An Asset Management Plan (AMP)

of the

Kalitar Water Supply System

Prepared by
Centre for Integrated Urban Development (CIUD)

under the
Kalitar Sustainable WASH Project
Ward Number 6, Godawari Municipality

2023

Foreword

The Asset Management Plan (AMP) of the Kalitar Water Supply System (KWSS) has been prepared as a part of the Kalitar Sustainable WASH project which is being implemented jointly by Centre for Integrated Urban Development (CIUD), WaterAid Nepal and Godawari Municipality under the funding support from The Coca-Cola Foundation.

With the direct participation and consultations with the water users' committees of Kalitar and Gairigaon, this plan has been developed incorporating the technical details of the water system such as asset inventory, risk assessment and mitigation and maintenance plans and subsequently calculating maintenance cost for the next fifteen years. As one of the key parts, the plan also consisted a comprehensive financial planning with income sources and the projected expenditures for the next fifteen years.

It has been anticipated that the plan will not only be a reference document for the water user committee in optimizing the service level ensuring functionality and sustainability with a operation and maintenance plan, but will also be authentic document based on which the service will be expanded in future and explore necessary resources.

The Project Team
Kalitar Sustainable WASH Project

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Abbreviations

ADB	: Asian Development Bank
AMP	: Asset Management Plan
AD	: Anno Domini
BS	: Bikram Sambat (Nepalese Year)
CIUD	: Centre for Integrated Urban Development
DWSSM	: Department of Water Supply and Sewerage Management
ENPHO	: Environment and Public Health Organization
HHs	: Households
JMP	: Joint Monitoring Project
kVA	: kilo Volt Ampere
LPCD	: Liters per capita per day
NDWQS	: National Drinking Water Quality Standard
ODF	: Open Defecation Free
O & M	: Operation and Maintenance
SDG	: Sustainable Development Goals
UNICEF	: The United Nations Children's Fund
WAN	: Water Aid Nepal
WASH	: Water, Saniation and Hygiene
WHO	: World Health Organization
WSS	: Water Supply System
WSSDO	: Water Supply and Sewerage Division Office
WSP	: Water Safety Plan
WUC	: Water Users' Committee
UEMS	: Urban Environment Management Society
VMW	: Village Maintanance Worker

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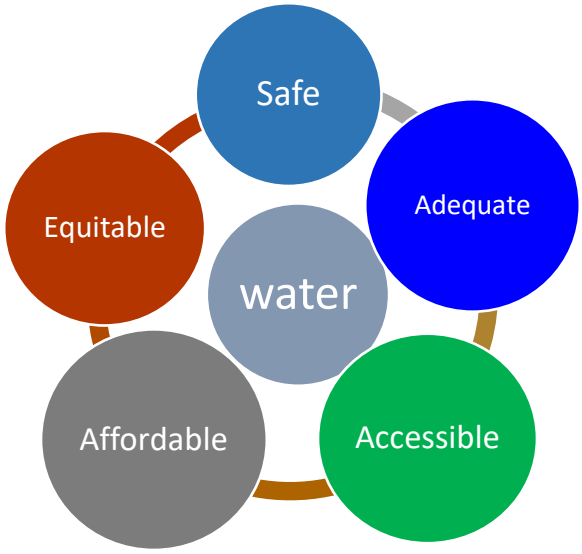
BACKGROUND



Safe and adequate drinking water has been addressed as a fundamental human right in the constitution of Nepal (Section 35, sub section 4). Increasing the ease of access, quality, reliability, affordability and sustainability of water and sanitation facilities falls under the priority strategies of the government. This is being turned into action by promulgation of a National Water Supply and Sanitation Act, which is already tabled in the parliament for discussions. A Sector Development Plan to guide the water and sanitation development, which will identify gaps in technical skills, human and financial resources, define monitoring and review framework, and layout the roadmap to 2030 and beyond is towards reaching completion. Standards and guidelines on water quality, wastewater discharge, fecal sludge management, etc. are being prepared or revised and updated as needed.

Nepal also has SDG target of attaining 99 percent household access to basic water supplies and 95 percent of households have access to a piped water supply and improved sanitation (National Planning Commission 2015). Currently, only 2.7% of the households in Nepal has safely managed drinking water, 87.8% of the households has access to the basic water supply. Of these, 51.69 % of the households have piped water supply and 33.38 % has shallow tube wells systems and 12.12% do not have access to any one of these systems (DWSSM Report 2019). The natures of various levels of water quality are based on the Joint Monitoring Program (JMP) launched by WHO and UNICEF. Nepal's target is to take leap from delivering basic water to the safely managed water. Nepal has made impressive progress during the past two decades in improving access to water, sanitation and hygiene services. This has been possible through government's overarching priority accorded to the sector and its leadership in WASH development, which was catalytically supported by international agencies, civil society and users of WASH services. Mobilization of household level investment and user's participation in decision making and control has also considerably contributed to this achievement. As a result of past two decades of intensive engagement, Nepal has achieved an impressive nominal coverage of water and sanitation facilities throughout the country. The updated coverage figure for basic water supply stands at above 90% of the total population, and with the country attaining the Open Defecation Free Status in September 2019, the nominal coverage for basic sanitation is close to one hundred percent.

After the successful achievement of open defecation free (ODF) nation in 2018, Nepal government is now promoting total sanitation program. As the water is the key driving agent for the safe and

sustainable sanitation and hygiene practices, the Nepal government has also been promoting one house-one tap approach in order to ensure each household has safe, adequate, accessible, affordable and equitable distribution of water. Here, safe water refers to physically, chemically and biologically contamination free water meeting the standard of 17 parameters as set of national drinking water quality standards (NDWQS) 2005.

In order to ensure that people get safe drinking water, the DWSSM has also initiated Water Safety Plan (WSP) that is planned to be implied in all water supply systems by the local level. The WSP is community led tool that deals with quality of water in order to assure consistently drinking water quality from catchment to consumers or from source to mouth. This approach which is based on the risk assessment and risk management principle, stresses on identifying hazard in water supply system, adopting control measures to prevent hazard, and monitoring regularly the effectiveness of control measures. WSP has played very important role in improving service level and sustaining the water supply system in many parts of the world. In Nepal too, it is necessary to prepare design and estimate for new water supply system adopting the WSP.

CHAPTER ONE

INTRODUCTION OF ASSET MANAGEMENT PLAN IN WATER SUPPLY SYSTEM

1.1 What is an Asset Management?

An asset management refers to a systematic approach to the governance and realization of value from the things that a group or entity is responsible for, over their whole life cycles. It may apply both to tangible assets (physical objects such as buildings or equipment) and to intangible assets (such as human capital, intellectual property, goodwill or financial assets). Asset management is a systematic process of developing, operating, maintaining, upgrading, and disposing of assets in the most cost-effective manner (including all costs, risks and performance attributes).

The term is commonly used in the financial sector to describe people and companies who manage investments on behalf of others. Those include, for example, investment managers that manage the assets of a pension fund. It is also increasingly used in both the business world and public infrastructure sectors to ensure a coordinated approach to the optimization of costs, risks, service/performance and sustainability (Wiki).

Infrastructure asset management is the combination of management, financial, economic, engineering, and other practices applied to physical assets with the objective of providing the best value level of service for the costs involved. It includes the management of the entire life cycle—including design, construction, commissioning, operating, maintaining, repairing, modifying, replacing and decommissioning/disposal of physical and infrastructure assets.[1] Operation and maintenance of assets in a constrained budget environment require a prioritization scheme. As a way of illustration, the recent development of renewable energy has seen the rise of effective asset managers involved in the management of solar systems (solar park, rooftops, and windmills). These teams often collaborate with financial asset managers in order to offer turnkey solutions to investors. Infrastructure asset management became very important in most of the developed countries in the 21st century, since their infrastructure network was almost completed in the 20th century and they have to manage to operate and maintain them cost-effectively (*Source: Vanier, D., 2001*). In short, asset management is a series of systematic and coordinated management practices of the assets to optimize their performances while minimizing operation costs and risk of asset failures.

1.2 Asset Management Plan in Water Supply System

Asset management is a tool to aims to optimize the income and thereby the functionality of the service. Ideally, the asset management is used during the design phase but it can also be used to optimize or rehabilitate existing infrastructure. The AMP is also implied in water supply systems of all kinds, should

it be large sized systems operated by the central or local government or a small sized system operated and maintained by the water users' committees. The AMP in any water supply systems help sustain the functionality and sustainability with a smooth operation and subsequently the regular service delivery through the strategic maintenance plans. The AMP also helps to manage the resources needed for all types of maintenances. Specifically, in the water supply schemes, asset refers to keeping detailed information of the scheme such as:

- Inventory of the physical components of water supply systems such as pipes, pumps, meters, generators, reservoir tanks, filtration tanks, valves, fittings and other physical infra structures in detail
- Resources mapping and planning including financial plans
- Capacity enhancement of the water users' committees for the sustainable operation and management of the schemes

Maintaining an asset means ensuring its ability to fulfill its functions and tasks to make sure the required service level is reached. It is used to increase the reliability of the hardwear and thereby reduce the entrepreneurial risk. In case of piped water systems this means that one ensures safe water is continuously provided to the customers. Customers are happy with a good service and are therefore willing to pay for the service provision. The money generated ensures that the system can be maintained, thereby making it reliable. This, again, has a positive effect on the customer's satisfaction. Not maintaining a water system will have the opposite effect. Maintenance of piped water systems is an activity that is often neglected or overlooked. Operators of these systems are often wrongfully assumed to know how to take care of their assets. However, if one observes the functionality rates of piped water systems and the service level provided it becomes clear that improvement of maintenance is needed. Maintaining a piped water system requires attention but is not too difficult. It comprises a sound combination of technical skills, planning, setting ambition levels, financial management and entrepreneurial skills.

It is the activity to ensure the water system can fulfil its intended function at the defined service level during a required lifetime. It is the whole process of inspecting the system, predicting when components may break down or have an unwanted effect on the service level and based on this replacing and repairing different parts.

What needs to be done depends on the effect of the breakdown on the service level. If the system stops functioning it is critical to react fast. If it has a less profound effect, there is more time to react. Some breakdowns can be predicted, some come as a surprise. Causes of failure can vary considerably. And they will differ for each component of the system. One can think of temperature (e.g. overheating), attachments (e.g. loose bolts), dust/moist/water, unwanted visits from animals (mice, insects), vandalism or theft, natural effects (such as lightning or earthquakes), the lack of regular inspection, incorrect installation, dirt on the solar panels etc. The moment of component or system failure depends on the type of component and the likeliness of the component to break down over time. Or more technically

stated: how is the probability of failure distributed over time. The following graphs show different failure scenarios.

1.3 Types of Maintenance

There are different methods to avoid a reduced service level. The following types of general maintenance approaches can be used:

- **Reactive maintenance**: a more technical term is 'Failure Dependent Maintenance'. One reacts when something breaks down or fails. It is basically the cheapest form of maintenance, but it has an impact on the level of service or reliability of a system.
- **Preventive maintenance**: Generally referred to as 'Use Dependent Maintenance'. This maintenance is done when certain specified parameters (a parameter is something you can measure) reach a certain value/level. These parameters can be lifetime, amount of water sold or volume, how often or frequent a part is used, etc. For example, when 5,000,000 liters of water is sold then the water meter is replaced to prevent it from breaking down and losing sales. Or the water tower is repainted every 3 years to avoid it will rust and break down.
- **Inspection based maintenance**: It is also known as 'State dependent maintenance'. One uses inspections to determine the state of the assets and based on the outcome of the inspections, maintenance is done. Examples are: you visit the site every 2 weeks and based on this inspection you decide to do clean the solar panels and do minor repairs to the slab.

More often than favorable the maintenance approach of water systems is only of the type "failure dependent maintenance". The practice is that the system is only maintained or repaired when it breaks down. When a system doesn't function anymore it is called 'Downtime'. If one only reacts when systems don't function anymore one will create a service level below the critical minimum threshold. And one loses income due to non-functionality and a lack of reliable service for the customers (the grey areas). Undertaking good maintenance based on a mix of the above-mentioned methods will therefore reduce the downtime and increase the power of business. Minimizing downtime will definitely pay off for the operator.

Step 1: Maintenance plan based on service level: By defining the service level one can estimate the yearly maintenance and replacement costs. A service level defines, for example, the amount and quality of water to be provided to whom, at what times and under what conditions. This service level is linked to the income of a system. Users are often willing to pay more for higher service levels.

Step 2: System optimization and communication: By comparing the cost estimation with the estimated income one can use the tool to optimize the system. For example, when a piped system has higher cost than income, one can either lower the service level or raise the water price to come to a sustainable situation. With these insights the funders and beneficiaries can actively be involved in this discussion. By integrating their preferences one can increase the likeliness of a successful uptake.

Step 3: Registration, monitoring and adjustment: The third step is to record the asset for future reference and compare the financial prognoses with the actual data: are the income and expenditures as expected? And if not, are there adjustments needed to ensure a sustainable situation. Or, in a better case, can the service level be increased for the same price?

Decreasing service levels over time as well as the premature failure of water infrastructure (in rural and urban area as well) is common in Nepal. Effective Asset Management helps avoid those problems and can be particularly useful in developing country like Nepal, where water supply coverage rate has reached a significant level but sustainability is becoming main issue. Emphasizing Asset Management is way to address sustainability since it focuses on understanding how existing assets should be managed for optimal performances and cost effectiveness. In practice Asset Management is about balancing priorities between extending coverage and sustaining service delivery or even increasing the existing level of services. The asset management not only helps reduce the cost of operation, but also help minimize the water loss, thereby reducing the unit cost of the water.

Asset management also means applying tools that help make these processes effective, such as setting service levels, computing life-cycle asset costs, maintaining an asset register, monitoring asset condition and performance, and carrying out risk analysis of possible asset failure. Asset management for water utilities is more complex than for most other sectors because of the number, variety, age, condition, and location of assets; the magnitude of asset investment; and the difficulty of inspecting and maintaining buried assets. This complexity is often compounded by lack of finance, information, and skills that can impede acquiring, commissioning, maintaining, overhauling, and replacing assets at the optimum time (*Source: Water Utility Asset Management, ADB, 2013)*.

1.4 Benefits of Asset Management in a Water Supply System

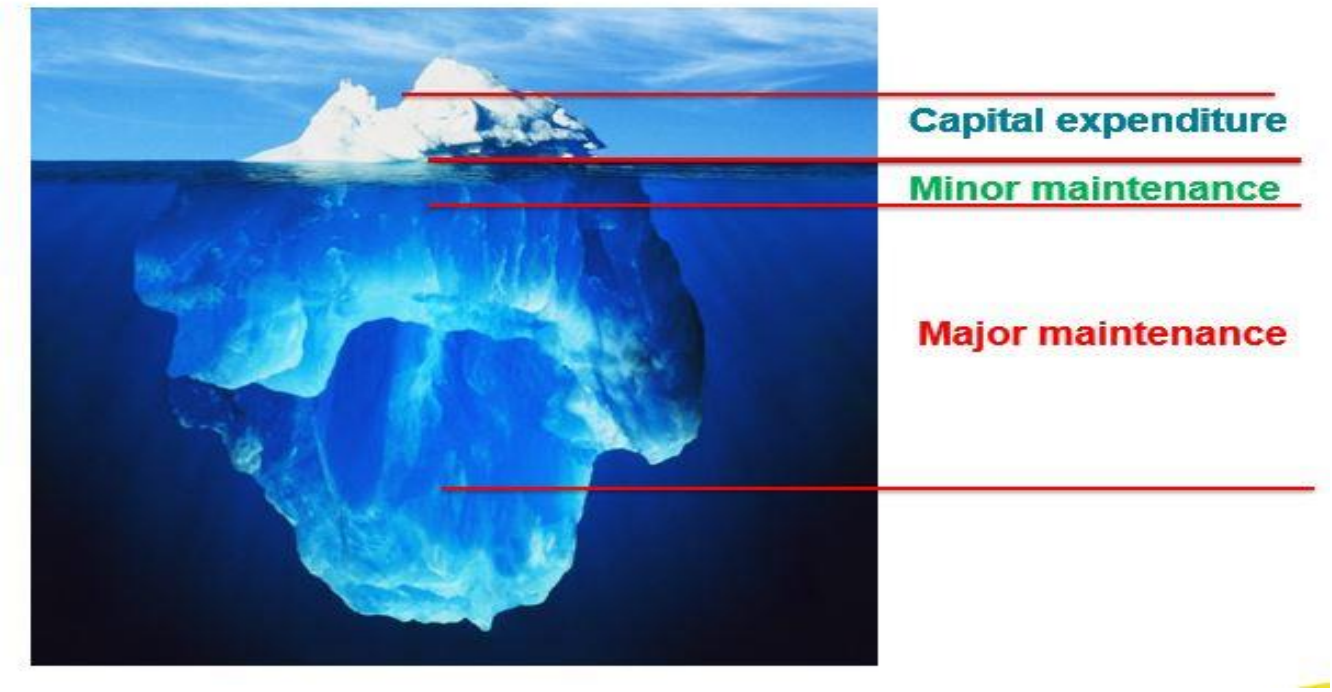
Asset management comes with two main potential benefits for any water supply systems.

- First of all, it serves as a tool in improving financial and technical sustainability. It allows water users' committees and entrepreneurs to understand and plan for the maintenance and get grip on their financial planning.
- Secondly, it would generate valuable long-term data. This can serve on multiple levels. On institutional level, it would provide an exact overview of the financial and operational status of all the infrastructure in their domain. Thereby providing data for improving functionality of existing infrastructure. Resulting in more informed decisions on future interventions: what is needed where and what is the best approach?

This data can also be used to attract external funding and thereby accelerating the process to make the system functional and sustainable overcoming all sorts of problems. Funders are more prepared in investing in proven success cases that come with little risk, rather than a patchy approach where no long term and sustainable strategy is in place.

1.5 Background of the Water Supply Systems in Nepal

Of the 41,000 water supply schemes in Nepal, only 26% are fully functional as intended (source: inception report 2020). One root cause of this failure is the strong focus on realizing infrastructure. Operational planning of existing infrastructure often lacks and the maintenance strategy 'when it breaks down one seeks funds to repair it' is prevalent. As a result, downtime increases while service levels and the willingness to pay reduces. Resulting in a downward spiral in functionality.



Moreover, during the design phase, very little data is available to optimize systems based on actual field data. Resulting in a situation where a faulty approach results in potential repetitive failure (non- or sub functional infrastructure) due to a lack of insight. The rare data that is available is often scattered and non-uniform making a clear analysis nearly impossible.

Lastly, with a strong focus on the realization of infrastructure, rehabilitation of existing infrastructure is often overlooked. Rather than continue building new infrastructure, it might be better to optimize the current existing hardwear and understand what is happening and what we can do better. This approach might result in much higher social impact with the same funds.

Especially the rural municipalities in the program area have a lack of information on the status of the infrastructure (e.g., water supply schemes) and their specific financial needs. Monitoring data often is limited to spot checks on functionality. Therefor there is a considerable information gap resulting in only ad hoc repair and funding based on emergency situations (broken schemes). Also new piped systems – using a (what appear to be be) standardized approach of systems that already failed - are constructed while non-functional systems are present.

As per the latest reporting, about 88% of Nepalese have access to basic level of drinking water services. Among that 51.69% of the people are getting drinking water services through piped water supply schemes of various sizes. There are about 42 thousand piped water supply schemes within the country. But only about 28% of them are fully functional. The other water supply schemes need various levels of repair and maintenances. About 8% of the constructed schemes are in need of total reconstruction and 16% schemes are in need of rehabilitation.

There are thousands of water supply schemes remained nonfunctional due to lack of proper repairing and maintenance. The major causes of non-functionality of the schemes are lack of timely repair and maintenance, lack of maintenance fund and necessary human resources in time. In other words, the lack of operation and management plan led to most of these water supply schemes partially or fully nonfunctional. Here management refers to management of infrastructures, human resources and financial resources. The sustainability of the water supply schemes is; therefore, a key challenge and it can only be managed through carefully planned operation and maintenance (O&M) system and asset management is one of the key parts of the system (Practica).

CHAPTER TWO

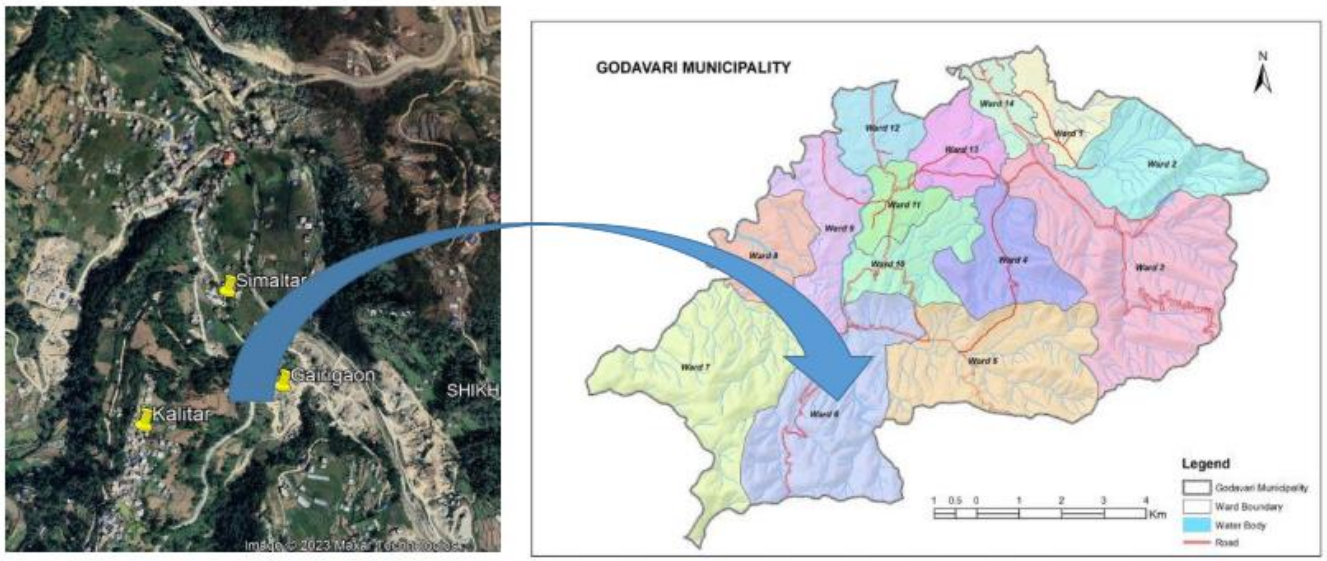
ASSET MANAGEMENT PLAN OF KALITAR SUSTAINABLE WATER SUPPLY SYSTEM

As part of the WaterAid Nepal (WAN) project in Godawari Municipality of Lalitpur district, an asset management plan for Kalitar Sustainable Water Supply System has been prepared by the CIUD with consultation WAN. With the direct participation of the members of Kalitar Water Users' Committee of the water supply system, the plan has been prepared based on the guidelines jointly developed by the Practica Foundation and CIUD.

2.1 Brief Information of the Kalitar Sustainable Water Supply System

Kalitar Su-WASH project was initiated by CIUD and implemented through the Kalitar Water Users' Committee. A fund of approximately Nepalese rupees 8,237,702.00 was available for the Kalitar Su-WASH project, of which 83.15% was funded by the WAN, 6.84% by the Godawari Municipality, and 10% by the Kalitar water users' committee. The construction of Kalitar Su-WASH started on January, 2023 and will completed end of November, 2023. On dated February 28, 2023, two ad-hoc users committee were formed one in Kalitar and other in Gairigaun. The committee is formed under the Nepal Drinking Water Regulation 2055 (1998 AD).

Location Map: Kalitar Su-WASH Project



Kalitar sustainable water supply system is located in Godavari Municipality Ward-6 of Lalitpur District and system is situated 19 kilometers south of Kathmandu district. The project had surveyed 151 households (HHs) based on which the design was completed with the key physical construction and rehabilitation of 5 reservoir tanks and laid down the transmission and distribution pipelines. The project will be completed in the month of December, 2023 with total cost of NRs. 8,237,702. The salient features of the Kalitar Su-WASH project are provided in table below;

Table#1 Details of the Kalitar Sustainable Water Supply System

S/N	Parameters	Description
1	Address	Kalitar, Ward # 6, Godavari Municipality, Lalitpur District, Baghmati Province, Nepal
2	Type of the System	Gravity
3	Source of Water	Spring
3	Storage Capacity RT-1 (Kalitar)	20000 liters
4	Storage Capacity RT-2 (Kalitar)	12000 liters
5	Storage Capacity RT-3 (Kalitar)	10000 liters
6	Storage Capacity RT-4 (Gairigaun)	20000 liters
7	Storage Capacity RT-5 (Gairigaun)	10000 liters
8	Total Length of Transmission Line	3136 meters
9	Total Length of Distribution Line	5835 meters
10	Total Household Coverage	151 HHs
11	Beneficiaries Population	Male: 321 Female: 326 (Total: 647)
12	Size of the WUC in Kalitar	11 (Male:5 Female:6)
13	Size of the WUC in Gairigaun	7 (Male:7 Female:0)
14	Name of WUC Chairman-Kalitar	Mr. Padam Bahadur Khadka
15	Name of WUC Chairmain-Garigaun	Mr. Kumar Tamang
16	Ownership of the System	Kalitar WUC, Godawari-6, Lalitpur

Source: *Kalitar Sustainable WASH Project/WAN/CIUD/2023*

2.2 Current Situation of the Kalitar Sustainable Water Supply System

To provide access to water supply to the Kalitar community, some organizations like Fund Board itself and UEMS initiated the water supply projects in the year 2062 BS and 2070 BS. At that time, it was initiated with the construction of 2 RVTs (12000 and 10000 lit. capacity) and laying of the pipelines. Only 67 HHs in Kalitar and 32 HHs in Gairigaun communities were able to consume water from the system. Drinking Water supply was distributed to the community through public taps which was not sufficient for daily use. The water supply distributed also was not of good quality either.

At present, the water supply system is fully operational. This year in 2023, in collaboration with WAN, CIUD has completed a new WASH project providing access to safe drinking water supply in Kalitar, Pokhari Danda, Khadagaun, Gairigaun and Similtar communities by rehabilitating old structures and building some new structures. So those 151 HHs of the five segments of Kalitar are the target beneficiaries.

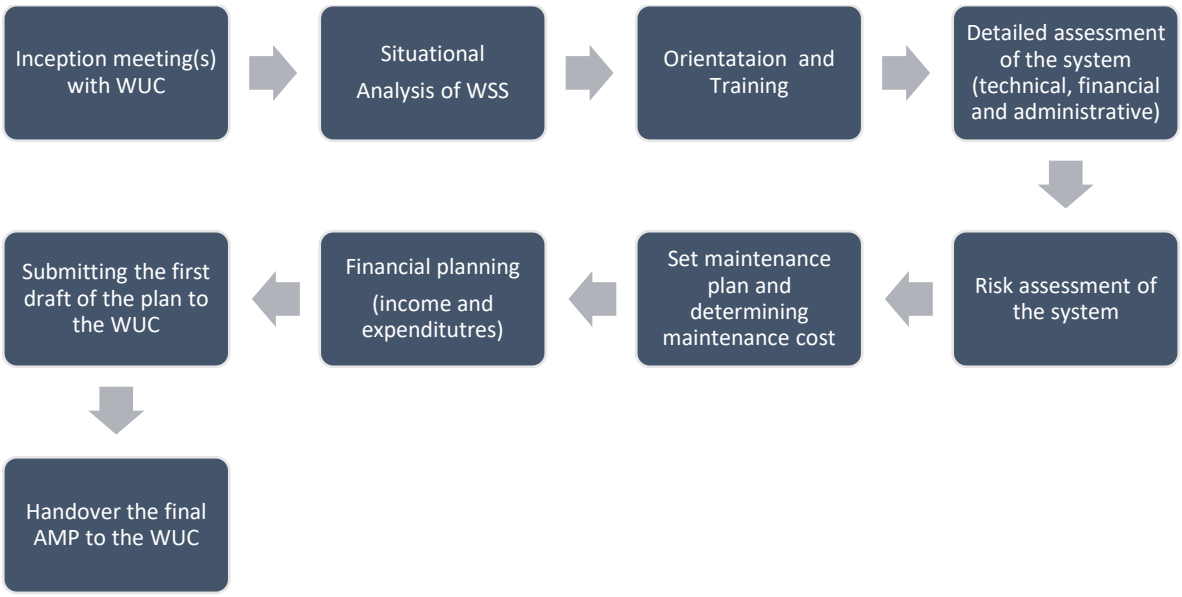
2.3 Objectives of the Asset Management Plan in the Kalitar Sustainable Water Supply System

The key objective of the AMP is to ensure the sustainability of the Kalitar sustainable water supply system optimizing the service level. The specific objectives of the asset management plan are to prepare the database of the all the physical assets, prepare maintenance plans with resources allocation and prepare financial planning in order to optimize service level of the system and for the long-term functionality and the sustainability of the water supply system. The specific objectives of the plan are;

- Preparing an asset inventory
- Preparing participatory based risk assessment to identify the possible risks and their type in advance
- Preparing various types of maintenance plans
- Preparing resources mapping and financial planning, and,
- Enhancing the capacity of water users' committee in operation and management of the schemes

2.4 Methodology

The asset management plan was preparatory with a participatory approach of direct participation of the key members of the WUC of the Kalitar water supply system. Both the qualitative and quantitative information were collected through the focus group discussion, questionnaire, check lists, secondary information and the on-site observations.



As shown in the chart above, the AMP was prepared through the series of steps which are briefly described below;

- **Meetings**: Several meetings with the Kalitar WUC members, were done to compile the knowledge and information and also to share initial information about the AMP.
- **Situation Analysis:** Based on the preliminary information collected, the team made situation analysis of technical, social and financial aspect of the system. This also included the willingness of the Kalitar WUC, municipality's plan and resources. It was crucial as it helps to prepare the steps ahead in making the AMP.
- **Orientation:** The Kalitar WUC was then induced with the AMP, its rationale, process and methodologies and the steps and their feedbacks and opinions. The orientation was done in a participatory approach and the participants were allowed to work on the preliminary planning of the AMP.
- **Assessment of the System:** The technical team carried out the detailed assessment of the system. This includes the preparation of an inventory of the physical components of the system.
- **Risk Assessment:** As one of the key parts of the AMP, the technical team then carried out the risk assessment of each components of the system using a risk-effect-probability matrix as shown below;

Table#2 Risk Matrix

Risk matrix	Key Functionality: Reliable safe & inclusive water provision				
Effect	Total loss of functionality	4	8	12	16
	Reduction of functionality of system	3	6	9	12
	Reduction of functionality of part	2	4	6	8
	Hardly any effect	1	2	3	4
		Minimal	Low	Medium	High
	Probability				

The risk assessment of each component of the water supply system was done based on the probability and subsequent effects to the functionality of the system. As shown above, probabilities are levelled as minimal, low, medium and high with the scores with respect to the degree of effects and they are also denoted by scores. The product of the degree of probability and the effect determines the level of risk.

2.5 Maintenance Plan

Based on the situation analysis, the asset inventory and the risk assessment, the team prepared the maintenance plans. As mentioned above, the maintenance plans were prepared incorporating all three types of maintenance plans. The resources needed for each maintenance plan, mostly the budget, was projected for the next fifteen years, considering the fluctuation of the monetary value in due course of time.

2.6 Financial Planning and Business Model:

The financial plan with a business model for fifteen years was also prepared based on the maintenance plans and the operation plan of the system. It included the tariff fixation, demographic survey with number of users and nature of users such as households.

2.7 Components of Asset Management Plan

- **The Asset Inventory list of the Kalitar Sustainable water supply system:** The major components of Kalitar water supply systems are intake, collection chamber, by pass tank, reservoir tank, pipes and fittings and chlorine dosing unit which were recently installed and

functional assets. The below mentioned table is an overview of the assets present in the Kalitar Sustainable Water Supply System and the information available about these assets.

Table#3 Details of Kalitar Water Supply Asset

ID Number	Asset	Quantity	Unit with its detailing	
1	**Intake-1 (Kalitar)**	1	Area (m^2)	2x1
1.1	GI Pipe	1	Diameter (mm)	40
1.2	GI Union	1	Diameter (mm)	40
2	Intake-2 (Gairigaun)	2	Area (m^2)	2x1
2.1	GI long nipple	2	Diameter (mm)	40
2.2	Gate Valve	2	Diameter (mm)	40
2.3	GI Short nipple	2	Diameter (mm)	40
2.4	GI End cap	2	Diameter (mm)	40
2.5	GI Union	2	Diameter (mm)	40
3	**Collection Chamber-1 (Kalitar)**	1	Area (m^2)	2.5x1.3
3.1	GI long nipple	4	Diameter (mm)	50
3.2	GI short nipple	1	Diameter (mm)	50
3.3	GM Gate Valve	1	Diameter (mm)	50
3.4	GI Unequal Tee	1	Diameter (mm)	50
3.5	Brass union	2	Diameter (mm)	50
3.6	GI Long nipple	1	Diameter (mm)	15
3.7	GI Equal Tee	1	Diameter (mm)	15
3.8	GI End cap	1	Diameter (mm)	50
4	**Collection Chamber-2 (Gairigaun)**	1	Area (m^2)	2.5x1.3
4.1	GI long nipple	4	Diameter (mm)	40

4.2	GI short nipple	1	Diameter (mm)	40
4.3	GM Gate Valve	1	Diameter (mm)	40
4.4	GI Unequal Tee	1	Diameter (mm)	40
4.5	GI Flange set	1	Diameter (mm)	40
4.6	GI Long nipple	1	Diameter (mm)	15
4.7	GI Equal Tee	1	Diameter (mm)	15
4.8	GI End cap	1	Diameter (mm)	40
5	**By Pass Tank-Kalitar**	1	Area (m^2)	2x1.5
5.1	GI Long nipple	3	Diameter (mm)	50
5.2	GI Long nipple	1	Diameter (mm)	25
5.3	Gate Valve	3	Diameter (mm)	50
5.4	End cap	1	Diameter (mm)	50
5.5	Unequal Tee	1	Diameter (mm)	50
5.6	GI Short nipple	3	Diameter (mm)	50
5.7	Brass union	3	Diameter (mm)	50
6	**Reservoir Tank-1 (Kalitar)**	1	Volume (m^3)	20
6.1	GI Long nipple	2	Diameter (mm)	65
6.2	Flange set (GIxHDPE)	2	Diameter (mm)	50
6.3	Flange set (GIxHDPE)	1	Diameter (mm)	65
6.4	GI Long nipple	8	Diameter (mm)	50
6.5	GI Long nipple	5	Diameter (mm)	15
6.6	GI Elbow	5	Diameter (mm)	50
6.7	GI Elbow	1	Diameter (mm)	65
6.8	GI Socket	2	Diameter (mm)	50

6.9	GI Union	1	Diameter (mm)	65
6.10	GI Short nipple	3	Diameter (mm)	65
6.11	GI Union	1	Diameter (mm)	50
6.12	GI Short nipple	2	Diameter (mm)	50
6.13	GI Equal Tee	1	Diameter (mm)	50
6.14	GI Gate Valve	1	Diameter (mm)	65
6.15	GI Gate Valve	1	Diameter (mm)	50
6.16	GI Unequal Tee	1	Diameter (mm)	65
6.17	GI Elbow	4	Diameter (mm)	15
6.18	GI Short Nipple	1	Diameter (mm)	15
6.19	GI Union	1	Diameter (mm)	15
6.20	GI Long nipple	4	Diameter (mm)	15
6.21	GI Socket	1	Diameter (mm)	15
6.22	GI Equal Tee	1	Diameter (mm)	15
7	**Reservoir Tank-2 (Kalitar)**	1	Volume (m^3)	12
7.1	GI Long nipple	10	Diameter (mm)	40
7.2	Flange set (GIxHDPE)	2	Diameter (mm)	40
7.3	GI Long nipple	4	Diameter (mm)	15
7.4	GI Elbow	5	Diameter (mm)	40
7.5	GI Socket	2	Diameter (mm)	40
7.6	GI Short nipple	4	Diameter (mm)	40
7.7	GI Union	2	Diameter (mm)	40
7.8	GI Equal Tee	1	Diameter (mm)	40
7.9	GM Gate Valve	2	Diameter (mm)	40

7.10	GI Unequal Tee	1	Diameter (mm)	40
7.11	GI Elbow	4	Diameter (mm)	15
7.12	GI Nipple	1	Diameter (mm)	15
7.13	GI Union	1	Diameter (mm)	15
7.14	GI Long nipple	1	Diameter (mm)	15
7.15	GI Equal Tee	1	Diameter (mm)	15
8	**Reservoir Tank-3 (Kalitar)**	1	Volume (m^3)	10
8.1	GI Long nipple	10	Diameter (mm)	50
8.2	Flange set (GIxHDPE)	3	Diameter (mm)	50
8.3	GI Long nipple	4	Diameter (mm)	15
8.4	GI Elbow	6	Diameter (mm)	50
8.5	GI Socket	2	Diameter (mm)	50
8.6	GI Union	2	Diameter (mm)	50
8.7	GI Short nipple	7	Diameter (mm)	50
8.8	GI Equal Tee	1	Diameter (mm)	50
8.9	GM Gate Valve	2	Diameter (mm)	50
8.10	GI Unequal Tee	1	Diameter (mm)	50
8.11	GI Elbow	4	Diameter (mm)	15
8.12	GI Short Nipple	1	Diameter (mm)	15
8.13	GI Union	1	Diameter (mm)	15
8.14	GI Socket	1	Diameter (mm)	15
8.15	GI Equal Tee	1	Diameter (mm)	15
9	**Reservoir Tank-4 (Gairigaun)**	1	Volume (m^3)	20
9.1	GI Long nipple	10	Diameter (mm)	50

9.2	Flange set (GIxHDPE)	3	Diameter (mm)	50
9.3	GI Long nipple	4	Diameter (mm)	15
9.4	GI Elbow	6	Diameter (mm)	50
9.5	GI Socket	2	Diameter (mm)	50
9.6	GI Union	2	Diameter (mm)	50
9.7	GI Short nipple	7	Diameter (mm)	50
9.8	GI Equal Tee	1	Diameter (mm)	50
9.9	GM Gate Valve	2	Diameter (mm)	50
9.10	GI Unequal Tee	1	Diameter (mm)	50
9.11	GI Elbow	4	Diameter (mm)	15
9.12	GI Short Nipple	1	Diameter (mm)	15
9.13	GI Union	1	Diameter (mm)	15
9.14	GI Socket	1	Diameter (mm)	15
9.15	GI Equal Tee	1	Diameter (mm)	15
10	**Reservoir Tank-5**	1	Volume (m^3)	10
10.1	GI Long nipple	10	Diameter (mm)	50
10.2	Flange set (GIxHDPE)	3	Diameter (mm)	50
10.3	GI Long nipple	4	Diameter (mm)	15
10.4	GI Elbow	6	Diameter (mm)	50
10.5	GI Socket	2	Diameter (mm)	50
10.6	GI Union	2	Diameter (mm)	50
10.7	GI Short nipple	7	Diameter (mm)	50
10.8	GI Equal Tee	1	Diameter (mm)	50
10.9	GM Gate Valve	2	Diameter (mm)	50

10.10	GI Unequal Tee	1	Diameter (mm)	50
10.11	GI Elbow	4	Diameter (mm)	15
10.12	GI Short Nipple	1	Diameter (mm)	15
10.13	GI Union	1	Diameter (mm)	15
10.14	GI Socket	1	Diameter (mm)	15
10.15	GI Equal Tee	1	Diameter (mm)	15
11	**Transmission Pipe line**		Length (m)	
11.1	HDPE Pipe mtr-Kalitar	1810	Diameter (mm)	32
11.2	HDPE Pipe mtr.-Gairigaun	1326	Diameter (mm)	32
12	**Distribution Pipe line**		Length (m)	
12.1	HDPE Pipe mtr.-Gairigaun	425	Diameter (mm)	40
12.2	HDPE Pipe mtr.-Gairigaun	1125	Diameter (mm)	32
12.3	HDPE Pipe mtr.-Gairigaun	150	Diameter (mm)	25
12.4	HDPE Pipe mtr.-Kalitar	420	Diameter (mm)	75
12.5	HDPE Pipe mtr.-Kalitar	1000	Diameter (mm)	63
12.6	HDPE Pipe mtr.-Kalitar	400	Diameter (mm)	50
12.7	HDPE Pipe mtr.-Kalitar	575	Diameter (mm)	40
12.8	HDPE Pipe mtr.-Kalitar	1640	Diameter (mm)	32
12.9	HDPE Pipe mtr.-Kalitar	100	Diameter (mm)	25
13	**Chlorine Dosing Unit**	2	Volume (m^3)	0.2
13.1	Mixer Agitator	2	Horsepower (HP)	0.5
13.2	200 ltr. Chemical Residue tank	2	Volume (m^3)	0.2
13.3	Pipe and fittings	2	Diameter (mm)	40
13.4	Electric Panel board	2	Area (m^2)	0.1

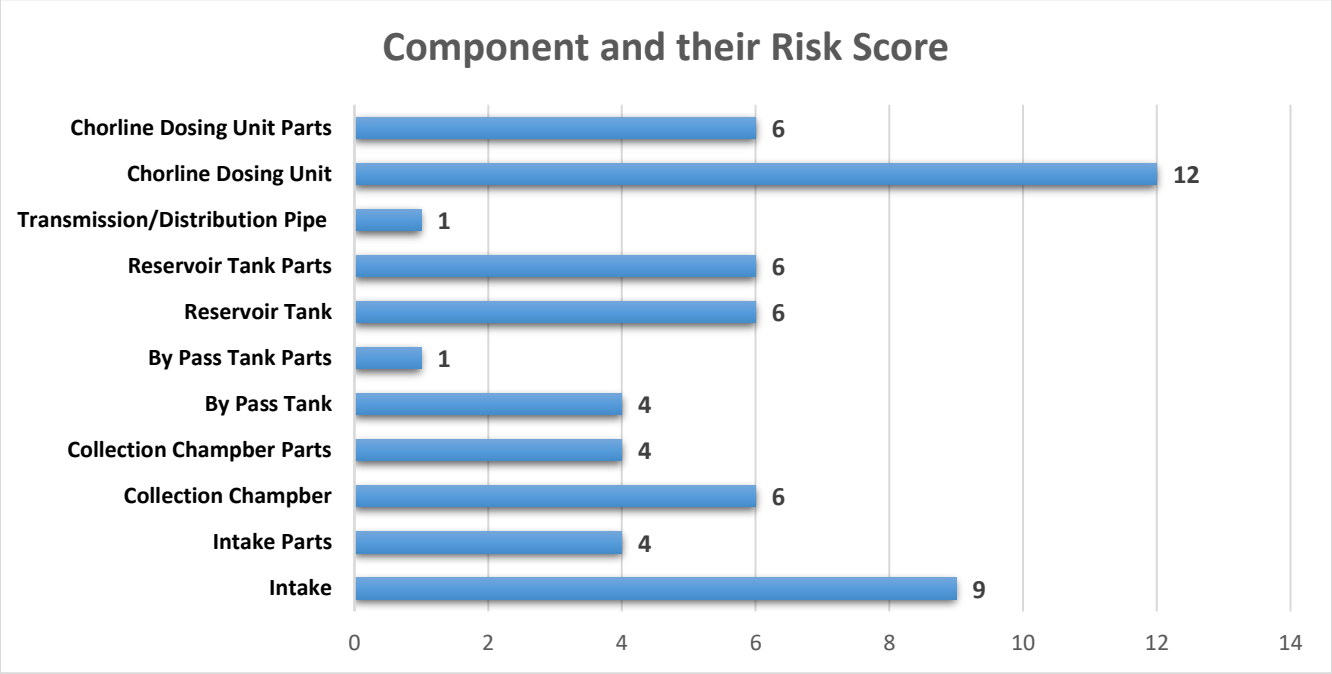
Source: *Kalitar Sustainable WASH Project/WAN/CIUD/2023*

2.8 Risk Assessment of the Components and Risk Projection and Its Degree

Once the comprehensive inventory of all the physical components of the Kalitar supply system was prepared, the team, with the direct participation and inputs from the members of the Kalitar WUC and care takers and the technicians, conducted the risk assessment of each component of the system (based on the asset inventory as mentioned above) and prepared the list with the assessment. The assessment was done on various factors such as possible hazards such as earthquakes and floods, weathering, wear and tears, handling and even the vandalizations, the team went through each component, discussed the possible risks, determined the degree of effects and probability and determined the level risk for each component.

The risk assessment has been taken as key reference based on which risk mitigation actions are taken to prevent or reduce the severity of the risk in the project as well as preparing the maintenance plans of the system. The following chart #1 and table# 4 depicts the risk assessment of the Kalitar Water Supply system.

Chart#1: Risk Score of Kalitar Water Supply System



Table#4 Risk Assessments of the Components and Risk Projection and Its Degree

Risk Mitigation Worksheet / Maintenance Plan Worksheet											
ID Number	**Asset**	**Size**		**Description of Possible Failure**	**Risk Score**	**Risk Mitigation Type**			**Risk Mitigation Action**	**Expected Maintenance Interval (Years)**	**Responsibility**
						Reactive	**Preventive**	**Observation**			
1	**Intake-1 (Kalitar)**	Area (m^2)	2x1	Flooding	9	✓			Retaining wall	7	WUSC
A	Intake-1 (Kalitar)	Area (m^2)	2x1	Landslide	9		✓		Tree plantation		WUSC
1.1	GI Pipe	Diameter (mm)	40	Rusting, wear and tear	4	✓			Replacement	5	VMW
1.2	GI Union	Diameter (mm)	40	Rusting, wear and tear	4	✓			Replacement	5	VMW
2	**Intake-2 (Garigaun)**	Area (m^2)	2x1	Flooding	9			✓	Retaining wall	7	WUSC
B	Intake-2 (Garigaun)	Area (m^2)	2x1	Landslide	9			✓	Tree plantation		WUSC
2.1	GI long nipple	Diameter (mm)	40	Rusting, wear and tear	4	✓			Replacement	10	VMW
2.2	Gate Valve	Diameter (mm)	40	Rusting & loose	6	✓			Repair	10	VMW
2.3	GI Short nipple	Diameter (mm)	40	Rusting, wear and tear	4	✓			Replacement	10	VMW
2.4	GI End cap	Diameter (mm)	40	Rusting, wear and tear	4	✓			Replacement	10	VMW
2.5	GI Union	Diameter (mm)	40	Rusting, wear and tear	4	✓			Replacement	10	VMW
3	**Collection Chamber-1 (Kalitar)**	Area (m^2)	2.5x1.3	Cracks in wall and foundation	6			✓	Plastering and painting	15	VMW
3.1	GI long nipple	Diameter (mm)	50	Rusting, wear and tear	4	✓			Replace and repair	15	VMW
3.2	GI short	Diameter	50	Rusting, wear	4	✓			Repair and	15	VMW

	nipple	(mm)		and tear					repair		
3.3	GM Gate Valve	Diameter (mm)	50	Rusting & loose	6	✓			Replace and repair	15	VMW
3.4	GI Unequal Tee	Diameter (mm)	50	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
3.5	Brass union	Diameter (mm)	50	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
3.6	GI Long nipple	Diameter (mm)	15	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
3.7	GI Equal Tee	Diameter (mm)	15	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
3.8	GI End cap	Diameter (mm)	50	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
4	**Collection Chamber-2 (Garigaun)**	Area (m^2)	1	Cracks in wall and foundation	6			✓	Plastering and painting	15	WUSC
4.1	GI long nipple	Diameter (mm)	40	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
4.2	GI short nipple	Diameter (mm)	40	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
4.3	GM Gate Valve	Diameter (mm)	40	Rusting & loose	6	✓			Replace and repair	15	VMW

4.4	GI Unequal Tee	Diameter (mm)	40	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
4.5	GI Flange set	Diameter (mm)	40	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
4.6	GI Long nipple	Diameter (mm)	15	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
4.7	GI Equal Tee	Diameter (mm)	15	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
4.8	GI End cap	Diameter (mm)	40	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
5	**By Pass Tank-Kalitar**	Area (m^2)	2x1.5	Cracks in structure	4			✓	Replace and repair	15	VMW
5.1	GI Long nipple	Diameter (mm)	50	Rusting & loose	1	✓			Replace and repair	15	VMW
5.2	GI Long nipple	Diameter (mm)	25	Rusting & loose	6	✓			Replace and repair	15	VMW
5.3	Gate Valve	Diameter (mm)	50	Rusting, wear and tear	1	✓			Replace and rusting, wear and repair	15	VMW
5.4	End cap	Diameter (mm)	50	Rusting, wear and tear	1	✓			Replace and rusting, wear and repair	15	VMW
5.5	Unequal Tee	Diameter (mm)	50	Rusting, wear and tear	1	✓			Replace and rusting, wear and repair	15	VMW

5.6	GI Short nipple	Diameter (mm)	50	Rusting, wear and tear	1	✓			Replace and rusting, wear and repair	15	VMW
5.7	Brass union	Diameter (mm)	50	Rusting, wear and tear	1	✓			Replace and rusting, wear and repair	15	VMW
6	**Reservoir Tank-1 (Kalitar)**	Volume (m^3)	20	Color fade and structure crack				✓	Coloring and maintenance	15	WUSC & VMW
6.1	GI Long nipple	Diameter (mm)	65	Rusting, wear and tear	6	✓			Replace and rusting, wear and repair	15	VMW
6.2	Flange set (GIxHDPE)	Diameter (mm)	50	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
6.3	Flange set (GIxHDPE)	Diameter (mm)	65	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
6.4	GI Long nipple	Diameter (mm)	50	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
6.5	GI Long nipple	Diameter (mm)	15	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
6.6	GI Elbow	Diameter (mm)	50	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
6.7	GI Elbow	Diameter (mm)	65	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW

6.8	GI Socket	Diameter (mm)	50	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
6.9	GI Union	Diameter (mm)	65	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
6.10	GI Short nipple	Diameter (mm)	65	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
6.11	GI Union	Diameter (mm)	50	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
6.12	GI Short nipple	Diameter (mm)	50	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
6.13	GI Equal Tee	Diameter (mm)	50	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
6.14	GI Gate Valve	Diameter (mm)	65	Rusting & loose	6	✓			Replace and repair	15	VMW
6.15	GI Gate Valve	Diameter (mm)	50	Rusting & loose	6	✓			Replace and repair	15	VMW
6.16	GI Unequal Tee	Diameter (mm)	65	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
6.17	GI Elbow	Diameter (mm)	15	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
6.18	GI Short Nipple	Diameter (mm)	15	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW

6.19	GI Union	Diameter (mm)	15	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
6.20	GI Long nipple	Diameter (mm)	15	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
6.21	GI Socket	Diameter (mm)	15	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
6.22	GI Equal Tee	Diameter (mm)	15	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
7	**Reservoir Tank-2 (Kalitar)**	Volume (m^3)	12	Color fade and structure crack	6			✓	Coloring and maintenance	15	WUSC & VMW
7.1	GI Long nipple	Diameter (mm)	40	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
7.2	Flange set (GIxHDPE)	Diameter (mm)	40	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
7.3	GI Long nipple	Diameter (mm)	15	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
7.4	GI Elbow	Diameter (mm)	40	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
7.5	GI Socket	Diameter (mm)	40	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW

7.6	GI Short nipple	Diameter (mm)	40	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
7.7	GI Union	Diameter (mm)	40	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
7.8	GI Equal Tee	Diameter (mm)	40	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
7.9	GM Gate Valve	Diameter (mm)	40	Rusting & loose	6	✓			Replace and repair	15	VMW
7.10	GI Unequal Tee	Diameter (mm)	40	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
7.11	GI Elbow	Diameter (mm)	15	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
7.12	GI Nipple	Diameter (mm)	15	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
7.13	GI Union	Diameter (mm)	15	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
7.14	GI Long nipple	Diameter (mm)	15	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
7.15	GI Equal Tee	Diameter (mm)	15	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW

8	**Reservoir Tank-3 (Kalitar)**	Volume (m^3)	10	Color fade and structure crack	6	✓			Coloring and maintenance	15	WUSC & VMW
8.1	GI Long nipple	Diameter (mm)	50	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
8.2	Flange set (GIxHDPE)	Diameter (mm)	50	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
8.3	GI Long nipple	Diameter (mm)	15	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
8.4	GI Elbow	Diameter (mm)	50	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
8.5	GI Socket	Diameter (mm)	50	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
8.6	GI Union	Diameter (mm)	50	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
8.7	GI Short nipple	Diameter (mm)	50	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
8.8	GI Equal Tee	Diameter (mm)	50	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
8.9	GM Gate Valve	Diameter (mm)	50	Rusting & loose	6	✓			Replace and repair	5	VMW

8.10	GI Unequal Tee	Diameter (mm)	50	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
8.11	GI Elbow	Diameter (mm)	15	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
8.12	GI Short Nipple	Diameter (mm)	15	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
8.13	GI Union	Diameter (mm)	15	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
8.14	GI Socket	Diameter (mm)	15	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
8.15	GI Equal Tee	Diameter (mm)	15	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
9	**Reservoir Tank-4 (Garigaun)**	Volume (m^3)	20	Color fade and structure crack	6			✓	coloring and maintenance	15	WUSC & VMW
9.1	GI Long nipple	Diameter (mm)	50	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
9.2	Flange set (GIxHDPE)	Diameter (mm)	50	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
9.3	GI Long nipple	Diameter (mm)	15	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW

9.4	GI Elbow	Diameter (mm)	50	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
9.5	GI Socket	Diameter (mm)	50	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
9.6	GI Union	Diameter (mm)	50	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
9.7	GI Short nipple	Diameter (mm)	50	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
9.8	GI Equal Tee	Diameter (mm)	50	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
9.9	GM Gate Valve	Diameter (mm)	50	Rusting & loose	6	✓			Replace and rusting, wear and repair	5	VMW
9.10	GI Unequal Tee	Diameter (mm)	50	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
9.11	GI Elbow	Diameter (mm)	15	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
9.12	GI Short Nipple	Diameter (mm)	15	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
9.13	GI Union	Diameter (mm)	15	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW

9.14	GI Socket	Diameter (mm)	15	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
9.15	GI Equal Tee	Diameter (mm)	15	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
10	**Reservoir Tank-5**	Volume (m^3)	10	Color fade and structure crack	6			✓	coloring and maintenance	10	WUSC & VMW
10.1	GI Long nipple	Diameter (mm)	50	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
10.2	Flange set (GIxHDPE)	Diameter (mm)	50	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
10.3	GI Long nipple	Diameter (mm)	15	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
10.4	GI Elbow	Diameter (mm)	50	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
10.5	GI Socket	Diameter (mm)	50	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
10.6	GI Union	Diameter (mm)	50	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
10.7	GI Short nipple	Diameter (mm)	50	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW

10.8	GI Equal Tee	Diameter (mm)	50	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
10.9	GM Gate Valve	Diameter (mm)	50	Rusting & loose	6	✓			Replace and rusting, wear and repair	5	VMW
10.10	GI Unequal Tee	Diameter (mm)	50	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
10.11	GI Elbow	Diameter (mm)	15	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
10.12	Short Nipple	Diameter (mm)	15	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
10.13	GI Union	Diameter (mm)	15	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
10.14	GI Socket	Diameter (mm)	15	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
10.15	GI Equal Tee	Diameter (mm)	15	Rusting, wear and tear	4	✓			Replace and rusting, wear and repair	15	VMW
11	**Transmission Pipe line**	Length (m)		Broken and Forest fire	1	✓			Public awearness, plantation, filling in exposed surface		VMW

11.1	HDPE Pipe mtr-Kalitar	Diameter (mm)	32	Broken & burnt by fire	1	✓			Replace and repair	5	VMW
11.2	HDPE Pipe mtr.-Garigaun	Diameter (mm)	32	Broken & burnt by fire	1	✓			Replace and repair	5	VMW
12	**Distribution Pipe line**	Length (m)		Broken	1	✓			Replace and repair		VMW
12.1	HDPE Pipe mtr.-Garigaun	Diameter (mm)	40	Broken	1	✓			Replace and repair	5	VMW
12.2	HDPE Pipe mtr.-Garigaun	Diameter (mm)	32	Broken	1	✓			Replace and repair	5	VMW
12.3	HDPE Pipe mtr.-Garigaun	Diameter (mm)	25	Broken	1	✓			Replace and repair	5	VMW
12.4	HDPE Pipe mtr.-Kalitar	Diameter (mm)	75	Broken	1	✓			Replace and repair	5	VMW
12.5	HDPE Pipe mtr.-Kalitar	Diameter (mm)	63	Broken	1	✓			Replace and repair	5	VMW
12.6	HDPE Pipe mtr.-Kalitar	Diameter (mm)	50	Broken	1	✓			Replace and repair	5	VMW
12.7	HDPE Pipe mtr.-Kalitar	Diameter (mm)	40	Broken	1	✓			Replace and repair	5	VMW
12.8	HDPE Pipe mtr.-Kalitar	Diameter (mm)	32	Broken	1	✓			Replace and repair	5	VMW
12.9	HDPE Pipe mtr.-Kalitar	Diameter (mm)	25	Broken	1	✓			Replace and repair	5	VMW
13	**Chlorine Dosing Unit**	Volume (m^3)	0.2	Contamination and broken	12			✓	Replace ad repair	5	WUSC
13.1	Mixer Agitator	Horsepower (HP)	0.5	Burnt out, damage electric short	6	✓			Circuit and other assets	10	WUSC
13.2	200 ltr. Chemical Residuce tank	Volume (m^3)	0.2	Contamination and broken	6	✓			Replace and repair	10	WUSC

13.3	Pipe and fittings	Diameter (mm)	40	Broken	4	✓			Replace and repair	10	VMW
13.4	Electric Panel board	Area (m^2)	0.09	Burnt out, damage electric short	4	✓			Circuit and other assets	10	VMW

Source: *Kalitar Sustainable WASH Project/WAN/CIUD/2023*

2.9 Maintenance Plan

Based on the risk assessment and identifying the components with the higher potential risks, the maintenance plan has been prepared. The plan largely consists of the preventative measures with periodic maintenance schedules. The field level of maintenance activities will generally be carried out by the care taker or the village maintenance workers. The detailed maintenance plan has been given in the table above

2.10 Distribution Plan

The following table provides an overview of the service level that was envisioned by the water user committee discussion.

Table # 5: Details of Service Level

Parameter	Value
Reliability	• The VMW should work for maximum of 7 hours per day. The water system should be operational 75% of the time, during operating hours.
Water Availability	• Water users are happy to receive water 12 hours per day. Main Ferro cement reservoir tank should be filled during night time. Currently the system design is split in 5 different segments of distribution pipes: each part of the system is served after each other. • The water supply system shall be operational between 6:00 AM to 6:00 PM.
Water Quality	• The water quality has been tested by ECO Concern ENPHO once. All the seventeen parameters as listed by National Drinking Water Quality Standards (NDWQS) should be tested at the interval of six months as far as possible. However, parameters like coliforms, iron, ammonia, arsenic and pH should be prioritized
Water Quantity	• The user group notes they want 85 liters per person per day. This is perceived above in average calculation. The design parameter was 85 liters per person. The assumption of all households connected with this System now.

Accessibility & Safety	• Currently water users are 151 HHs, and 4.37 members assumed as average for the consumption of piped water. • Assumption of no more queuing system and one house one tap system exist except in the institutions/ schools.

CHAPTER THREE

FINANCIAL PLAN

The financial plan is one of the key components of the AMP of the Kalitar Water Supply System. This is a comprehensive financial modelling that incorporates the detailed income sources such as tariff in three different periods of the projected fifteen years and connection charge as well as expenditures such as operation cost (human resource cost, office cost and the maintenance costs). The projected usage of water by the people in rural areas is 35-55 liters per day and the average Nepali family size in rural area is 4.37 (Source: Household Survey 2021, CBS & LPCD WHO).

The regular yearly repair and maintenance cost which has been discussed in the related chapter. Based upon the lifespan of the pipes, fittings and accessories the regular maintenance cost varies. The detailed calculation was done in the subsequent chapter.

Cost incurred to extend the water coverage area to increase the community members in the fifth and tenth years of the project period. This is the cost where community needs to extend the system to increase the beneficiaries. The cost incurred in the human resources and office management. The total cost (as mentioned above all) for project period considering the inflation rate would be NRs. 10,310,237

3.1 Income

The system will be sustainable if the system is economically viable and technically feasible. The main purpose of community people is to develop an economically viable business plan for drinking water system. The following are the possible income sources;

- **Water Tariff:** According to the decision of Kalitar WUC meeting held on December 3, 2023, when the water tariff was discussed, it was decided to collect Rs. 200 per HHs tap with a minimum of 10 units. If the unit is more than that, the rate of Rs. 25 per unit is fixed. The main sources of the community is selling the water to its members. Each and every household will be connected with the provision of water meter and levied the water tariff per unit (one unit = 1,000 litre of water) .

- **Tap connection:** Each and every household should connect their individual tap connection for the distribution line and the charge for tap connection per each tap is NRs. 2000 for locally resides and NRs. 25,000 for those who come from outside. With this amount, WUC will provide a water meter and 3 meter ½" pipe. In case of required more than 3 m of ½" pipe, the individual houses should manage rest of the pipe by themselves.

- **Grant received from Municipality and Provincial Government:** Safe and adequate drinking water has been considered as a fundamental human rights. If the systems could not be function standalone effort of community. There should be support from local and provincial government as it required very high investment to resume the water system.

Some assumption for forecasting the water demand in the community

- **Average family size:** The average family size is taken as 4.37 for projecting the beneficiaries population for the water use.
- **Water consumption rate**: The water consumption rate per person per day is considered as follows:

  For individual house use – 85 litre of water per person per day
  Percentage of the beneficiaries for affordable to pay water tariff: It is assumed that 100% people could pay the water tariff.

If the proposed criteria for the proposed business plan be fulfilled, the Kalitar WUC will have a surplus of nearly **NRs 1,697,363.**

3.2 Maintenance Cost :

As per analysis the collected data of the Kalitar WSS, in every five years this water supply scheme's structures needed to be done. In the first five years cost of maintenance could Rs. **281,562**, and then in second five years the cost could be Rs. **424,273,** and then in next third five years the cost could be Rs. **662,350**. So, the total cost in fifteen years could be Rs.**1, 368,185**. The details of the total coast of the each structure maintenance cost are given below;

Table#16: Cost of Maintenance

ID Number	Asset	Description of Risk Mitigation Action	Quantity	Rate	Total Cost	Expected Interval (Years)	Yearly Cost Distribution		
							5	10	15
1	**Intake-1 (Kalitar)**	Retaining wall	1	100,000	100,000	15			100,000
A	Intake-1 (Kalitar)	Tree plantation	1	5,000	-				
1.1	GI Pipe	Replacement	1	680	680	10		680	
1.2	GI Union	Replacement	1	325	325	10		325	
2	**Intake-2 (Gariga un)**	Retaining wall	1	100,000	100,000	15			100,000

B	Intake-2 (Garigaun)	Tree plantation	2	2,000	-				
2.1	GI long nipple	Replacement	1	755	755	10		755	
2.2	Gate Valve	Repair	1	3,133	3,133	10		3,133	
2.3	GI Short nipple	Replacement	1	142	142	10		142	
2.4	GI End cap	Replacement	1	275	275	10		275	
2.5	GI Union	Replacement	1	401	401	10		401	
3	**Collection Chamber-1 (Kalitar)**	Plastering and painting	1	2,500	5,000	5	5,000	5,000	5,000
3.1	GI long nipple	Replace and repair	4	1,312	5,248	15			5,248
3.2	GI short nipple	Repair and repair	1	269	269	15			269
3.3	GM Gate Valve	Replace and repair	1	4,883	4,883	15			4,883
3.4	GI Unequal Tee	Replace and rusting, wear and repair	1	517	517	15			517
3.5	Brass union	Replace and rusting, wear and repair	2	1,562	3,124	15			3,124
3.6	GI Long nipple	Replace and rusting, wear and repair	1	136	136	15			136
3.7	GI Equal Tee	Replace and rusting, wear and repair	1	66	66	15			66
3.8	GI End cap	Replace and rusting, wear and repair	1	250	250	15			250
4	**Collection Chamber-2 (Garigaun)**	Plastering and painting	1	2,500	2,500	5	2,500	2,500	2,500

4.1	GI long nipple	Replace and rusting, wear and repair	4	142	568	15			568
4.2	GI short nipple	Replace and rusting, wear and repair	1	986	986	15			986
4.3	GM Gate Valve	Replace and repair	1	3,133	3,133	15			3,133
4.4	GI Unequal Tee	Replace and rusting, wear and repair	1	325	325	15			325
4.5	GI Flange set	Replace and rusting, wear and repair	1	675	675	15			675
4.6	GI Long nipple	Replace and rusting, wear and repair	1	227	227	15			227
4.7	GI Equal Tee	Replace and rusting, wear and repair	1	66	66	15			66
4.8	GI End cap	Replace and rusting, wear and repair	1	175	175	15			175
5	**By Pass Tank-Kalitar**	Replace and repair	1		5,000	5	5,000	5,000	5,000
5.1	GI Long nipple	Replace and repair	3	1,312	3,936	15			3,936
5.2	GI Long nipple	Replace and repair	1	650	650	15			650
5.3	Gate Valve	Replace and rusting, wear and repair	3	4,883	14,649	15			14,649
5.4	End cap	Replace and rusting, wear and repair	1	250	250	15			250
5.5	Unequal Tee	Replace and rusting, wear and repair	1	517	517	15			517
5.6	GI Short nipple	Replace and rusting, wear and repair	3	269	807	15			807
5.7	Brass union	coloring and maintenance	3	1,562	4,686	15			
6	**Reservoir Tank-1 (Kalitar)**	coloring and maintenance	1	10,000	10,000	5	10,000	10,000	10,000

6.1	GI Long nipple	Replace and rusting, wear and repair	2	1,136	2,272	15			2,272
6.2	Flange set (GIxHD PE)	Replace and rusting, wear and repair	2	1,562	3,124	15			3,124
6.3	Flange set (GIxHD PE)	Replace and rusting, wear and repair	1	1,824	1,824	15			1,824
6.4	GI Long nipple	Replace and rusting, wear and repair	8	1,310	10,480	15			10,480
6.5	GI Long nipple	Replace and rusting, wear and repair	5	295	1,475	15			1,475
6.6	GI Elbow	Replace and rusting, wear and repair	5	344	1,720	15			1,720
6.7	GI Elbow	Replace and rusting, wear and repair	1	653	653	15			653
6.8	GI Socket	Replace and rusting, wear and repair	2	241	482	15			482
6.9	GI Union	Replace and rusting, wear and repair	1	1,138	1,138	15			1,138
6.1	GI Short nipple	Replace and rusting, wear and repair	3	373	1,119	15			1,119
6.11	GI Union	Replace and rusting, wear and repair	1	611	611	15			611
6.12	GI Short nipple	Replace and rusting, wear and repair	2	179	358	15			358
6.13	GI Equal Tee	Replace and rusting, wear and repair	1	492	492	15			492
6.14	GI Gate Valve	Replace and repair	1	8,772	8,772	15			8,772
6.15	GI Gate Valve	Replace and repair	1	4,883	4,883	15			4,883
6.16	GI Unequal Tee	Replace and rusting, wear and repair	1	517	517	15			517

6.17	GI Elbow	Replace and rusting, wear and repair	4	42	168	15			168
6.18	GI Short Nipple	Replace and rusting, wear and repair	1	68	68	15			68
6.19	GI Union	Replace and rusting, wear and repair	1	113	113	15			113
6.2	GI Long nipple	Replace and rusting, wear and repair	4	295	1,180	15			1,180
6.21	GI Socket	Replace and rusting, wear and repair	1	38	38	15			38
6.22	GI Equal Tee	Replace and rusting, wear and repair	1	66	66	15			66
7	**Reservoir Tank-2 (Kalitar)**	coloring and maintenance	1	10,000	10,000	5	10,000	10,000	10,000
7.1	GI Long nipple	Replace and rusting, wear and repair	10	142	1,420	15			1,420
7.2	Flange set (GIxHDPE)	Replace and rusting, wear and repair	2	675	1,350	15			1,350
7.3	GI Long nipple	Replace and rusting, wear and repair	4	227	908	15			908
7.4	GI Elbow	Replace and rusting, wear and repair	5	342	1,710	15			1,710
7.5	GI Socket	Replace and rusting, wear and repair	2	144	288	15			288
7.6	GI Short nipple	Replace and rusting, wear and repair	4	142	568	15			568
7.7	GI Union	Replace and rusting, wear and repair	2	401	802	15			802
7.8	GI Equal Tee	Replace and rusting, wear and repair	1	325	325	15			325
7.9	GM Gate Valve	Replace and repair	2	3,133	6,266	15			6,266

7.1	GI Unequal Tee	Replace and rusting, wear and repair	1	325	325	15			325
7.11	GI Elbow	Replace and rusting, wear and repair	4	42	168	15			168
7.12	GI Nipple	Replace and rusting, wear and repair	1	68	68	15			68
7.13	GI Union	Replace and rusting, wear and repair	1	113	113	15			113
7.14	GI Long nipple	Replace and rusting, wear and repair	1	295	295	15			295
7.15	GI Equal Tee	Replace and rusting, wear and repair	1	63	63	15			63
8	**Reservoir Tank-3 (Kalitar)**	coloring and maintenance	1	10,000	10,000	5	10,000	10,000	10,000
8.1	GI Long nipple	Replace and rusting, wear and repair	10	1,136	11,360	15			11,360
8.2	Flange set (GIxHDPE)	Replace and rusting, wear and repair	3	1,562	4,686	15			4,686
8.3	GI Long nipple	Replace and rusting, wear and repair	4	1,136	4,544	15			4,544
8.4	GI Elbow	Replace and rusting, wear and repair	6	344	2,064	15			2,064
8.5	GI Socket	Replace and rusting, wear and repair	2	241	482	15			482

8.6	GI Union	Replace and rusting, wear and repair	2	611	1,222	15			1,222
8.7	GI Short nipple	Replace and rusting, wear and repair	7	269	1,883	15			1,883
8.8	GI Equal Tee	Replace and rusting, wear and repair	1	492	492	15			492
8.9	GM Gate Valve	Replace and repair	2	4,883	9,766	5	9,766	9,766	9,766
8.1	GI Unequal Tee	Replace and rusting, wear and repair	1	517	517	15			517
8.11	GI Elbow	Replace and rusting, wear and repair	4	42	168	15			168
8.12	GI Short Nipple	Replace and rusting, wear and repair	1	68	68	15			68
8.13	GI Union	Replace and rusting, wear and repair	1	113	113	15			113
8.14	GI Socket	Replace and rusting, wear and repair	1	38	38	15			38
8.15	GI Equal Tee	Replace and rusting, wear and repair	1	66	66	15			66
9	**Reservoir Tank-4 (Garigaun)**	coloring and maintenance	1	10,000	10,000	5	10,000	10,000	10,000
9.1	GI Long nipple	Replace and rusting, wear and repair	10	1,136	11,360	15			11,360
9.2	Flange set (GIxHD PE)	Replace and rusting, wear and repair	3	1,562	4,686	15			4,686
9.3	GI Long nipple	Replace and rusting, wear and repair	4	1,136	4,544	15			4,544
9.4	GI Elbow	Replace and rusting, wear and repair	6	344	2,064	15			2,064

9.5	GI Socket	Replace and rusting, wear and repair	2	241	482	15			482
9.6	GI Union	Replace and rusting, wear and repair	2	611	1,222	15			1,222
9.7	GI Short nipple	Replace and rusting, wear and repair	7	269	1,883	15			1,883
9.8	GI Equal Tee	Replace and rusting, wear and repair	1	492	492	15			492
9.9	GM Gate Valve	Replace and rusting, wear and repair	2	4,883	9,766	5	9,766	9,766	9,766
9.1	GI Unequal Tee	Replace and rusting, wear and repair	1	517	517	15			517
9.11	GI Elbow	Replace and rusting, wear and repair	4	42	168	15			168
9.12	GI Short Nipple	Replace and rusting, wear and repair	1	68	68	15			68
9.13	GI Union	Replace and rusting, wear and repair	1	113	113	15			113
9.14	GI Socket	Replace and rusting, wear and repair	1	38	38	15			38
9.15	GI Equal Tee	Replace and rusting, wear and repair	1	66	66	15			66
10	**Reservoir Tank-5**	coloring and maintenance	1	10,000	10,000	5	10,000	10,000	10,000
10.1	GI Long nipple	Replace and rusting, wear and repair	10	1,136	11,360	15			11,360
10.2	Flange set (GIxHD PE)	Replace and rusting, wear and repair	3	1,562	4,686	15			4,686
10.3	GI Long nipple	Replace and rusting, wear and repair	4	1,136	4,544	15			4,544
10.4	GI Elbow	Replace and rusting, wear and repair	6	344	2,064	15			2,064

10.5	GI Socket	Replace and rusting, wear and repair	2	241	482	15			482
10.6	GI Union	Replace and rusting, wear and repair	2	611	1,222	15			1,222
10.7	GI Short nipple	Replace and rusting, wear and repair	7	269	1,883	15			1,883
10.8	GI Equal Tee	Replace and rusting, wear and repair	1	492	492	15			492
10.9	GM Gate Valve	Replace and rusting, wear and repair	2	4,883	9,766	5	9,766	9,766	9,766
10.1	GI Unequal Tee	Replace and rusting, wear and repair	1	517	517	15			517
10.11	GI Elbow	Replace and rusting, wear and repair	4	42	168	15			168
10.12	Short Nipple	Replace and rusting, wear and repair	1	68	68	15			68
10.13	GI Union	Replace and rusting, wear and repair	1	113	113	15			113
10.14	GI Socket	Replace and rusting, wear and repair	1	38	38	15			38
10.15	GI Equal Tee	Replace and rusting, wear and repair	1	66	66	15			66
11	**Transmission Pipe line**	Public awareness, plantation, filling in exposed surface		1,000	-				
11.1	HDPE Pipe mtr-Kalitar	Replace and repair	1810	96	173,760	5	17,376	17,376	17,376
11.2	HDPE Pipe mtr.-Garigaun	Replace and repair	1326	96	127,296	5	12,730	12,730	12,730
12	**Distribution Pipe line**	Replace and repair		-	-				

12.1	HDPE Pipe mtr.- Garigaun	Replace and repair	425	147	62,475	5	6,248	6,248	6,248
12.2	HDPE Pipe mtr.- Garigaun	Replace and repair	1125	96	108,000	5	10,800	10,800	10,800
12.3	HDPE Pipe mtr.- Garigaun	Replace and repair	150	58	8,700	5	870	870	870
12.4	HDPE Pipe mtr.- Kalitar	Replace and repair	420	342	143,640	5	14,364	14,364	14,364
12.5	HDPE Pipe mtr.- Kalitar	Replace and repair	1000	244	244,000	5	24,400	24,400	24,400
12.6	HDPE Pipe mtr.- Kalitar	Replace and repair	400	155	62,000	5	6,200	6,200	6,200
12.7	HDPE Pipe mtr.- Kalitar	Replace and repair	575	147	84,525	5	8,453	8,453	8,453
12.8	HDPE Pipe mtr.- Kalitar	Replace and repair	1640	96	157,440	5	15,744	15,744	15,744
12.9	HDPE Pipe mtr.- Kalitar	Replace and repair	100	58	5,800	5	580	580	580
13	**Chlorine Dosing Unit**	Replace ad repair	2	1,000	2,000	5	2,000	2,000	2,000
13.1	Mixer Agitator	Circuit and other assets	2	35,000	70,000	5	70,000	70,000	70,000
13.2	200 ltr. Chemical Residuce tank	Replace and repair	2	16,500	33,000	10		33,000	
13.3	Pipe and fittings	Replace and repair	2	30,000	60,000	10		60,000	
13.4	Electric Panel board	Circuit and other assets	2	22,000	44,000	10		44,000	
				Sum Total Cost	**1,185,368**		**281,562**	**424,273**	**662,350**

Source: *Kalitar Sustainable WASH Project/WAN/CIUD/2023*

3.3 Financial Modeling and Cash Flow

If the proposed criteria for the proposed business plan be fulfilled, the cash flow for the project looks like as given below;

Cash Flow Worksheet

Inflation Rate	**7**	**Inflation Rate Correction Factor**	**1**	**1.07**	**1.14**	**1.23**	**1.31**	**1.4**	**1.5**	**1.61**	**1.72**	**1.84**	**1.97**	**2.1**	**2.25**	**2.41**	**2.58**
	S.N.	**Heading**	**Yearly Cost Distribution**														
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Expected Expenditure	**1**	Maintenance/Replacement Cost	-	-	-	-	281,562	-	-	-	-	424,273	-	-	-	-	662,350
		Total Maintenance/Replacement Cost	-	-	-	-	281,562	-	-	-	-	424,273	-	-	-	-	662,350
		Operation Cost															
	1	Human Resources Cost	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000
	2	Stationeries	3,600	3,600	3,600	3,600	3,600	3,600	3,600	3,600	3,600	3,600	3,600	3,600	3,600	3,600	3,600
	3	Utilities (Electricity, Telephone)	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000
	4	WUSC Meeting	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000

	5	Minor Purchases (Buying Tools, Replacement of Valves, Water Meters, etc.)	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000
	6	Water Quality Test LS	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000
	7	Purchase of Bleaching Powder	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000
			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Operation Cost	296,600	296,600	296,600	296,600	296,600	296,600	296,600	296,600	296,600	296,600	296,600	296,600	296,600	296,600	296,600
		Total Operation and Maintenance Cost	296,600	296,600	296,600	296,600	578,162	296,600	296,600	296,600	296,600	720,873	296,600	296,600	296,600	296,600	958,950
		Total Expected Expenses (incorporating inflation rate correction factor)	296,600	317,362	339,577	363,348	757,852	415,997	445,117	476,275	509,614	1,325,295	583,457	624,299	668,000	714,760	2,472,684
Expected Income	1	Water Tariff	684,300	684,300	702,600	702,600	724,800	724,800	747,900	747,900	770,100	770,100	815,400	815,400	860,700	860,700	906,000

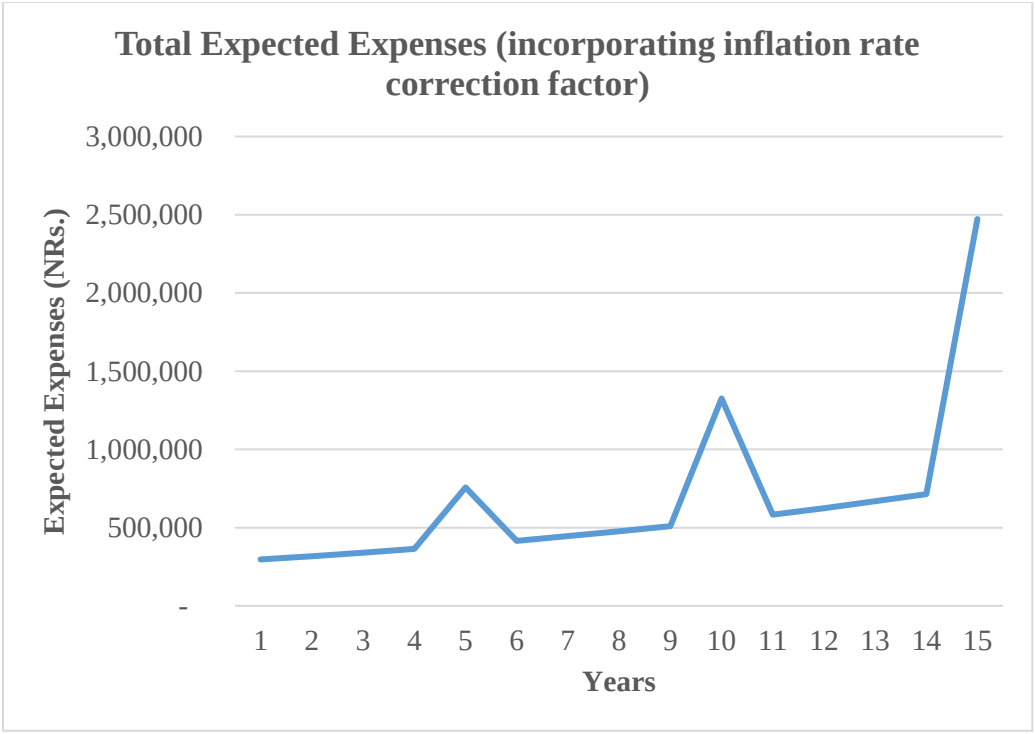
	2	Tap Connection Charge (one time)		-	40,000	-	50,000	-	50,000	-	50,000	-	100,000	-	100,000	-	100,000
		Total Expected Income	684,300	684,300	742,600	702,600	774,800	724,800	797,900	747,900	820,100	770,100	915,400	815,400	960,700	860,700	1,006,000
Expected Income - Expenses			387,700	366,938	403,023	339,252	16,948	308,803	352,783	271,625	310,486	-555,195	331,943	191,101	292,700	145,940	-1,466,684
Expected Cumulative Cash flow			387,700	754,638	1,157,661	1,496,913	1,513,861	1,822,664	2,175,448	2,447,073	2,757,559	2,202,364	2,534,307	2,725,408	3,018,108	3,164,048	1,697,363

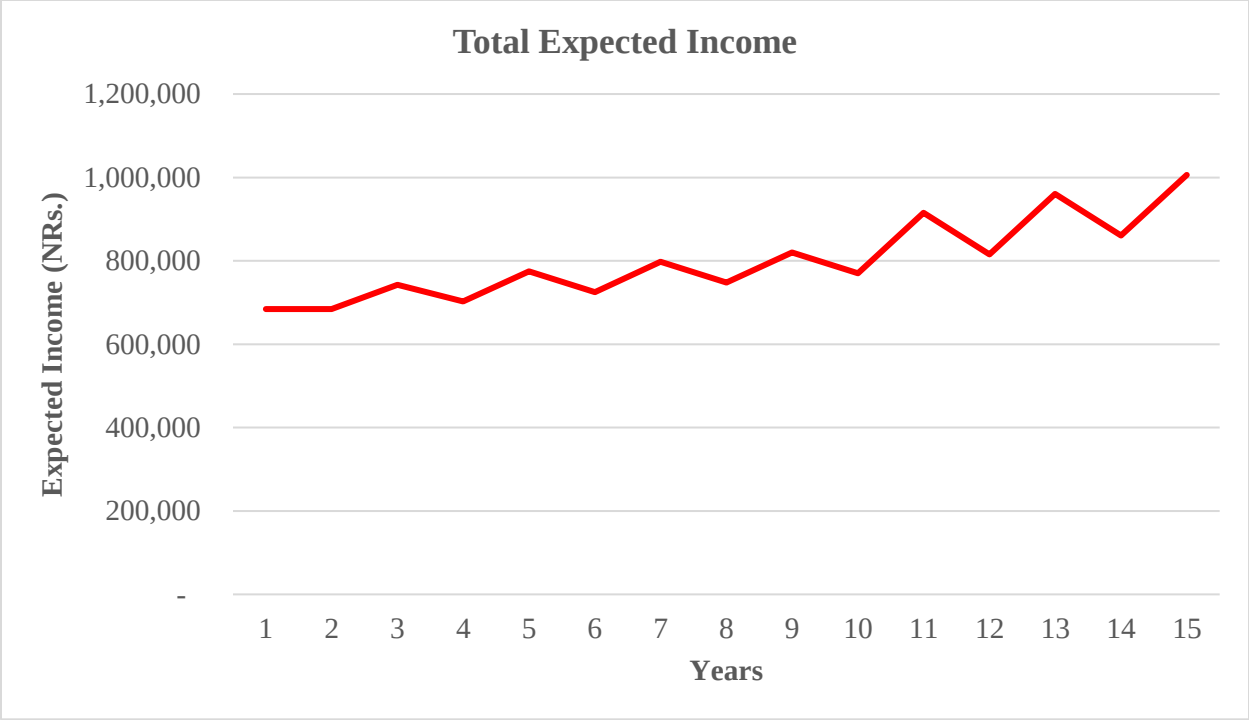
Source: *Kalitar Sustainable WASH Project/WAN/CIUD/2023*

3.4 Cash Flow in Summary

	Cash Flow (Yearly Cost Distribution)														
Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Total Expected Expenses (incorporating inflation rate correction factor)	296,600	317,362	339,577	363,348	757,852	415,997	445,117	476,275	509,614	1,325,295	583,457	624,299	668,000	714,760	2,472,684
Total Expected Income	684,300	684,300	742,600	702,600	774,800	724,800	797,900	747,900	820,100	770,100	915,400	815,400	960,700	860,700	1,006,000
Expected Income - Expenses	387,700	366,938	403,023	339,252	16,948	308,803	352,783	271,625	310,486	(555,195)	331,943	191,101	292,700	145,940	(1,466,684)
Expected Cumulative Cash flow	387,700	754,638	1,157,661	1,496,913	1,513,861	1,822,664	2,175,448	2,447,073	2,757,559	2,202,364	2,534,307	2,725,408	3,018,108	3,164,048	1,697,363

Source: *Kalitar Sustainable WASH Project/WAN/CIUD/2023*


Total Expected Expenses (incorporating inflation rate correction factor)
Expected Expenses (NRs.)
3,000,000
2,500,000
2,000,000
1,500,000
1,000,000
500,000
-
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Years


Total Expected Income
1,200,000
1,000,000
800,000
600,000
400,000
200,000
-
Expected Income (NRs.)
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Years


Total Expected Expenses vs. Income
3,000,000
2,500,000
2,000,000
1,500,000
1,000,000
500,000
-
Expenses/Income (NRs.)
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Years
Total Expected Expenses (incorporating inflation rate correction factor)
Total Expected Income

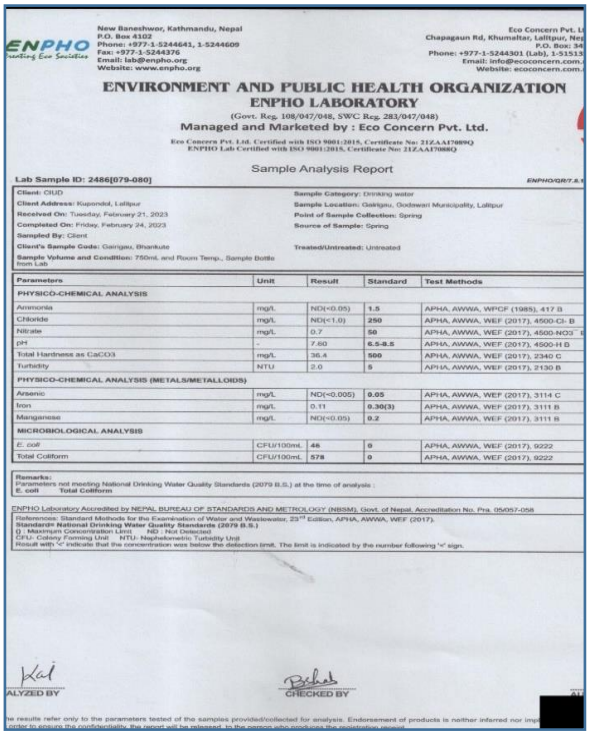
3.5 Water Tariff

Fixing water tariff was one of the key parts of the financial plan of the AMP. Through the broad discussion and reviews and consultations, the Kalitar WUC team, in presence of the AMP team, determined the water tariff for the system. Guided by the financial projection of the plan, the WUC fixed the water sale charges as mentioned above.

3.6 ANNEXTURES:

Annex 1: Water Quality Test Report

Water Quality Report-Garigaun



ENVIRONMENT AND PUBLIC HEALTH ORGANIZATION
ENPHO LABORATORY
(Govt. Reg. 108/047/048, SWC Reg. 283/047/048)
Managed and Marketed by : Eco Concern Pvt. Ltd.

Sample Analysis Report

Lab Sample ID: 2486[079-080]

Parameters	Unit	Result	Standard	Test Methods
PHYSICO-CHEMICAL ANALYSIS				
Ammonia	mg/L	ND(<0.05)	1.5	APHA, AWWA, WPCF (1985), 417 B
Chloride	mg/L	ND(<1.0)	250	APHA, AWWA, WEF (2017), 4500-Cl- B
Nitrate	mg/L	0.7	50	APHA, AWWA, WEF (2017), 4500-NO3- I
pH	-	7.60	6.5-8.5	APHA, AWWA, WEF (2017), 4500-H B
Total Hardness as CaCO3	mg/L	36.4	500	APHA, AWWA, WEF (2017), 2340 C
Turbidity	NTU	2.0	5	APHA, AWWA, WEF (2017), 2130 B
PHYSICO-CHEMICAL ANALYSIS (METALS/METALLOIDS)				
Arsenic	mg/L	ND(<0.005)	0.05	APHA, AWWA, WEF (2017), 3114 C
Iron	mg/L	0.11	0.30(3)	APHA, AWWA, WEF (2017), 3111 B
Manganese	mg/L	ND(<0.05)	0.2	APHA, AWWA, WEF (2017), 3111 B
MICROBIOLOGICAL ANALYSIS				
E. coli	CFU/100mL	46	0	APHA, AWWA, WEF (2017), 9222
Total Coliform	CFU/100mL	578	0	APHA, AWWA, WEF (2017), 9222

Remarks:
Parameters not meeting National Drinking Water Quality Standards (2079 B.S.) at the time of analysis :
E. coli Total Coliform

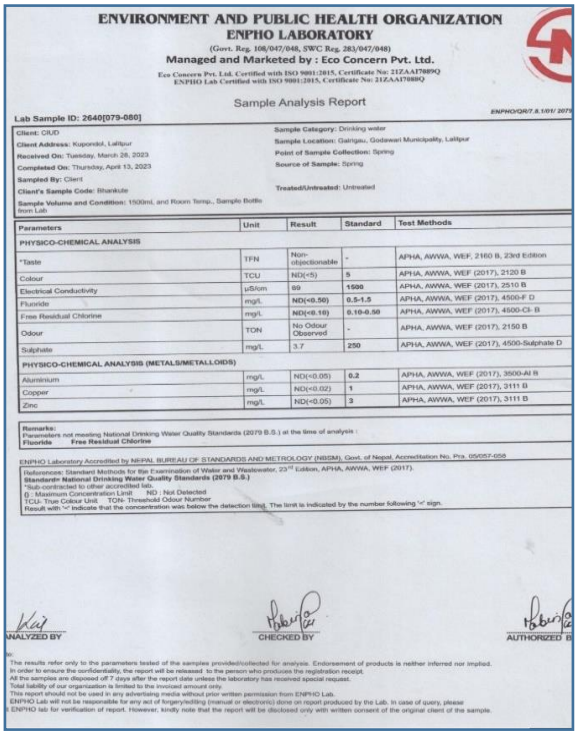
ENPHO Laboratory Accredited by NEPAL BUREAU OF STANDARDS AND METROLOGY (NBSM), Govt. of Nepal. Accreditation No. Pra. 05/057-058

References: Standard Methods for the Examination of Water and Wastewater, 23rd Edition, APHA, AWWA, WEF (2017).
Standard= National Drinking Water Quality Standards (2079 B.S.)
() : Maximum Concentration Limit ND : Not Detected
CFU- Colony Forming Unit NTU- Nephelometric Turbidity Unit
Result with '<' indicate that the concentration was below the detection limit. The limit is indicated by the number following '<' sign.

ANALYZED BY CHECKED BY

The results refer only to the parameters tested of the samples provided/collected for analysis. Endorsement of products is neither inferred nor implied.
In order to ensure the confidentiality, the report will be released to the person who produces the registration receipt.

Water Quality Test Report-Kalitar



ENVIRONMENT AND PUBLIC HEALTH ORGANIZATION
ENPHO LABORATORY
(Govt. Reg. 108/047/048, SWC Reg. 283/047/048)
Managed and Marketed by : Eco Concern Pvt. Ltd.

Sample Analysis Report

Lab Sample ID: 2640[079-080]

Parameters	Unit	Result	Standard	Test Methods
PHYSICO-CHEMICAL ANALYSIS				
*Taste	TFN	Non-objectionable	-	APHA, AWWA, WEF, 2160 B, 23rd Edition
Colour	TCU	ND(<5)	5	APHA, AWWA, WEF (2017), 2120 B
Electrical Conductivity	µS/cm	89	1500	APHA, AWWA, WEF (2017), 2510 B
Fluoride	mg/L	ND(<0.50)	0.5-1.5	APHA, AWWA, WEF (2017), 4500-F D
Free Residual Chlorine	mg/L	ND(<0.10)	0.10-0.50	APHA, AWWA, WEF (2017), 4500-Cl- B
Odour	TON	No Odour Observed	-	APHA, AWWA, WEF (2017), 2150 B
Sulphate	mg/L	3.7	250	APHA, AWWA, WEF (2017), 4500-Sulphate D
PHYSICO-CHEMICAL ANALYSIS (METALS/METALLOIDS)				
Aluminium	mg/L	ND(<0.05)	0.2	APHA, AWWA, WEF (2017), 3500-Al B
Copper	mg/L	ND(<0.02)	1	APHA, AWWA, WEF (2017), 3111 B
Zinc	mg/L	ND(<0.05)	3	APHA, AWWA, WEF (2017), 3111 B

Remarks:
Parameters not meeting National Drinking Water Quality Standards (2079 B.S.) at the time of analysis :
Fluoride Free Residual Chlorine

ENPHO Laboratory Accredited by NEPAL BUREAU OF STANDARDS AND METROLOGY (NBSM), Govt. of Nepal. Accreditation No. Pra. 05/057-058

References: Standard Methods for the Examination of Water and Wastewater, 23rd Edition, APHA, AWWA, WEF (2017).
Standard= National Drinking Water Quality Standards (2079 B.S.)
*Sub-contracted to other accredited lab.
() : Maximum Concentration Limit ND : Not Detected
TCU- True Colour Unit TON- Threshold Odour Number
Result with '<' indicate that the concentration was below the detection limit. The limit is indicated by the number following '<' sign.

ANALYZED BY CHECKED BY AUTHORIZED BY

The results refer only to the parameters tested of the samples provided/collected for analysis. Endorsement of products is neither inferred nor implied.
In order to ensure the confidentiality, the report will be released to the person who produces the registration receipt.
All the samples are disposed off 7 days after the report date unless the laboratory has received special request.
Total liability of our organization is limited to the invoiced amount only.
This report should not be used in any advertising media without prior written permission from ENPHO Lab.
ENPHO Lab will not be responsible for any act of forgery/editing (manual or electronic) done on report produced by the Lab. In case of query, please
ENPHO lab for verification of report. However, kindly note that the report will be disclosed only with written consent of the original client of the sample.

Annex 2: Parameters of NDWQS applicable for Rural Surface Water Supply Systems

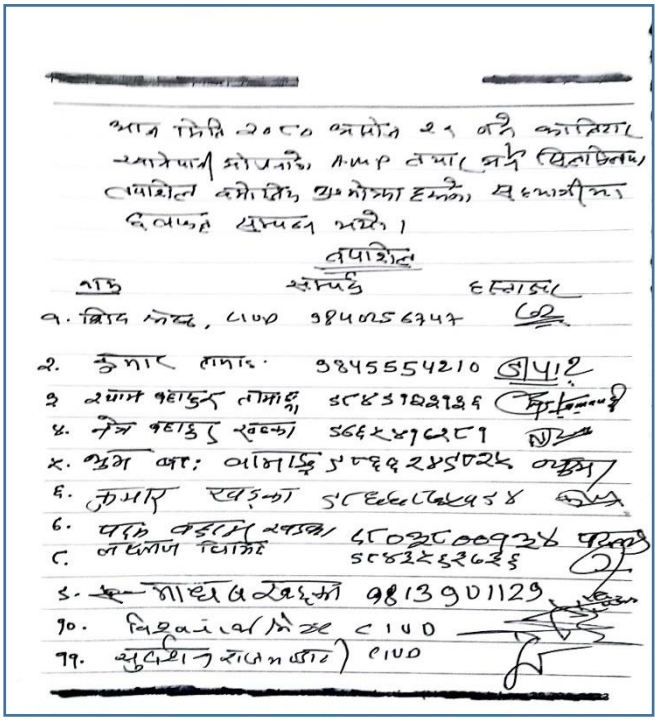
S/N	Category	Parameters	Units	Concentration Limits	Remarks
1	Physical	Turbidity	ntu	5 (10)	
2		pH		6.5-8.5*	
3		Color	TCU	5 (15)	
4		Taste and Odor		Non-objectionable	
5		TDS	mg/L	1000	
6		Electrical Conductivity	µs/cm	1500	

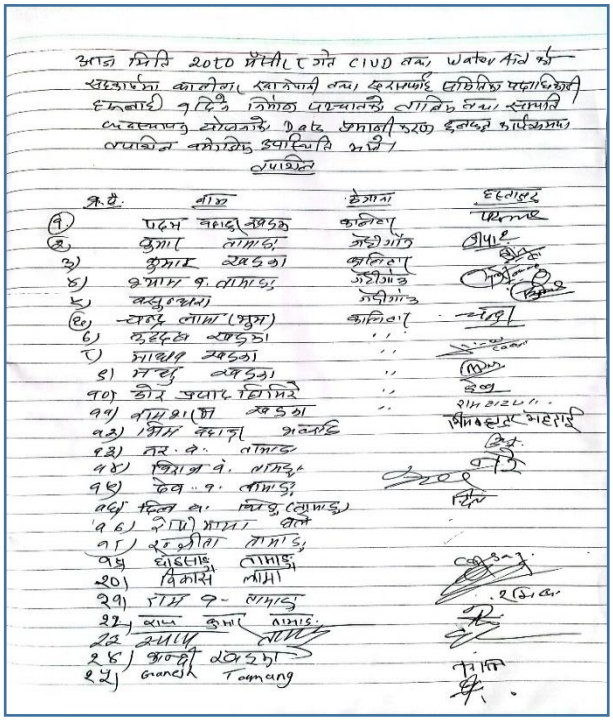
7	Chemical	Iron	mg/L	0.3 (3)	
8		Manganese	mg/L	0.2	
9		Arsenic	mg/L	0.05	
10		Cadmium	mg/L	0.003	
11		Chromium	mg/L	0.05	
12		Cyanide	mg/L	0.07	
13		Fluoride	mg/L	0.5 -1.5	
14		Lead	mg/L	0.01	
15		Ammonia	mg/L	1.5	
16		Chloride	mg/L	250	
17		Sulphate	mg/L	250	
18		Nitrate	mg/L	50	
19		Copper	mg/L	1	
20		Total Hardness	mg/L as CaCo3	500	
21		Calcium	mg/l	200	
22		Zinc	mg/L	3	
23		Mercury	mg/L	0.001	
24		Aluminum mg/L 0.2	Aluminum mg/L 0.2	Aluminum mg/L 0.2	
25		Chemical Residual Chlorine	mg/L	0.1-0.2	in systems using chlorination
26	Microbiologic	E. Coli	MPN/100 ml	0	
27		Total Coliform	MPN/100 ml	0 in 95% samples	

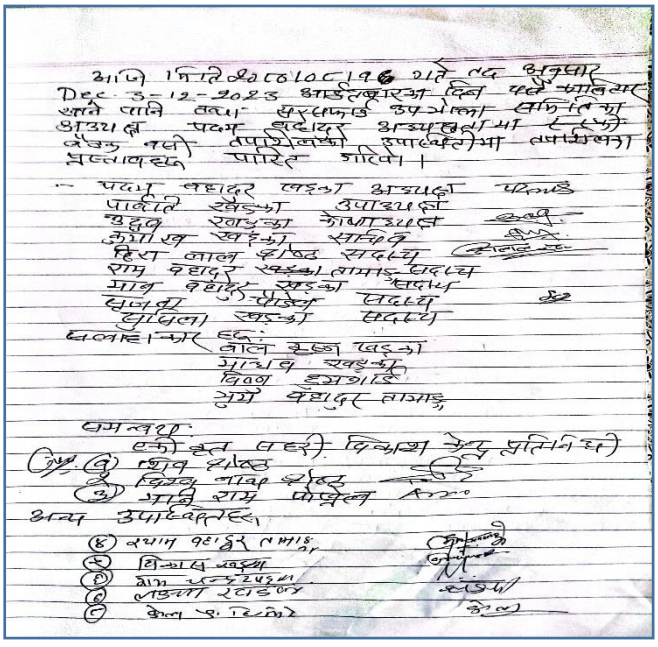
	al		0 in 95% samples		

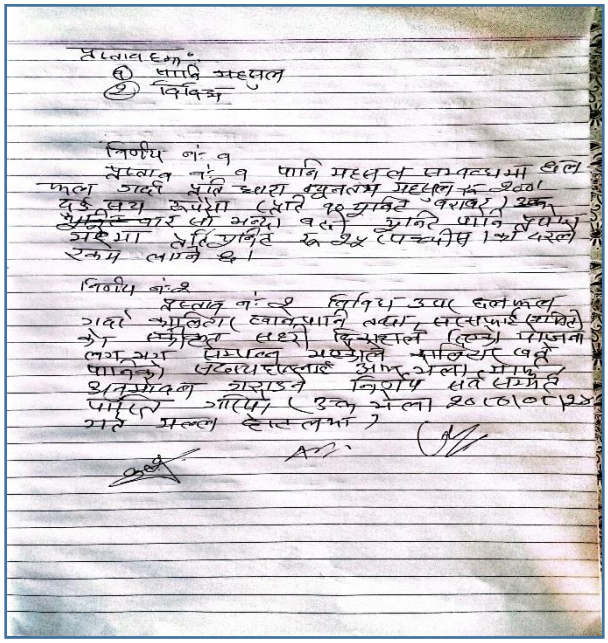
(Source: National Drinking Water Quality Standard 2062)

Annex 3: Meeting Minutes









Annex 4: List of Water Users' Committee

A.Kalitar Water Users' Committee:			
S.No	**Name of Member**	**Positiion**	**Contact Number**
1	Mr. Padam Bahadur Khadka	Chairperson	9803800134
2	Ms. Sarita Tamang	Vice Chairperson	9808727994
3	Mr. Kumar Khadka	Secretary	9866875195
4	Ms. Anita Khadka	Under Secretary	
5	Mr. Bhum Bahadur Tamang	Treasurer	9866249825
6	Ms. Shirjana Poudel	Member	9840242399
7	Mr. Ram Sharan Khadka	Member	
8	Mr. Madhav Khadka	Member	9813901129
9	Ms. Sunimaya Tamang	Member	
10	Ms. Laxmi Khadka	Member	9742475304
11	Ms. Sunita Khadka	Member	9861143280

B.Garigaun Water Users' Committee:			
S.No	**Name of Member**	**Positiion**	**Contact Number**
1	Mr. Kumar Tamang	Chairperson	9845554210
2	Mr. Bhim Bahadur Tamang	Vice Chairperson	
3	Mr. Shyam Bahadur Tamang	Secretary	
4	Ms. Basundhara Lama	Treasurer	
5	Mr. Suresh Tamang	Member	
6	Mr. Choisang Tamang	Member	
7	Mr. Dev Bahadur Tamang	Member	

Annex 5: Photographs

References

- *Annual Household Survey 2021*, Central Bureau of Statistics National Planning Commission Secretariat, Government of Nepal
- *Asset Managment and Monitoring Manual*, Practica foundation , Geulweg 16 – 3356LB Papendrecht – The Netherlands, 2020
- *National Drinking Water Quality Standard*, Ministry of Physical Planning and Works, Government of Nepal, 2062
- *Vanier, D. (2001) Why Industry Needs Asset Management Tools*, ASCE Journal of Computing in Civil Engineering. Vol 15(1)
- *Water Utility Asset Management*, ADB, 2013
- *Wikipe*