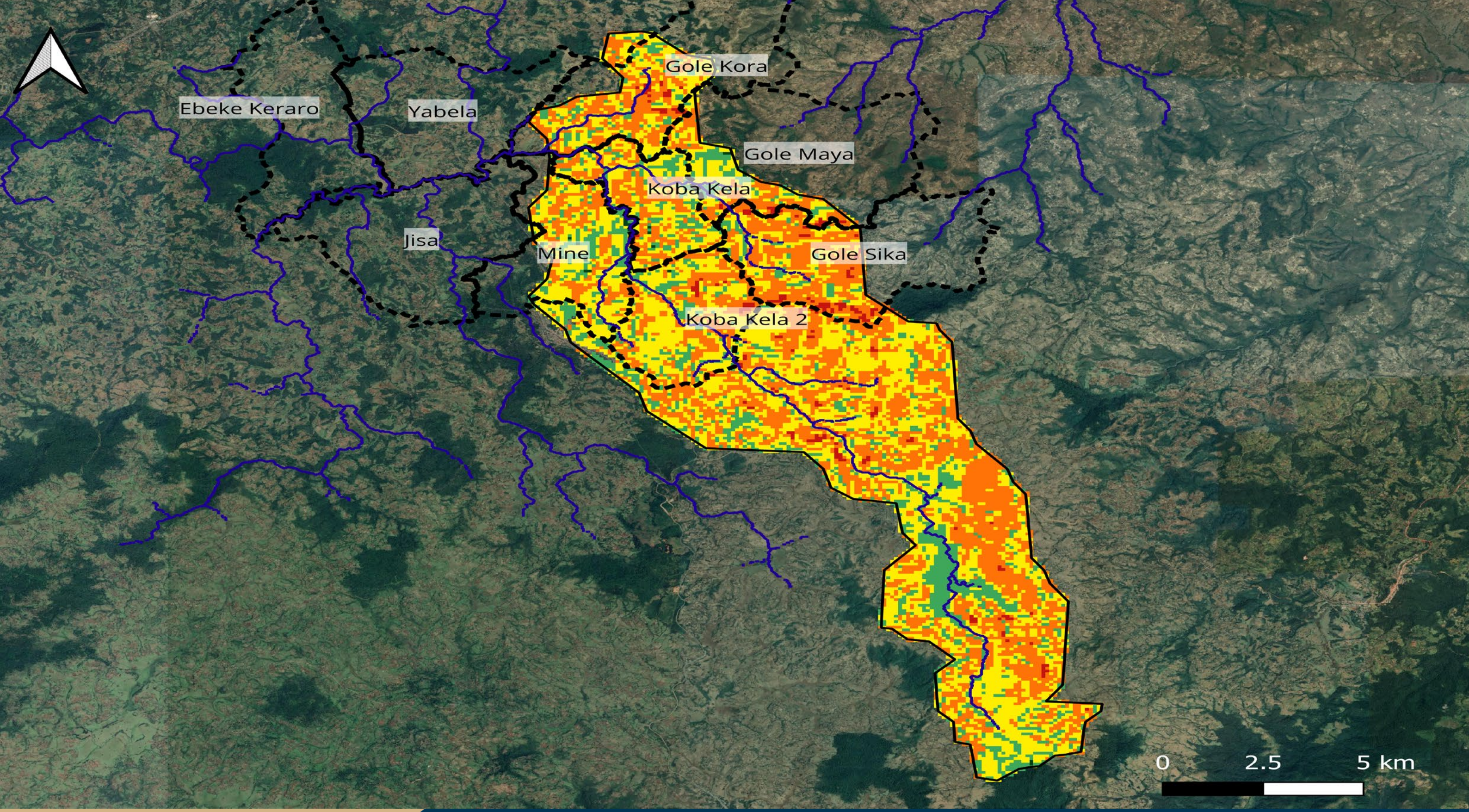

Burqaa Phase II

Catchment Management Guideline Bedele- Upper Dabena Catchment

Burqaa Phase II

Catchment Management Guideline Bedele- Upper Dabena Catchment

Executive summary

The BURQAA Initiative Phase I significantly advanced water balancing and socio-economic improvement in the Upper Dabena and Hakim Gara sub-watersheds. The project aimed to compensate for the water consumption of the Bedele and Harar Breweries by implementing soil and water conservation measures that restored degraded lands and improved water retention. These efforts yielded positive results, achieving and even exceeding water-saving targets in the Bedele area while enhancing the local environment and community well-being. Building on this success, the project resumes activities under BURQAA Phase II, expanding focus to the targeted kebeles to further support effective catchment management.

This catchment management guideline aims to enhance water resource management and improve the livelihoods of local communities. Its primary objectives include increasing water retention and availability, improving water quality, minimizing soil loss, boosting agricultural productivity, and fostering cooperation among local government sectors. The guideline outlines a comprehensive implementation framework that encompasses institutional arrangements, capacity-building initiatives, stakeholder collaboration, and risk management strategies. It promotes active community participation in decision-making processes and intervention implementation, facilitating water balancing and livelihood activities. The catchment management plan details the objectives, management strategies, action plans, and monitoring and evaluation processes to ensure sustainable water management and environmental conservation.

Colophon

Client
HEINEKEN

Status
Final Catchment management guideline

Date
January 30, 2025

Reference number
AW24_295-2_KM_221330

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3R	Recharge, Retention and Reuse
BCM	Billion Cubic Meter
CBO	Community Based Organization
BI	Burqaa Initiatives
IWRM	Integrated Watershed Management
MERL	Monitoring, Evaluation and Learning
NDVI	Normalized Difference Vegetation Index
SWC	Soil and Water Conservation
UDC	Upper Dabena Catchment

1 Introduction

1.1 Background

In Ethiopia, water scarcity, land degradation, and the impacts of climate change pose significant challenges, particularly in rural areas where agriculture and community livelihoods are closely tied to natural resources. To address these challenges, localized and practical solutions are essential. Catchment management, which focuses on managing the land and water resources within a specific watershed area, is one such approach that can play a vital role in improving water availability, restoring ecosystems, and enhancing community resilience.

The BURQAA Initiative Phase I, implemented between July 2020 and June 2023, took a significant step in this direction. It aimed to balance water use in the Upper Dabena (UDC) and Hakim Gara sub-watersheds by compensating for the water consumption of the Bedele and Harar Breweries. Through soil and water conservation measures, degraded lands were restored, and water retention was improved, benefiting both the local environment and community. The project saw positive results, achieving nearly 100% of its water-saving targets in the Bedele area and even exceeding expectations in Harar.

Building on this success, the BURQAA Initiative Phase II expands these efforts to new areas while focusing on ensuring long-term sustainability. A key element of this phase is the development of a Catchment Management Guideline that is simple, practical, and specifically designed for small-scale implementation at the community level. This guideline will serve as a hands-on tool for local experts to carry out effective catchment management in ways that are directly applicable to the needs of their communities.

1.2 The Need for a Community-Based Catchment Management Guideline

This Catchment Management Guideline is the first of its kind developed within the BURQAA project, and it provides a straightforward, actionable framework for managing catchments on a small scale. Unlike larger, more complex plans, this guideline is tailored to be easily implemented by local woreda (district) and kebele (community) experts. It focuses on practical, low-cost, and community-driven interventions that can be adopted quickly and effectively by the people living within these catchment areas.

The simplicity and accessibility of this guideline are what make it unique. It is designed to be a user-friendly document that offers clear instructions for local actors, including government officials, community groups, and private sector stakeholders, enabling them to carry out sustainable land and water management activities. The guideline draws on the successes and lessons from BURQAA Phase I, ensuring that best practices are scaled up while addressing the unique challenges of the UDC and Hakim Gara sub-watersheds.

1.3 Purpose and Scope of the Catchment Management Guideline

The purpose of this guideline is to provide a practical, step-by-step framework for effective catchment management at the community level. It aims to empower local experts with the tools and knowledge needed to implement small-scale interventions that improve water availability, restore degraded lands, and enhance the resilience of local ecosystems and livelihoods.

The scope of the guideline includes:

- Practical Water Management Interventions: Simple techniques for enhancing water retention and availability, designed to be implemented with limited resources.
- Soil and Water Conservation: Low-cost measures such as tree planting, check dam construction, and soil bunds, which can be easily adopted by communities.
- Community Participation: Emphasis on involving residents in planning and implementing catchment management activities, ensuring ownership and sustainability.
- Monitoring and Reporting: Basic tools and methods for tracking progress and ensuring accountability, accessible to woreda and kebele-level experts.

This guideline is not a comprehensive catchment management plan, but rather a straightforward tool that offers practical guidance for immediate, small-scale actions. It builds on local knowledge and the experiences of BURQAA Phase I to create simple, implementable solutions for enhancing water security and restoring ecosystems in the project areas.
By providing this resource, the project aims to support local stakeholders in taking a leading role in managing their natural resources, with the ultimate goal of improving both environmental outcomes and community well-being.

2 Catchment Description and Assessment

UDC catchment is in the western rainforest region of Ethiopia. The area receives high rainfall throughout the whole year. However, due to soil erodibility and run-off generated small amount of rainfall contributed to groundwater recharge. The high land parts of the UDC are highly vulnerable to erosion due to high rainfall magnitude and erodible soil properties.

2.1 Catchment Characteristics

The UDC highlands located in the Southwestern part of Ethiopia are generally known for high rainfall as it receives whole year-round rainfall.   As a result of the high magnitude of rainfall, deep gorges were formed, where the change in the landscape profile was observed. The following Figure 1 shows the target area planned to implement the interventions under Burqaa phase II. Goba Kella, Gole Kora and Gole Maya were the highland parts where highly eroded areas (erosion hotspots). The following Figure 1 shows the locations of target areas for Burqaa phase II project.

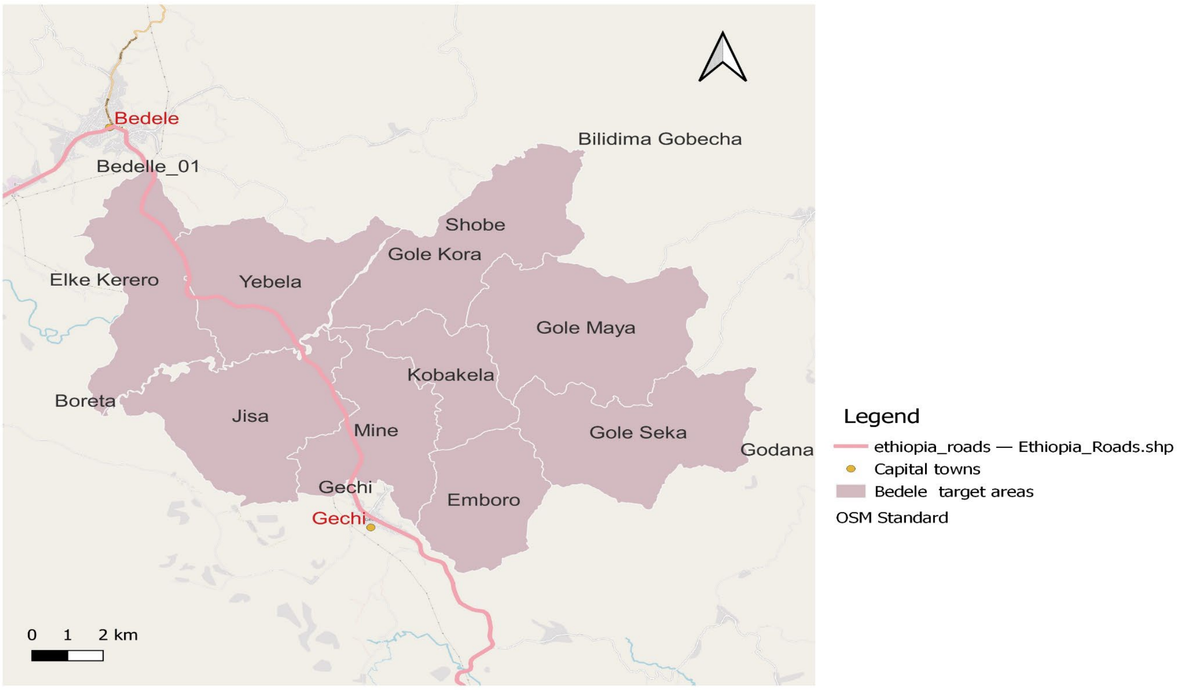


Figure 1. Locations of target area (Bedele sites)

2.1.1 Physical Characteristics

The UDC elevation ranges from a minimum of 1476 m to a maximum of 2370m above sea level. Gole Seka, Gole Maya, and Gole Kora kebeles are located on the highest elevation point between 2000 to 2200m. Even though Emboro, Mine, and Jisa kebeles are located downstream of the catchment, the maximum elevation point is between 1800 to 2100m. The drainage divides are at the peak elevation of Gole Kora kebele, and the river drainage flows in the South-North direction to Dabena River. The perennial river tributaries flow to Dabena river downstream.   The upper UDC catchment is mainly covered by the forest. The slope in the target area varies from 0 to 30%.

The mountainous areas of Gole Seka, Gole Maya, and Gole Kora have high slope variations up to 30% of slope variations. The catchment area has an average slope between (5 -15) %. The Bedelle area is mostly covered with open grass trees and croplands. The green areas are forest cover. The land use and cover in the target areas are shown in Figure 2.

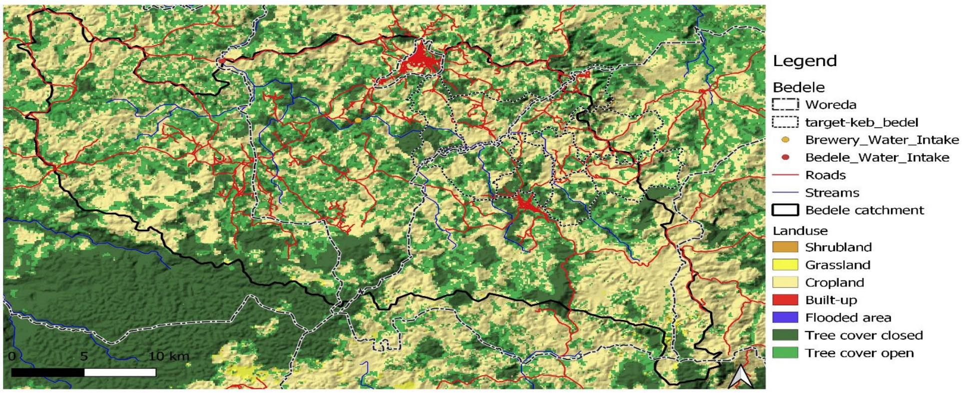


Figure 2. Upper Dabena land use and land cover

2.1.2 Hydrology and Water Resources

The hydrologic condition of the UDC is influenced by the magnitude of rainfall. Dabena river is the biggest river that joins Didessa in the area that flows Northwest to Bedele town. Upper Dabena target kebeles are considered moist and perennial river flows. The maximum (peak) water flow could happen during summer season in June, July and August.

Also, the minimum river flow occurred during the winter Autumn season in March, April, may
The river water sources are used for irrigation, water supply and industrial uses.

2.1.3 Socio-economic Aspect

The largest proportion of inhabitants practice agricultural work for a living. Coffee is the main cash crop for the export standard while food crops such as maize, wheat and barley are cultivated for personal consumption. This medium-sized market facilitates trade in various commodities centers including maize, teff, sorghum, vegetables, potatoes, beetroot, coffee, meat (cow, sheep, and goat), fruits, and honey. Within the catchment area, two nurseries, namely Dabena and Koba Kella, produce seedlings, e.g., Gerillia Robusta, Pinus patula, Nim tree, and bamboo. Target kebeles have primary and secondary schools, health care facilities and accessible roads. Accessible road and community services still lagging behind for remote kebeles and highland areas.

2.2 Catchment Assessment and Analysis

The catchment feasibility study is required before recommendation of catchment management activities. The first step is to identify and delineate the boundary of the watershed. Biophysical and socio-economic data should be collected to support evaluation and the requirements of interventions. In addition to that, stakeholders' participation and involvement are required in each step of activity. Here in, we should discuss the baseline assessment conducted and co design, implementation and exit strategies.

2.2.1 Data Collection and Baseline Studies

Precipitation

According to CHIRPS data, the annual rainfall in the Bedelle target area varies between 1400 to 2200 mm/year. The following map depicts the annual rainfall variations in the target and surrounding areas. Figure 3 below shows the rainfall variations in Bedelle, UDC (the blue color shows high rainfall while red is less rainfall).

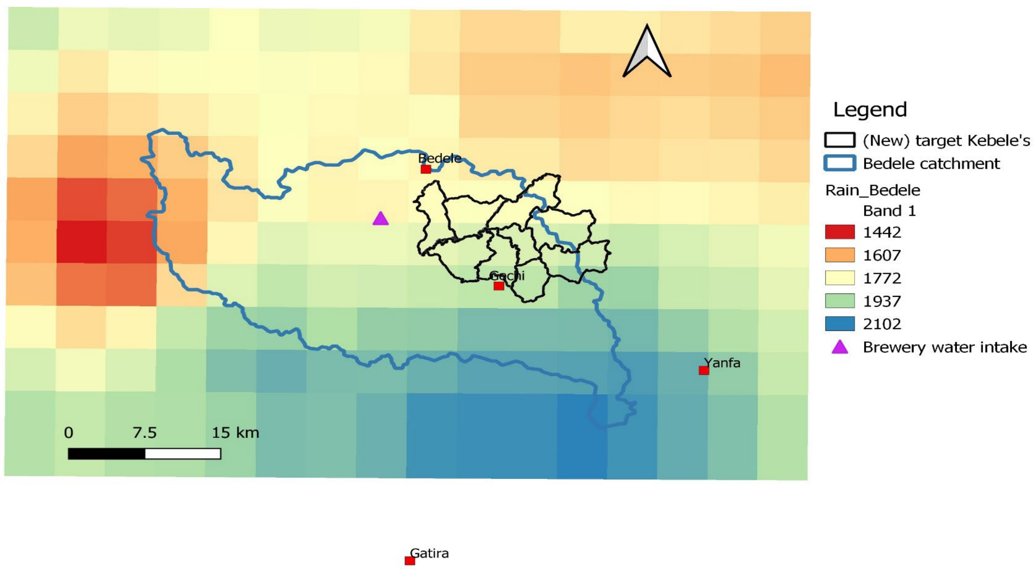


Figure 3. Annual rainfall variation at Bedele catchment.

Normalized Difference Vegetation Index (NDVI)

NDVI helps to assess and quantify vegetation greenness, identify vegetation density and assess changes in plant health. It is correlated to water availability in the soil. For each year that the sentinel data is available (2019-2022), several months of data have been analyzed for comparison. January – February, beginning of the dry season, when the soil starts to dry up and vegetation is minimum. March – April, Dry season, to see the land at its driest and to assess if any available moisture is being retained.

Soil Moisture

The Acacia Water team collected soil moisture in all kebeles of target areas. These measurements were taken every two weeks and recorded regularly. The soil moisture measurement data were collected from May 2022 to August 2022, was compiled under Burqaa phase I report. The baseline data were supported with data collected in June 2024. The collected soil moisture data has been shown that the soil moisture in the intervention areas are high due to improved soil water holding capacity.

2.2.2 Hydrology

2.2.3

In UDC catchment most rivers are perennial due to long season rainfall. The small streams and springs join Dabena river. The kebele target areas are considered as moist and perennial river flows. Recently, agricultural land use has drastically changed. As a result, the vegetation cover change affected the rate of evapotranspiration. Despite the availability of rainfall in the area, the natural water recharges to groundwater are limited due to soil erosion upstream and the occurrence of flooding in the area. Larger volumes of groundwater are available in perennial riverbeds, in inland alluvial valleys.

2.2.4 Land degradation (Erosion vulnerability)

Gole kara, Gole maya and Gole Saka areas are highly vulnerable to erosion and Gole maya highland areas are considered erosion hot spot areas. The other new kebeles are not considered as non-vulnerable sites to erosion. It is recommended to implement soil and water conservation practices to reduce the impact of erosion. The following map shows the erosion vulnerability and erosion hot spot areas in Bedele kebele target areas.

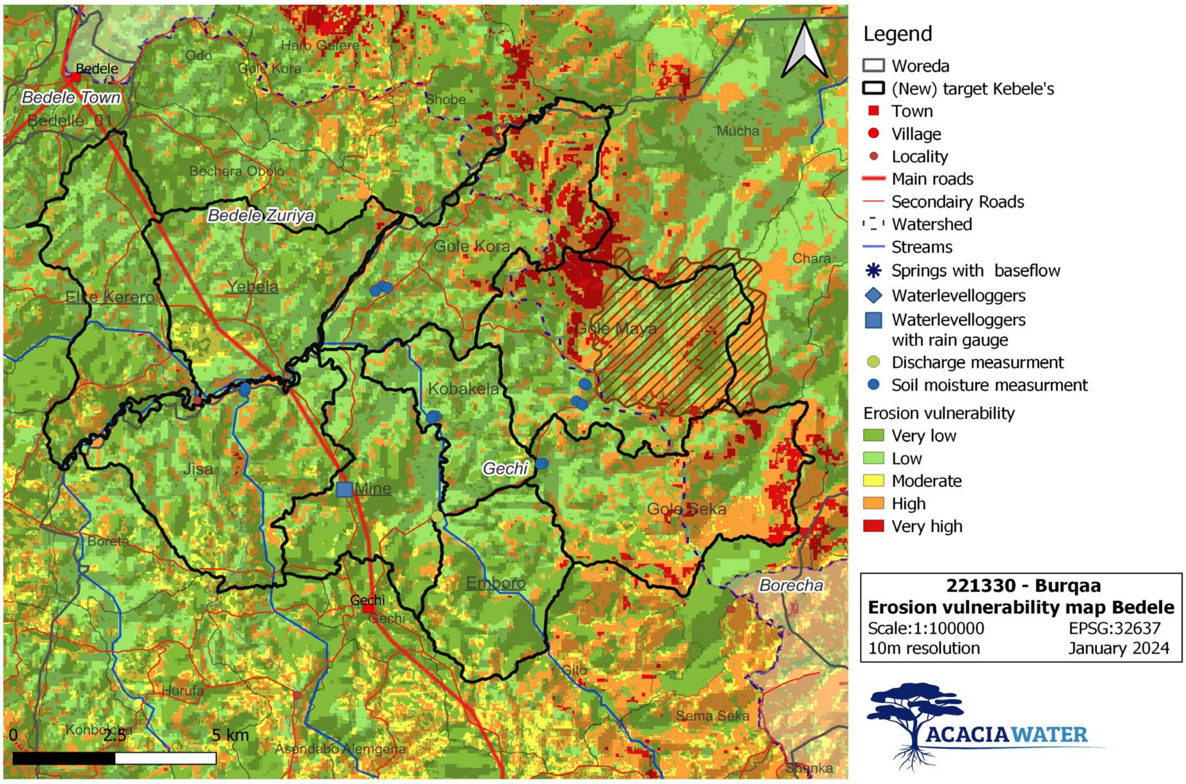


Figure 4. Soil erosion vulnerability map and erosion hotspots

2.2.5 Stakeholder Mapping

Engaging with local stakeholders is crucial for the success of water resource management initiatives. The presence of local water committees in the kebele is vital for community participation and sustainable management.

Local Water Committee

A local water committee has been established in Hakim Gara, serving as a platform for community members to discuss water management issues, share knowledge, and collaborate on sustainable practices. Their involvement ensures that local needs and perspectives are incorporated into project planning and implementation.

Engagement Strategies

The community engagement strategies include:

- Community Workshops: Organized to educate the community about water conservation practices and the importance of sustainable land management. Regular Meetings: Conducted with the water committee to review progress, address concerns, and adapt strategies as needed. Feedback Mechanisms: Established to allow community members to voice their experiences and suggestions regarding water management practices.

2.2.6 Hydrological Assessment

The hydrological assessment of UDC focuses on rainfall patterns, groundwater recharge, surface water availability, and soil moisture dynamics in the area. The primary goal is to evaluate the current water availability and its potential for supporting sustainable land and water management.

2.2.7 Catchment Delineation sub catchment

Sub watershed catchment is more important than that of kebele boundaries when it comes to watershed (catchment management) plan. Usually sub watershed boundaries will not necessarily overlap. The hydrological process of catchment is influenced by physical characteristics within natural boundaries. In general, subsurface water does flow from one sub catchment to another except underlying complex geology. The following figure shows the delineated watershed targeted to Burqaa initiative in Upper Dabena catchment. The Highlands parts of Gole Seka, Gole Maya and Gole Kora have high slopes where bench terraces and protected area closure are recommended. The highland parts are shrublands and easy for implementation of area closure. Sub watershed selection is the first step to starting SWC activities for ground water recharge.
The following Figure 5 and Figure 6 shows the delineated watershed for water balancing activities used during catchment management action plan

Catchment: Bedele
Map displaying the classification of the Revised Universal Soil Loss Equation for subbasin B6.

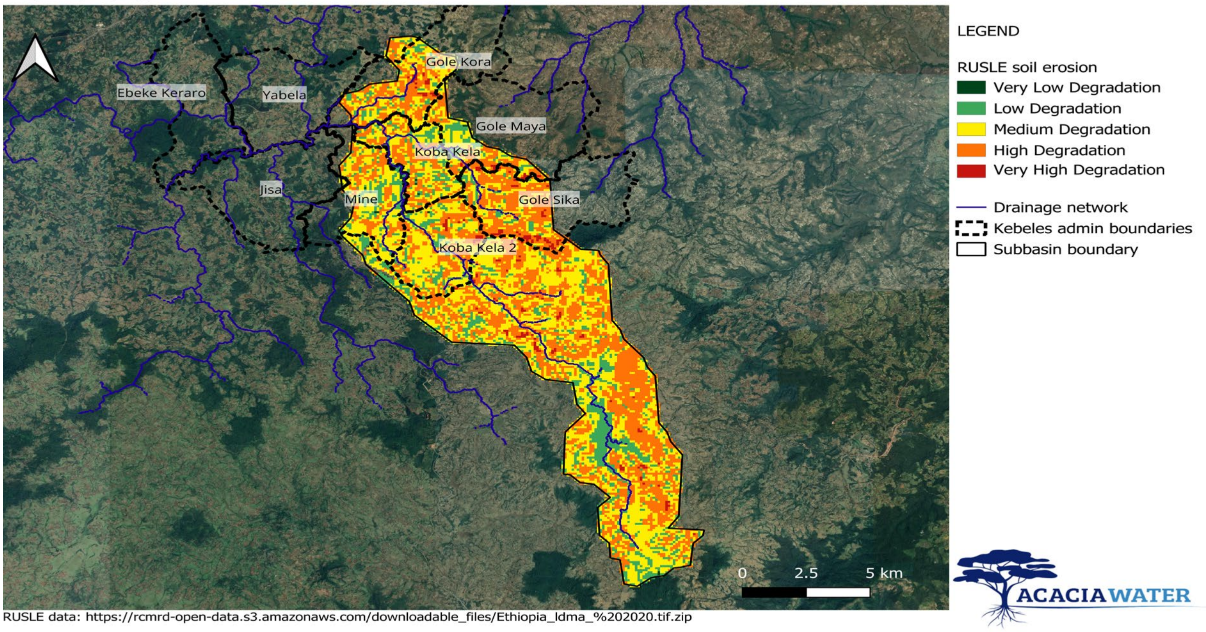


Figure 5. Subwatershed delienation and erosion vulnerability mapping

Catchment: Bedele
Map displaying the classification of the Revised Universal Soil Loss Equation for subbasin B4.

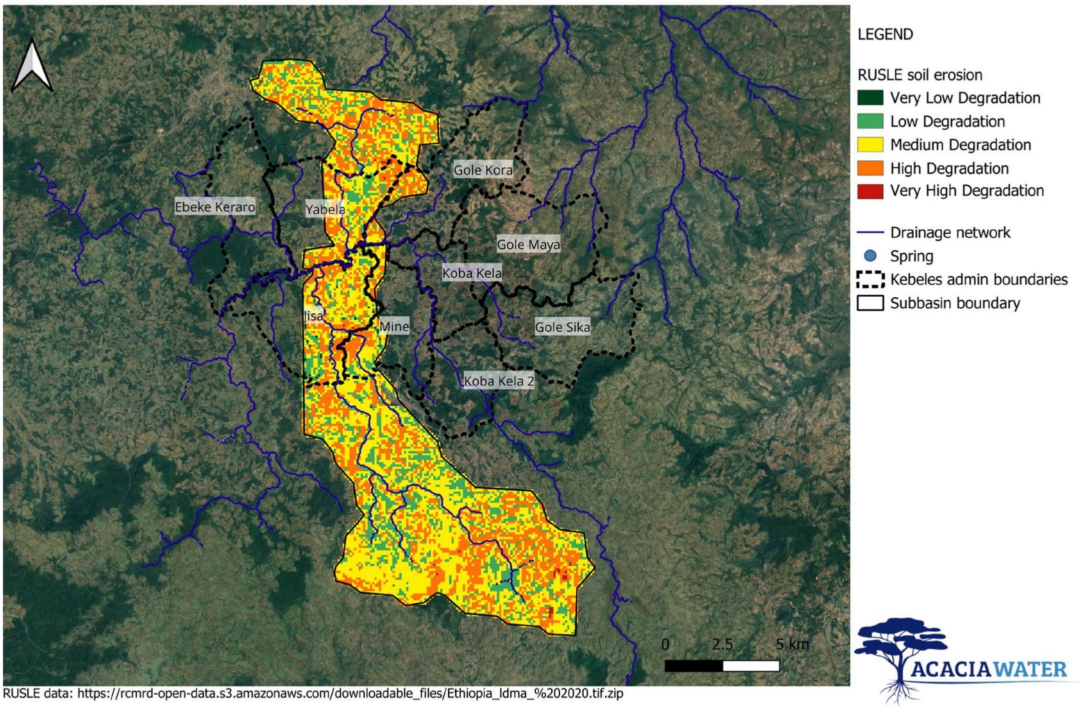


Figure 6. Sub watershed delineation and erosion vulnerability mapping

Key Points:

- **Seasonal Distribution**: The spatial distribution of rainfall is uniform receives high rainfall annually. Rainfall peaks resulted in high erosion and runoff in highland parts.

- **Groundwater Recharge**: Limited recharge capacity due to high surface runoff that contributed to less ground recharge.

Surface Water and River Systems

Dabena river is the main river in Bedelle target areas. Discharge measurements from various locations show high flow rates, indicating limited surface water availability in high land parts of the catchment. Measurements were made using the telemetric monitoring system.

- **Brewery intake**: Flow rate of maximum **38.6 m^3/s** and minimum **2.4 m^3/s.**
- **Dabena gauging station**: Flow rate of maximum **112.5 m^3/s** and minimum **10 m^3/s**.

These results highlight no surface water stress in the area. However, soil water retention is low for agriculture and ground water recharges.

Soil Moisture and Land Restoration

Soil moisture levels were recorded at multiple locations of the Bedele upper plateau, both in old and new kebeles (e.g., **Emboro**, **Mine**, and **Yabala**). These measurements provide insights into the effectiveness of land restoration efforts and water conservation techniques. For further information please refer to the soil moisture data report mission in Burqaa Phase I and phase II document.
Findings in June 2024:

- At Gole Kora, average soil moisture in the summer season is **0.35 m^3/m^3**. Summer season soil moisture is highly variable as it depends on several factors.
- In new kebeles, such as **Yabala,** soil moisture levels were **0.38 m^3/m^3**. confirming that low slope areas have high water retention high slope areas Gole Kora **0.35 m^3/m^3**.

These variations in soil moisture indicate the effectiveness of conservation interventions, such as bund construction and tree plantations, but also point to areas where further action is needed.

Impacts of Water Scarcity on Agriculture and Livelihoods

The hydrological assessment aimed to understand water availability and quality in upper Dabena focusing on rainfall patterns, groundwater recharge, and surface water dynamics.
The limited availability of soil moisture directly affects agricultural productivity and domestic water supply from ground water.
The seasonal nature of water resources has led to:

- **Reduced agricultural yields** due to water shortages during critical growing periods.
- **Low ground water recharges** as observed by high runoff magnitude, particularly during high season flooding.

2.2.8 Key Pressure and Challenges

Population growth, soil infertility through land degradation, put pressure on the living conditions of the community. Particularly, deforestation and unsustainable land management (USLM) with hydro meteorological risks causes exposure to challenges
The following water related challenges are observed in Hakim Gara catchment:

- **Land Degradation & Soil Erosion**: Deforestation and unsustainable land management practices cause soil erosion, increased overland flow and erratic flooding, reducing soil moisture storage opportunities and agricultural productivity.
- **Low Management Capacity**: The community struggles with inadequate infrastructure, maintenance skills, and awareness for sustainable water and land management.
- **Water Pollution**: Urban waste disposal pollutes surface and groundwater, affecting health and agricultural production.
- **Lack of soil conservation and Water Harvesting Technology**: Limited access to water harvesting and efficient agricultural water use techniques for soil conservation.

- **Climate Change Vulnerability**: Unpredictable rainfall and prolonged droughts worsen water scarcity and land degradation.

3 Management Objectives and Strategies

Effective catchment management requires clear objectives and strategies that align with the overall goal of improving water availability, reducing land degradation, and enhancing the livelihoods of the community. The management objectives in this guideline focus on promoting sustainable use of water resources, improving soil and land conditions, and ensuring active community participation.

3.1 Criteria/Indicators for Sustainable Water Resource Management

Effective water resource management relies on a range of criteria and indicators that ensure the sustainability of water practices and the health of the catchment area. Monitoring these indicators helps evaluate the success of various interventions and guide future strategies. Key criteria include water availability during dry seasons, water quality, soil erosion, agricultural productivity, the functionality of local water management committees, and collaboration among different sectors.

To assess water availability, indicators such as water storage levels, baseflow measurements, and water usage efficiency are used. Improved water quality is monitored through chemical and microbial contaminant levels, as well as sediment load. Soil erosion and sedimentation are evaluated by measuring erosion rates, sediment accumulation, and soil stability. Increased agricultural production is gauged by monitoring crop yields, food security, and income levels. The effectiveness of local water management committees and sectoral collaboration is assessed through committee activity, community engagement, capacity building, joint initiatives, information sharing, and policy alignment. The table below contains the identified indicators and a detailed description.

Table 1. Criteria and Indicators for Monitoring Summary Table

Criterion	Indicator	Description
More Water Availability During Dry Seasons	Water Storage Levels	Monitor levels in reservoirs, ponds, and wells to assess water availability during dry periods.
	Baseflow Measurements	Observe baseflow recession in streams and rivers to gauge groundwater recharge status and sustained water flow.
	Water Usage Efficiency	Measure water used per unit of agricultural production to evaluate water use practices.
Improved Water Quality and Reduced Pollution	Chemical Contaminant Levels	Measure harmful chemicals (e.g., nitrates, phosphates, fluoride) in water bodies to assess pollution control.
	Microbial Contaminants	Test for pathogens and bacteria to ensure water safety and reduce health risks.
	Sediment Load	Assess sediment concentrations and turbidity to evaluate sediment control measures. Create sediment

		rating curves from simultaneous discharge – sediment concentration measurements.
Reduced Soil Erosion and Sedimentation	Erosion Rates	Measure soil loss rates with erosion pins or sediment traps to evaluate erosion control practices.
	Sediment Accumulation	Observe sediment build-up in water bodies and reservoirs to assess sediment control efforts.
	Soil Stability	Evaluate soil stability and monitor for gully formation to determine erosion control effectiveness.
Increased Agricultural Production	Crop Yields	Measure the quantity and quality of crops to assess the impact of water and soil management.
	Food Security	Evaluate local food security and reduced reliance on external sources to reflect agricultural success.
	Income Levels	Monitor changes in agricultural income to assess economic benefits of improved management practices.
Functioning of Local Water Management Committees	Committee Activity	Track meeting frequency and decision-making to evaluate committee effectiveness and engagement.
	Community Engagement	Assess community involvement and feedback to evaluate local governance effectiveness.
	Capacity Building	Monitor training sessions and workshops for committee members to gauge capacity building efforts.
Effective Collaboration Between Agriculture, Water, and Environmental Offices	Joint Initiatives	Track collaborative projects and initiatives to assess integrated management efforts.
	Information Sharing	Evaluate the frequency and quality of information exchange between sectors for cooperation.
	Policy Alignment	Review the alignment of policies across sectors to assess coherence and effectiveness.

3.2 Strategies for Sustainable Water Management

To achieve the desired management objectives, a combination of strategies is needed that address the specific challenges within the catchment. The following strategies offer practical solutions for improving water availability, reducing land degradation, and promoting resilience to climate change.

A. Water Resource Management: Efficient Use and Conservation Techniques

Water efficiency can be enhanced through various practices, such as **rainwater harvesting**, which collects and stores rainwater for dry periods. Techniques like **building small check dams**, **retention ponds**, and **infiltration trenches** help manage overland flow and surface runoff. Efficient use of soil conservation systems like **mulching** can reduce overland flow water loss in the wet season and improve productivity, especially in agriculture.

Rainwater harvesting is especially effective in arid and semi-arid regions, where annual rainfall averages between 200-800mm. It serves communities where traditional water sources are unavailable, helping to improve vegetative cover and resource conservation. The method involves gathering rainwater from rooftops, rocky or other low-permeability surfaces, channeling it into storage reservoirs, and thereby providing a reliable water supply for domestic, agricultural, and livestock purposes.

Rooftop rainwater harvesting offers an affordable, decentralized accessible solution for both urban and rural settings. Schools, churches, and offices can also utilize their large roof surfaces to capture rainwater, which is particularly valuable when managed properly to meet community needs. When properly executed, the quality of the harvested water can be considered high, with low salinity and low needs for treatment.

B. Soil and Land Management: Soil Conservation Practices

Terracing and **contour plowing** are effective methods to reduce soil erosion on sloped lands. Contour plowing aligns furrows with the natural curves of the land, reducing water flow, preventing soil loss, and improving infiltration and groundwater recharge. It helps maintain soil fertility by acting as a natural barrier to erosion. To further prevent soil degradation, **gully rehabilitation** measures such as **check dams** and **vegetation planting** can stabilize land and reduce gully expansion. Studies in Northwestern Ethiopia show that these methods can significantly reduce gully depth and soil loss, enhancing landscape stability.

Moreover, introducing **cover crops** and **grass strips** helps stabilize soil and reduces sediment runoff into water bodies. These practices improve soil health, water quality, and reduce pollution, making them essential for agricultural sustainability. Cover crops like cereal rye and crimson clover provide year-round ground cover, preventing soil erosion and enhancing water retention.

C. Biodiversity Conservation: Protecting Habitats and Species

Conserving critical habitats such as wetlands, riverbanks, and forests is crucial to maintaining biodiversity and ecosystem services within catchment areas. Establishing **buffer zones** around water bodies reduces pollution and provides a habitat for local wildlife.

Promoting the planting of **indigenous trees** and shrubs supports local biodiversity while also preventing soil erosion. **Agroforestry**, which integrates tree planting with farming activities, enhances soil structure, water retention, and overall ecosystem resilience. Trees like ***Acacia***, ***Grevillea robusta***, and ***Moringa oleifera*** are commonly used for such purposes, contributing to both environmental and community well-being.

D. Climate Change Adaptation: Building Resilience

To build resilience against climate change, adopting **climate-resilient agricultural practices** is essential. Drought-resistant crops and varieties with deep root systems can improve productivity in challenging environments. These crops require less water and are better suited to withstand extreme weather conditions.

Flood protection structures like **levees** and **retention ponds** are also vital to managing flood risks. Levees prevent water overflow, while retention ponds slow down stormwater release, reducing the risk of erosion and flooding. In addition, these structures can serve as wildlife habitats and enhance the aesthetic value of communities. The adoption of **early warning systems** is critical for disaster preparedness. Communities can use these systems to anticipate and respond effectively to extreme weather events, minimizing damage and safeguarding lives and livelihoods. Current monitoring equipment has the capability of sending warning alarms through SMS messages when water levels exceed a set emergency level.

E. Community Involvement: Engaging Local Stakeholders

Engaging communities in the planning, implementation, and monitoring of water management practices is key to ensuring the sustainability of these initiatives. Community members can participate in activities such as **tree planting**, **clean-ups**, and **monitoring water quality**. Training programs can help locals collect data on key indicators, report issues, and stay informed about the progress of management efforts. Establishing **local water management committees** fosters ownership of water conservation initiatives. These committees can include representatives from different sectors, ensuring a holistic approach to water management. Regular community training on sustainable water and land management practices will further enhance local capacity. Promoting **gender-inclusive strategies** ensures that both men and women play an active role in decision-making processes. This inclusive approach leverages the strengths of all community members, leading to more effective and sustainable outcomes.

4 Action Plan

Preparation of action plan is mandatory for catchment management/IWRM implementation at small watershed/basin scale level. The plan serves as a guiding document that elaborates the objectives, list activities with roles and responsibilities, time line, procedures and detail works are clearly mentioned. The holistic and participatory approach shall be employed in the development of the action plan with high consensus of understanding. All efforts should be made with genuine involvement, interested member groups and beneficiaries. All stakeholders should be involved in developing the strategy and implementation with their clear roles and responsibilities. In action plan clear methodologies were developed to facilitate planning and implementation of catchment management.

Development of the action plan has the following procedures:

1. Identify your catchment area and define your objectives of what to do list.
2. Define clear methodology and procedures using the check list.
3. Propose detail action plan
4. Identify high priority actions using criteria
5. Implementation of plan and follow-up

Table 2. Schematic overview of catchment management action plan

Indicator	Criteria	Strategy	Action check list: in Upper Dabena catchment
More Water Availability During Dry Seasons (Low priority)	Water level increased after intervention in springs/ Enhanced base flow.	Stakeholder participation, preparation of action plan, study, campaigning, resource mobilization, preparation, design and implementation plan, monitoring and operation strategy	Applying soil and water conservation practices, Gully rehabilitation, check dams and trenches.
	Water Usage efficiency improved.	Providing technical training on detection and reduction of water losses, efficient irrigation water application.	For now , the catchment area is not considerd as a water scarce area. However, it is better to include effecient water use as a result of population growth and climate change.
Improved soil moisture	Increased soil moisture	. stakeholder consultation, preparation of intervention plan, resource mobilization	Implementation of contour bunds, micro basin (half-moon),

			mulching, area closure, grass strips.
Degraded land rehabilitation	Erosion / sediment transport reduced	Recommendations of 3R interventions, design, planning, stakeholder involvement, cooperation, implementation techniques.	With high priority applying soil and water conservation practices,. Gully rehabilitation and check dams.
Improved vegetation cover	Increased Normalized difference vegetation index (NDVI).	Planning, identification of plants type, recommendations of fruit bearing trees, stake holder participation, collaboration, mobilizing resources.	Area closure, fruit bearing plantation, grass cover or regreening, development of nursery sites and plantation. The highland parts are highly degraded and mandatory to make area closure.
Level of institutionalization and sustainability	Functionality of CBOs Interactions and engagement, water management and governance	Stakeholder mapping, documentation of institutionalization, planning, communication, responsibilities and involvement	CBOs working in action, Decision making, legal policies and regulations required for kebele DA, Water supply offices (**High priority**).

4.1 Detailed Action Plans

In upper Dabena catchment, the community apply participatory watershed management for tree plantation and agricultural practices. Therefore, the catchment management plan is developed based on the existing participatory watershed management at the kebele level.
guideline action plan follows the following procedures:

Step 1- characterize the watershed overview biophysical components such as cover, vegetation, agricultural practices. Identify if the land use is grazing land, homestead, cultivation land, forest or bare land. Define the scope of intervention whether it is kebele/ woreda or catchment-based implementation plan.

Upper Dabena catchment has high forest coverage. The highland parts are covered by bushes and shrubs while the low land parts of the target areas are covered with coffee farms in the forest. The area receives high amount of rainfall and application of Soil and Water Conservation (SWC) by community is needs to improved. The main driver for water problems in upper Dabena is land degradation that caused high runoff and less groundwater recharge. For the success of the work in upper Dabena it is better campaigning and awareness creation should be provided for the communities with clear objectives and participation. The catchment intervention plan could be facilitated at kebele administrative boundary and defined watershed boundaries. More importantly, in participatory watershed management the activities and responsibilities are managed at the kebele level.

Step 2 - Characterize the socio-economic and livelihood aspects of the community, Characterize upper Dabena catchment socio economic aspects such as demography, income, infrastructures and services. Promote women and youth participation, list down the roles and responsibilities of community members and active participation. Agriculture is main source of income and their livelihood depends on water availability. Socio economics and livelihood should be characterized in detail to show the benefits and limitations of the interventions.

Step 3 - Present the report of the situation analysis about the land degradation, water availability, ecosystem and environment.

- The baseline report of present situation related to objectives of the project.
- The traits and opportunities are proposed under this section.
- The biophysical maps and socio-economic data analysis.

Finally, the reports should be presented to the stakeholders for review, analysis and plan for the intervention plan with the activities. The community came together to propose watershed representative committee to discuss with communities and build common understanding.

Step 4 - Build a team to create a plan from the bottom that includes community inputs, in addition to technical aspects. In the building team at woreda level, Watershed expert (irrigation expert), soil and water conservation expert. Composition of the KWT will include the (1) Kebele Chairman; (2) Kebele rural development Head; (3) three DAs; (4) one male representative/leader of each community, (5) one female representative/leader of each community (6) one respected and influential person from each community and (7) representative of the youth.

Step 5 - Identification of community watersheds within broader units with team member participation: each of the prioritized critical watersheds can be further subdivided based upon community locations into community based sub-watersheds. The team members shall ensure water shed planning, prioritizing, coordinate the interventions work, settle the dispute and provide guidance for the community.

Step 6- Development action plan. Propose key actions and plan the intervention procedures. To support the catchment management plan and to identify what possible measures are. It is better to develop 3R suitability mapping to cross-check the alternatives.

It is important to consider intervention action for catchment management. To support the decision system, integrated and systematic methodology were developed using 3R/ water balancing suitability analysis with a consideration of socio-economic aspects. Based on biophysical controlling factors, intervention measures were proposed for specific target kebeles.
Generally, selection of intervention measures is developed as follows:

1. Determine the location of your focus area on the map. This can be a woreda or kebele, a micro catchment, or any other specific area or location. The core team members decide the location and focus area based on different factors under step 1-6.
2. Mapping the area of interest based on biophysical factors that constitute land use, land cover, slope, soil and Agro climatic zones. In socio economic mapping, the market based (income generating) and reforestation (environment) interventions shall be considered.
3. Determine and short list possible interventions which are possible and present in your focus area. Often you will find more than one intervention measure within a focus area, and it is better to prioritize the intervention by setting criteria and goals.
4. Look up in the intervention table, to decide which interventions are recommended for water balancing, carbon sequestration and socio-economic activities.

Before decision-making about interventions, the 3R/ SWC/ water balancing intervention suitability mapping has been developed based on biophysical parameters reclassified based on slope, land use land cover and agroclimatic zones. It is better to consider 3R intervention plan in participatory watershed management for the recommendations of soil and water conservation structures.

4.1.1 Setting short, medium, and long-term goals

Setting goals is mandatory in participatory watershed management to identify if specific objectives are achieved in action. In short term goals the interventions /SWC measures of achieving the goals with short period of time, e.g. In rainy season of rainfall water. Implementation of gully plugs, gabions and check dams are recommended to reduce the rate of erosion.

In the medium term, the intervention could be executed within two or three years. For example, implementation of contour stone/ soil bunds in a successive way with in two or three ways with proper maintenance and operation. The long term includes all interventions and cooperation of all kebele works together by considering water shed as one basic unit. In the long term the cooperation of soil and water conservation practice involves the upstream and downstream relationships all contribution from stakeholders, government, NGOs and community members.

4.2 Priority Actions

Priority action helps to focus on action put in order that gives more concern to compromise with limitations and setbacks. Identification of intervention and priority setting of community watersheds with respect to actions are important. The constraints and limitations related to resources like financial and manpower requirements should be settled before implementation of action. Priority setting and selection of community watersheds can be conducted in an objective manner by using a combination or all the following parameters listed below:

- Agro-ecological diversity (Biophysical characteristics that constitute soil condition, rainfall and land use and cover).
- Agriculture potential.
- Watershed landscape approach and sequence (location/orientation in upper reaches of the broader watershed).
- Severity of land degradation and encroachment.
- Food insecurity and support activities.
- Material availability and cost.

Actions for implementation of interventions are prioritized based on stakeholder discussions and community needs. During the discussions, proper explanations of why certain actions are prioritized and how they will benefit land and water management must be presented to the committee and community to have a better understanding of the plan.

In upper Dabena catchment erosion reduction is a priority due to high runoff. The top fertile soil could erode that resulted in low ground water recharge. Soil water retention and enhancement water availability followed action as the priority. Sustainable land management for agriculture to improve soil moisture and reduction of soil erosion. The top part of upper Dabena , particularly Gole Kora, Gole Maya and Gole seka plateau is vulnerable to erosion, therefore stone bunds (high slope terraces) are recommended as intervention measures.

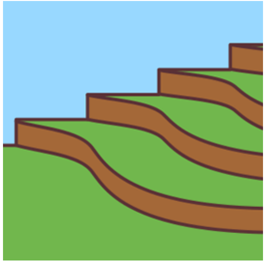
4.3 Implementation

During the implementation of interventions in the catchment, guidance is important according to participatory watershed management. The action plan must support the implementation strategy. Each implementation techniques require the guidelines that could be used a reference or manual.

4.3.1 Participatory catchment management supporting manual

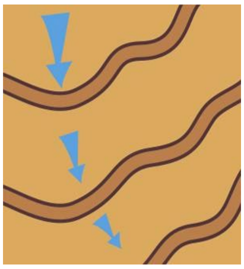
In upper Dabena catchment through Burqaa project, soil and water conservation practices are recommended specially for the reduction of erosion. The guiding manual is prepared for the community to implement interventions to the standard

Terraces



Platforms or benches built along a slope to make hilly areas arable. Terraces usually follow the contour lines of a terrain and might have a gentle slope to allow dewatering.

Contour bunds



Contour bunds and contour trenches prevent soil erosion by intercepting surface water runoff. They are constructed along lines of equal elevation (contour lines) at a right angle to the slope of a plot of land.

Purpose of the interventions

- Reduce surface water flow velocity
- Enhance infiltration, thereby recharging soil moisture and groundwater
- Prevent soil erosion and washing out of nutrients
- Prevent silting of water bodies
- Construct a level crop field that can be easily worked

Terraces, contour bunds and trenches should ideally be implemented in combination with other practices of sustainable agriculture, such as agroforestry, farmer managed natural regeneration (FMNR) and sustainable rangeland management.
Terraces, contour bunds and contour trenches are erosion control and water retention measures that can be used on agricultural fields, especially in semi-arid and sub-tropical climates.

Table 3. Terraces and contour bunds implementations guid

	Terraces	Contour bunds
Slope	10 - 50% = 1 - 5 m elevation gain for every 10 m horizontal distance	0.5 - 10% = 0.5 - 1 m elevation gain for every 10 m horizontal distance
Soil	More than 1.5 m thick permeable soil, preferably no clay: hard to work and low infiltration	More than 0.5 m thick preferably permeable soil
Gullies	There should be NO, or only small erosion gullies or rills present on the field (<0.5 m deep). Gullies should be filled or intercepted with check dams, so that waterflow during heavy rains does not destroy the terrace / contour bund.	

4.3.2Roles and Responsibilities

Assignment of roles: who is responsible for each action (local authorities, NGOs, community leaders).
Clarification of inter-agency collaboration and coordination. The roles and responsibilities are subdivided among partners and stakeholders. The role and responsibilities of stakeholders in the catchment will be identified and drawn during the workshop together with stakeholders.

4.3.3 Construction Methods

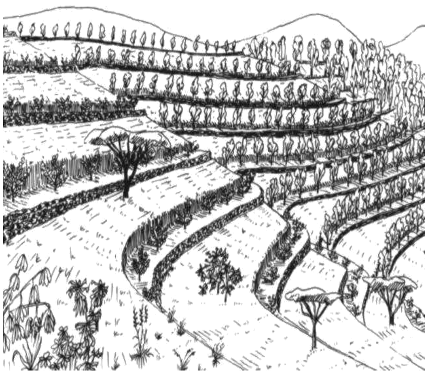
Terraces

- The terrain is dug out upslope and the excavated material is used downslope to create a level platform. The fertile topsoil should be separated and reapplied on the top of the terraces
- The downslope walls are best constructed of stones. They can also be made of soil, reinforced by vegetation such as vetiver grass.
- The walls should be sturdy, well protected from erosion and should not exceed 2 m in height.
- Optionally, every terrace can have a drainage ditch just above the ridge that collects water and channels it to the next step this can be helpful in preventing erosion.
- The platform might have a gentle slope to allow dewatering.

Contour bunds

Can be built of soil and/or stones.

- Are often constructed parallel to an infiltration trench (ditch). The excavated soil from the trench is then placed downslope along the edge of the trench to form the bund (dyke).
- Optional: Build crossties every few meters. These are small earth walls or excavated trenches, perpendicular to the bunds, that subdivide the system into micro catchments and prevent lateral flow along the bund which might cause erosion.
- Plant native grasses, legumes or perennials on the bunds to stabilize them. Apply mulch, especially while the plants develop



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4.4 Timeline and Milestones

1. Preliminary desk development of term of references (TOR), maps and conceptual reports requires (2-3) weeks.
2. Field work data collection and reconnaissance survey for illustration of features, delineate and catchment description (3- 4) days.
3. Prepare 3R suitability map considering the principles of participatory watershed management. The workload requires (2-3) weeks. Present reports and suitability mapping of the catchment area.
4. Participatory session with planning core team members and presenting the findings to the community and facilitate the cooperation (within 1 week). During this milestone the inception or minute of discussion by core members prepared. The community members and other stakeholders decide on the minute of discussion for approval. This process will take up to three weeks. The report of approved catchment management intervention report as a deliverable.
5. Summary of reporting of working documents, action plan, roles and responsibility on monthly time step.
6. Implementation with continuous follow up in monitoring to maintain and operate regularly (2- 5) years. Prepare the annual or biannual report the status of intervention works those practices through landscape restoration including soil and water conservation practice and afforestation.

5 Implementation Framework

The implementation framework for catchment management is designed to provide a structured and comprehensive approach to sustainably managing water resources. It includes key components such as institutional arrangements, capacity building, stakeholder collaboration, and risk management, all aimed at enhancing coordination and engagement among local stakeholders. By fostering local ownership and integrating training programs, the framework ensures that individuals and organizations are equipped with the necessary skills and knowledge to implement effective management strategies. Additionally, it emphasizes proactive risk management to address potential challenges, enabling communities to adapt to changing environmental conditions and pressures. Ultimately, this framework serves as a vital tool for achieving sustainable water resource management, benefiting both the ecosystem and the local population.

5.1 Institutional Arrangements

The success of small-scale catchment management depends on clear local institutional arrangements that define roles, responsibilities, and collaboration mechanisms at the community level (Table 4).

Table 4. Roles and responsibilities of key stakeholder institutions.

Level	Key Institutions	Roles and Responsibilities
Local Authorities	Village or town-level government units (e.g., councils, local environmental offices)	- Oversee the implementation of the catchment management plan - Provide resources and technical support for water and land management practices - Facilitate enforcement of local rules
Catchment Committee	Representatives from local government, farmers, community leaders, and local NGOs	- Develop and update the catchment management plan - Monitor and assess ongoing management activities - Ensure local stakeholder involvement
Water User Groups	Groups representing farmers, water users, or irrigators within the catchment area	- Maintain water infrastructure - Resolve water use conflicts within the group - Ensure equitable water distribution

The catchment committee should lead local-level decision-making processes, while water user groups handle the on-ground maintenance and management of shared water resources.

5.2 Capacity Building

Capacity Building emphasizes the importance of developing the skills and knowledge of community members, local organizations, and stakeholders. Through training and education initiatives, the framework aims to empower individuals and groups to implement sustainable practices that protect and enhance water resources.
Building the skills and knowledge of local actors is critical to ensure sustainable management. Focus on practical training, peer learning, and access to technical expertise. The aspects are summarized in Table 5.

Table 5. Aspects of capacity building actions.

Capacity Building Activity	Target Group	Key Topics	Implementation Method
Technical Training on Water Management	Local authorities, farmers	- Rainwater harvesting - Water-efficient irrigation - Soil conservation practices (e.g., terracing)	- On-site workshops - Demonstration plots
Community Workshops on Catchment Health	Community members	- Benefits of catchment conservation - Reducing erosion and sedimentation - Protecting water sources	- Community meetings - Educational campaigns
Monitoring and Data Collection Training	Water user groups, catchment committee members	- Monitoring water flow and quality - Tracking land degradation - Managing simple data collection tools	- Practical sessions - Peer-to-peer learning

Ongoing capacity building should emphasize locally relevant practices and rely on collaboration with NGOs or local experts.

5.3 Stakeholder Collaboration

Stakeholder Collaboration is vital for fostering a sense of ownership and shared responsibility among all parties involved in catchment management. By promoting dialogue and cooperation among stakeholders, the framework encourages integrated approaches that consider diverse perspectives and interests.
Collaborative efforts among local stakeholders ensure broad participation and buy-in for catchment management. Stakeholder collaboration aspects are listed in Table 6.

Table 6. Stakeholder collaboration aspects.

Stakeholder Group	Roles in Collaboration	Methods for Engagement
Farmers and Water Users	- Participate in water conservation and soil management activities - Implement sustainable agricultural practices	- Regular meetings with the catchment committee - Field visits
Local NGOs	- Provide technical expertise and resources - Facilitate community education and capacity-building initiatives	- Partner agreements with local authorities
Local Authorities (Municipal)	- Facilitate legal and financial support - Coordinate local resources and oversee compliance with management plans	- Joint planning and progress review meetings

The **Catchment Committee** plays a central role in fostering ongoing communication and cooperation between stakeholders.

5.4 Risk Management

Risk Management addresses the various challenges that may arise during catchment management. By identifying potential risks and developing strategies for mitigation, the framework aims to enhance resilience and adaptability in the face of changing environmental and socio-economic conditions. The table below shows the specific risks and outlines targeted strategies for mitigating them, along with assigning responsible entities. Risk mitigation strategies and responsibilities are given in Table 7.

Table 7. Risk mitigation aspects.

Risk	Strategy for mitigation	Responsible Entity
High population growth and poverty can increase pressure on water resources.	- Promote alternative livelihoods to reduce pressure on water resources - Improve water use efficiency and conservation	- Local authorities - NGOs
Resistance to change the inherited practices	Conduct community engagement and awareness campaigns - Demonstrate successful practices through pilot projects	- Catchment committee - Local NGOs
Deforestation for agricultural activities and fuelwood collection	- Implement community-led afforestation programs - Promote the use of alternative energy sources such as biogas	- Local communities - Environmental NGOs
sectoral interests and lack of integrated approaches	- Foster intersectoral collaboration and regular communication between stakeholders - Establish catchment coordination mechanisms	- Catchment committee - Water user groups
Change in the rainfall patterns	- Develop rainwater harvesting systems - Implement climate-resilient agricultural practices	- Local authorities - Farmers
Policy changes	- Ensure flexibility in management plans to adapt to policy shifts - Engage policymakers early in catchment planning	- Catchment committee - Policy advisors

6 Monitoring, Evaluation, Learning, and Reporting (MERL)

A thoughtfully crafted Monitoring and Evaluation (M&E) plan acts as a guiding compass for any plan, steering it towards its goals, ensuring accountability, promoting learning, and presenting its impact to stakeholders.

6.1 Monitoring and Evaluation

These indicators must be SMART (specific, measurable, achievable, relevant and time bound), and a baseline record for each indicator should be assessed. Then a target value for each indicator should be defined, with a clear data source to measure it. The frequency of measuring the indicator is an important element to be identified with assigned responsible person or entity to follow up.

Increase Water Availability During Dry Seasons

- Objective: Enhance water retention and availability during periods of low rainfall.
- Indicators (Table 8):
  - Increase in water storage levels in local reservoirs, ponds, and wells.
  - Improved baseflow in streams and rivers during dry months, both in quantity and duration.
  - Water usage efficiency per unit of agricultural production.

Monitoring Strategies:

- Water storage levels: Use sensors and satellite imagery to monitor surface area and water volume changes over time.
- Baseflow measurements: Observe baseflow in streams and rivers to gauge groundwater recharge.
- Water use efficiency: Measure water use per unit of crop production to assess irrigation practices.

Table 8. Water quantity availability assessment criteria

Criterion	Indicator	Monitoring Method
Water Availability	Water storage levels in reservoirs, ponds, wells	Sensors, satellite imagery
Baseflow in streams	Gauge baseflow during dry months	Ground-based flow meters
Water Use Efficiency	Water use per unit of crop production	Flow meters, crop yield analysis

Improve Water Quality and Reduce Pollution

- Objective: Reduce pollutants entering water bodies to provide cleaner water for both communities and ecosystems.
- Indicators (Table 9):
  - Decrease in harmful chemicals (nitrates, phosphates) in water.
  - Reduction in pathogens and microbial contamination.
  - Lower sedimentation and turbidity levels.

Monitoring Strategies:

- Chemical contaminants: Regular testing for nitrates and phosphates.
- Pathogen levels: Use water quality tests for microbial safety.
- Sediment load: Monitor turbidity and suspended solids using sensors and satellite data.

Table 9. Water quality assessment criteria.

Criterion	Indicator	Monitoring Method
Water Quality	Chemical contaminant levels (nitrates, phosphates)	Chemical water tests
Pathogen Levels	Microbial safety testing	Pathogen testing kits
Sediment Load	Turbidity and suspended solids	Turbidity meters, sediment traps

Reduce Soil Erosion and Sedimentation

Aspects for the reduction of erosion and sediment concentrations in surface water are given in **Error! Reference source not found.**.

- Objective: Reduce soil loss and sediment accumulation in water bodies.
- Indicators:
    - Decreased soil erosion rates.
    - Reduced sediment build-up in reservoirs.
    - Improved soil stability and reduced gully formation.

Monitoring Strategies:

- Soil erosion rates: Use erosion pins or sediment traps.
- Sediment build-up: Conduct sonar surveys or turbidity assessments in reservoirs.
- Soil stability: Evaluate through gully monitoring and vegetation cover assessments.

Table 10. Erosion and sedimentation aspects.

Criterion	Indicator	Monitoring Method
Soil Erosion Control	Soil loss rates	Erosion pins, sediment traps
Sediment Accumulation	Sediment levels in reservoirs	Sonar, turbidity meters
Soil Stability	Gully formation, vegetation health	Soil stability tests, vegetation surveys

Increasing Agricultural Production

Table 11 shows the aspects of agricultural production.

- Objective: Boost agricultural productivity through better water and soil management.
- Indicators:
    - Increase in crop yields.
    - Improved food security.
    - Increased agricultural income levels.

Monitoring Strategies:

- Crop yields: Regular measurements of harvested crops per unit area.
- Food security: Use household surveys and market analysis to assess food availability.
- Income levels: Monitor changes in agricultural income and economic benefits

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Table 11. Aspects related to agriculture.

Criterion	Indicator	Monitoring Method
Agricultural Production	Crop yields	Harvest records, satellite imagery
Food Security	Household surveys	Community assessments
Agricultural Income	Income monitoring	Financial records, surveys

Strengthen Local Water Management Committees

- Objective: Build the capacity of community-based water management groups.
- Indicators:

- Active committee participation and regular meetings.
- Clear roles and responsibilities within committees.
- Capacity building and training for members.

Monitoring Strategies:

- Committee activity: Track attendance, decision-making, and participation in meetings.
- Capacity building: Document training sessions and skills acquired.

Table 12. Aspects of local water management committees.

Criterion	Indicator	Monitoring Method
Committee Effectiveness	Meeting frequency and participation	Meeting records
Community Involvement	Engagement in decision-making	Surveys, interviews
Capacity Building	Training sessions	Attendance logs, feedback surveys

Promote Cross-Sectoral Collaboration

- Objective: Foster collaboration between local government sectors to align strategies for water, land, and agricultural management.
- Indicators:
  - Joint initiatives between water, land, and agriculture sectors.
  - Information exchange across sectors.
  - Policy alignment and coherence in management strategies.

Monitoring Strategies:

- Collaborative initiatives: Track joint projects and integrated management efforts.
- Information sharing: Document meetings and exchanges between sectors.
- Policy coherence: Review alignment between water, agriculture, and environmental policies.

Table 13. Aspects of promoting cross-sectoral collaboration.

Criterion	Indicator	Monitoring Method
Cross-Sector Collaboration	Joint initiatives and projects	Project documentation
Information Sharing	Meeting frequency	Meeting minutes
Policy Alignment	Coherence in management policies	Policy reviews

Table 14 shown provides a comprehensive framework for monitoring and evaluating the implementation of catchment management strategies. The indicators, baseline, and target are flexible, depending on the specific catchment data available.

Table 14. Monitoring and Evaluation Framework.

Objective	Indicator	Target	Data Source	Collection Method	Frequency	Responsible Person
Ensure increased water retention and availability during periods of low rainfall.	Water Storage Levels	Increased	Local Water Authorities	Water Level Monitoring	Quarterly	Water Resource Officer
	Baseflow Measurements	Increased	Hydrological Monitoring Reports	Streamflow Gauging	Quarterly	Hydrologist

	Water Usage Efficiency	Improved	Water Usage Reports	Field Surveys	Annually	Water Resource Manager
Improved water quality and reduced pollution	Chemical Contaminant Levels	Reduced	Water Quality Testing	Sampling and Lab Analysis	Quarterly	Environmental Specialist
	Microbial Contaminants	Reduced	Water Quality Testing	Sampling and Lab Analysis	Quarterly	Environmental Specialist
	Sediment Load	Reduced	Sediment Surveys	Field Sampling	Annually	Environmental Specialist
Minimize soil loss and prevent sediment from clogging rivers, streams, and reservoirs.	Erosion Rates	Reduced	Soil Erosion Monitoring	Field Surveys	Annually	Soil Scientist
	Sediment Accumulation	Reduced	Sediment Surveys	Field Sampling	Annually	Environmental Specialist
	Soil Stability	Improved	Soil Erosion Monitoring	Field Surveys	Annually	Soil Scientist
Boost agricultural productivity through improved water management and soil conservation.	Crop Yields	Increased	Agricultural Surveys	Field Surveys	Annually	Agricultural Extension Officer
	Food Security	Improved	Household Surveys	Field Surveys	Annually	Agricultural Extension Officer
	Income Levels	Increased	Household Surveys	Field Surveys	Annually	Agricultural Extension Officer
Strengthen the capacity of community-based water management groups to lead local conservation efforts	Committee Activity	Increased	Committee Reports	Meeting Reports	Quarterly	Local Committee Leader
	Community Engagement	Increased	Community Surveys	Surveys and Interviews	Annually	Community Leader
	Capacity Building	Increased	Training Reports	Field Surveys	Annually	Capacity Building Coordinator
Foster cooperation among local government sectors to align water, land, and agriculture strategies	Joint Initiatives	Increased	Government Reports	Meeting Minutes	Biannually	Government Coordinator
	Information Sharing	Increased	Government Reports	Meeting Minutes	Biannually	Government Coordinator
	Policy Alignment	Achieved	Government Reports	Meeting Minutes	Biannually	Government Coordinator

6.2 Evaluation Techniques

The best approach to evaluate the progress and the effectiveness of a project or a plan is to conduct a feedback mechanism during and after the implementation period, this can be through developing list of questions align with the main objectives and the information needs of key stakeholders and conduct a field survey for instance.

6.3 Learning aspects

To ensure continuous improvement and resilience in project management, it's essential to capture lessons learned from the implementation of the management plan. Establishing a process for documenting best practices, successes, and challenges faced during the project is crucial. Encouraging knowledge-sharing among stakeholders through workshops, training sessions, and community exchanges fosters a culture of continuous improvement. Integrating these learnings into future management plans and strategies enhances their effectiveness. Additionally, promoting a culture of learning by actively involving local stakeholders in reviewing outcomes and refining approaches based on experiences ensures that the project evolves and adapts effectively.

6.4 Reporting Mechanisms

- Clear guidelines for reporting to stakeholders and decision-makers.
- Frequency of reports and structure (monthly, quarterly, annually, (Table 15).

The foundation of effective reporting lies in understanding the diverse needs of stakeholders and decision makers. Effective stakeholder reporting involves delivering the right information, in the right format, at the right time using clear communication strategies that enhance transparency and support informed decision-making.

Create a reporting schedule to keep stakeholders informed. While quarterly or annual reports are standard, some stakeholders may require more frequent updates. Utilize dashboards and reporting tools for easy access to current information. Based on the monitoring and evaluation framework, its preferable to have a quarterly report contains the water storage levels, base flow measures, and the chemical and biological contaminants based on monthly recorded data base, in addition to the community activity which have to be reported quarterly. The table below indicates the frequency of reports for each indicator.

Table 15. Monitoring indicators and corresponding reporting frequencies.

Indicator	Frequency		
	Quarterly	Biannually	Annually
Water Storage Levels	x		
Baseflow Measurements	x		
Water Usage Efficiency			x
Chemical Contaminant Levels	x		
Microbial Contaminants	x		
Sediment Load			x
Erosion Rates			x
Sediment Accumulation			x
Soil Stability			x
Crop Yields			x
Food Security			x

Income Levels			x
Committee Activity	x		
Community Engagement			x
Capacity Building			x
Joint Initiatives		x	
Information Sharing		x	
Policy Alignment		x	

6.5 Adaptive Management

Mechanisms for adjusting strategies are essential for maintaining the effectiveness and resilience of project management. This can be achieved through regular monitoring and evaluation, collecting data on key indicators, and review progress against the set goals to identify areas needing adjustment. in addition to adopt an adaptive management approach, which is a structured, iterative process of robust decision-making in the face of uncertainty, involves making decisions as part of an ongoing process, learning from the outcomes, and adjusting strategies accordingly. Scenario planning is used to anticipate potential future conditions and develop flexible strategies that can be adjusted as conditions change, helping to prepare for various possible futures and make informed decisions. Moreover, versatility in resource allocation to respond to unexpected challenges or opportunities is a clear feature of flexible management style where it is easy to reallocate funds, personnel, or other resources to areas where they are most needed at any given time. While still the regular stakeholder engagement, through community meetings, surveys, and workshops, is crucial for gathering diverse perspectives and insights, ensuring that evolving needs and conditions are understood and addressed.

7 Conclusion and Recommendations

7.1 Summary of Key Points

The key issues for the implementation of improved water management through a catchment management plan are listed below. These include the primary objectives, strategies, and outcomes of the catchment management plan. These strategies for water management not only help in achieving the management objectives but also foster a sense of ownership and responsibility among community members. In the light of these objectives and strategies, some indicators have been specified to highlight crucial aspects of effective water resource management. These ensure the sustainability, and the health of catchment areas and include:

Water Availability During Dry Seasons: This is critical for maintaining agricultural productivity and ensuring water supply for domestic, livestock and industrial use. Techniques like harvesting rainwater on the supply side, and promoting efficient irrigation systems on the demand side, can help manage this.

Water Quality: Regular monitoring of pollutants and maintaining standards for drinking water and agricultural use is essential. This includes managing sources of contamination and implementing purification processes. In addition, training on the correct application of fertilizers and pesticides may help reduce negative impacts.

Soil Erosion: Preventing soil erosion helps maintain the agricultural production capacity of the soil, as well as the quality of water bodies. Practices like afforestation, terracing, and using cover crops can be effective in avoiding soil loss.

Agricultural Productivity: Sustainable farming practices, crop rotation, and the use of more drought-resistant crops can enhance productivity while conserving water.

Functionality of Local Water Management Committees: These committees play a vital role in managing local water resources, resolving conflicts, and implementing policies. Their effectiveness often depends on community involvement and proper training.

Collaboration Among Different Sectors: Integrated water resource management requires cooperation between agricultural, industrial, and urban sectors. This ensures that water use is balanced and sustainable. Monitoring and evaluation these indicators help in making informed decisions and adapting strategies to changing conditions.

Generally, catchment management plan must focus on the reality of biophysical and socio-economic aspects. Even though, the concept of catchment management is similar, one catchment management plan does not fit for other catchments, due to different factors. For example, water scarcity is the main problem in Hakim Gara catchments and land degradation issues in Upper Dabena catchment. The main reason for the difference is rainfall variability and land use and cover condition. Also, socio economic parameters have influence in catchment management plan through stakeholders participation and involvement in every steps of the planning process.

7.2 Recommendations for Stakeholders

- ✓ Begin the conversation early with all the stakeholders from the planning phase.
- ✓ Assure the continuity of these conversations during the whole project cycle by agreeing on a regular meeting date as regular communication is key to gaining stakeholder support.
- ✓ Build the trust by being transparent in your objectives and goals, plans, and be strict to the timeline.
- ✓ Stay consistent with your messaging and whenever there is a need to change; be clear about what has changed and why.

- ✓ Some stakeholders want the opportunity to voice their opinions and their needs; therefore, provide multiple ways for stakeholders to share their inputs.
- ✓ Whenever there is a complaint, try connecting with the complaint stakeholder in person rather than relying on their online feedback so that issues can be resolved with limited misunderstandings.
- ✓ Keep your plans flexible and adaptable to ensure sustainability and long-term success.

Generally, catchment management plan must focus on the reality of biophysical and socio-economic aspects. Even though, the concept of catchment management is similar, one catchment management plan does not fit for other catchments, due to different factors. For example, water scarcity is the main problem in Hakim Gara catchments and land degradation issues in Upper Dabena catchment. The main reason for the difference is rainfall variability and land use and cover condition. Also, socio economic parameters have influence in catchment management plan through stakeholders' participation and involvement in every step of the planning process.

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Annex

Table 16. Look up interventions – Bedele target areas – Burqaa Phase II

Biophysical controlling factors				Recommended water balancing, Agro-forestry, and livelihood improvement interventions			
Land cover	Agro-Climate	Slope class	Legend	Water balancing interventions		Restoration (Environment)	Income generating activities
				Soil and Water conservation measures (SWC)	Water harvesting/recharging interventions		
Open forest	Dry	Flat (<5%)		-Micro basins (Half-moons) - tie ridges/ grass strips - Zai pits,	-Sand dams (On-stream) -Harvesting surface runoff -Retention ditches	-Reforestation/ Agro-forestry practice -Seedlings - Nursery sites	-Bee hives -Plantation of drought resistant fruit trees; that adaptable to Agro-ecological zone
		Low slope (5-15%)					
		Medium slope (15-30%)		-Gabion check dams (on-stream) -Soil /stone bunds - Bench terraces	-Runoff retention basin - Infiltration ponds		
		High slope (>30%)		Area closure Bench terraces	-		-
	Moist	Flat (<5%)		-Micro basins (half-moons) -Grass strips	-Sand dams (On- stream) -Harvesting surface run off -Roof top water harvesting	-Reforestation/ --Agro-forestry practice -Seedlings - Nursery sites	- Bee hives - Plantation of fruit trees; that adaptable to Agro- ecological zone -Bee hives
		Low slope (5-15%)		-Fanya Juu -Stone/soil bunds			
		Medium slope (15-30%)		-Check dams			
		High slope (>30%)		-Area closure -Bench terraces			-
Croplands and mixed farming	Dry	Flat (<5%)		-Pre-season ploughing -Water conservation tillage	-Roof top water harvesting -Construction of artificial pond (Off -stream) -Sand dams (On-stream)	-Crop rotation -Low tillage	- Production of vegetables and crops - Poultry farming - Bee hives

		Low slope (5-15%)		-Mulching -Field bunds -Fanya Juu -Stone/soil bunds	-Water retention ponds	Compost/ organic manure - seedlings, providing drought resistant crops	
		Medium slope (15-30%)				-	-Bee hives
		High slope (>30%)		-Area closure -Bench terraces		-	-Bee hives
	Moist	Flat (<5%)		-Field bunds -Grass strips -Tie ridges -Fanya Juu -Stone/soil bunds	-Construction of artificial -water retention ponds - Roof top water harvesting	- Improved varieties for seedlings, nursery sites, - Improved and hybrid breedings	- Bee hives - vegetables and food crops - Poultry farming - Cow fattening/ Dairy farm
		Low slope (5-15%)					
		Medium slope (15-30%)				-	
		High slope (>30%)		-Gabion check dams -Area closure			-
Range lands	Dry	Flat (<5%)		-Grass strips -Zai pits -Micro basins	- Sand dams - Infiltration ponds	-	-Cow fattening and dairy farm

		Low slope (5-15%)					-Bee hives -Poultry farming
	Moist	Flat (<5%)		-Micro basins -Stone /soil bunds -Gabion check dams	-Sand dams -Infiltration ponds	-	-Pig farming -Fish farming -Cow fattening -Dairy farming
		Low slope (5-15%)					-Poultry farming
		High slope (>30%) & Leptosols	-	-Bench terraces -Area closure			
Urban area/homesteads				Roof top water harvesting			
Permanent water/ Wetlands				Fish farming, pig farming, wetlands and flood plain protection			
Wurch (elevation > 3,200 masl)			------	Area closure and forestation			

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