Level (m)	Remarks
From	To					

Note: Plz enclose a layout plan

Signature: ______________________________

Surveyed by: ______________________________

Date: ______________________________

Format - 3

Nepal Climate Change Support Project (NCCSP)

Household Tap Information

Scheme Name: ______________________________

Location______________________________

SN	Tap No.	Cluster Name / Locality	Name of House owner	Population			Land Holding (Ropani)		Remarks
				M	F	Total	Total land	for Veg Production	
1									
2									
3									
4									
5									
Total									
6									
7									
8									
9									
10									
Total									
11									
12									

13									
14									
15									
Total									
Grand Total									

Signature: ___________________________________

Surveyed by:

Date:

Additional formats

1.Facilities

Facilities	**Yes/ No**	**Distance from community (km)**	**Comments**
School			Primary ,secondary
Health Post			
Banks			
VDC Office			
Collection Centre			
Agri Input Supplier			
Micro-irrigation dealers			
Agro-processing mill			

II.Users willingness to Invest on Micro-irrigation

Willingness to pay for drip irrigation kits: Yes/NO.

Estimated amount for drip kits/ sprinklers HH: ………NPR

Source of funding for drip kits: Saving ☐ Loan ☐