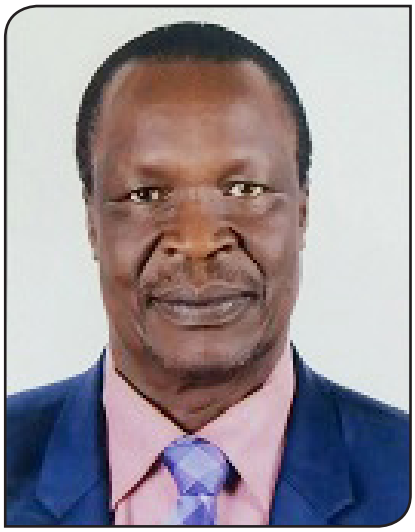
REPUBLIC OF UGANDA

MINISTRY OF WATER AND ENVIRONMENT
DIRECTORATE OF WATER RESOURCES MANAGEMENT
VICTORIA WATER MANAGEMENT ZONE

MAZIBA CATCHMENT MANAGEMENT PLAN

REVISED VERSION INCORPORATING ASPECTS OF CLIMATE CHANGE, 2020

FOREWORD



Hon. Sam Cheptoris

Water resources support key sectors of the economy namely hydropower generation, agriculture, fisheries, domestic water supply, industry, navigation, etc. However, efficiency and sustainability of intervention under these sectors has recently been a concern in Uganda mainly due to inadequate sectoral collaboration in planning and implementation, increasing frequency of floods and droughts, environmental degradation and pollution of water resources. This situation therefore calls for development of mechanisms for promoting integrated planning, development and management of water resources so as to create synergy among various sectors, promote efficiency in utilization of available resources, reduce water and environment degradation and ensure more efficient utilization of water resources to meet various social and economic demand.

In 2011, my Ministry embarked on preparation of Catchment Management Plans (CMPs) as tools for ensuring equitable access to, and use of water resources, and safeguard of key natural resources for sustainable socio-economic development of the country.

A CMP provides a long-term strategy for sustainable development and utilization of water and related water resources. Catchment based water resources planning and management is in line with the integrated Water Resources Management (IWRM) paradigm, which ensures that land, water and related resources are developed and managed in a coordinated manner without compromising sustainability of vital ecosystems. As a lead agency for implementing Catchment based Water Resources Management (CbWRM) in Uganda, my Ministry through the Directorate of Water Resources Management is operationalizing the CbWRM framework through the four Water Management Zones of Albert, Kyoga, Upper Nile and Victoria WMZ.

In order to develop this CMP, a number of studies were undertaken which included an assessment of the existing catchment knowledge base, the current and projected water resources situation, the catchment's social and environmental assessment, and stakeholder engagement. The CMP identifies critical issues, challenges, opportunities, and threats within the catchment which need to be addressed to ensure the economic development of the people.

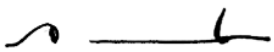
Guided by the key issues, challenges, threats, opportunities, key water resources planning principles and national strategies, the stakeholders developed a vision for the catchment. To achieve the vision, stakeholders came up with a number of strategic objectives, options and actions that need to be perused in the short, medium and long-term up to the year 2040.

Maziba CMP was first developed in 2014 following the Uganda Catchment Planning Guidelines of 2014. In 2018, the Uganda Catchment Planning Guidelines were updated to include aspects of climate change. Using the updated guidelines, the Maziba CMP has been updated to include aspects of climate change.

My Ministry is therefore pleased to formally make this updated CMP available for use by various stakeholders. It will enormously help and guide all developers and users of water and related resources at the national and local levels. I therefore wish to call upon all the relevant government ministries and agencies at both national and local levels, the civil society, private sector, academia and research institutions, cultural institutions, religious institutions and the local communities to utilize this plan in order to optimally plan for the development and management of water and related resources for prosperity.

In line with the provisions of Section 5 of the Water Act Cap 152, I formally approve this Updated Catchment Management Plan for use by various stakeholders.

For God and My Country.



Hon. Sam Cheptoris

Minister of Water and Environment
The Republic of Uganda

ACKNOWLEDGEMENTS

Alfred Okot Okidi

I would like to thank the Directorate of Water Resources Management for spearheading the preparing of Catchment Management Plans in Uganda. This is a stakeholder driven process that is key in ensuring that water resources are effectively planned for and sustainably developed and managed so as to support the achievement of the country's vision 2040.

Special thanks go to all the stakeholders at the national, regional and local levels for their active participation and involvement in preparation of this plan. Special appreciation goes to Victoria Water Management Zone for coordinating the plan preparation process and the Maziba Catchment Management Organization through the Maziba Catchment Management Committee for ensuring that the plan is stakeholders' driven and addresses the needs of the people in the catchment.

Finally, I wish to thank the Nile Equatorial Subsidiary Action Program (NELSAP) of the Nile Basin Initiate (NBI) for providing funds that enabled preparation of the Maziba CMP in 2014. I also wish to thank the Adaptation Fund, through Sahara and Sahel Observatory, for providing funds that facilitated updating of the CMP to incorporate climate change issues as well as printing and disseminating the plan to stakeholders.

Alfred Okot Okidi
PERMANENT SECRETARY
Minister of Water and Environment

EXECUTIVE SUMMARY

This report presents the Catchment Management Plan (CMP) for Maziba Catchment which lies in the Victoria Water Management Zone. The CMP was developed in 2014 following the Uganda CMP guidelines, 2014. The 2014 CMP guidelines were limited in Climate Change aspects and were thus updated in 2018 to include climate change considerations in catchment management planning. Upon updating the guidelines, the necessity to update the CMP to include climate change aspects was evident. This CMP therefore focuses on the catchment management issues and proposed interventions to sustainably manage the natural resources within the catchment while considering climate change considerations.

The Maziba catchment is part of the Kagera basin which is shared between Uganda and Rwanda, making it a trans-boundary catchment that drains into Lake Victoria. The entire Maziba catchment (both in Uganda and Rwanda) has an area of about 3680km^2, with 57% (about 2111 km^2) in Uganda and the rest in Rwanda. The Ugandan part of the Maziba catchment partially covers the districts of Kabale, Rukiga, Rubanda, and Ntungamo. The Maziba CMP developed in 2014 detailed issues and interventions for sustainable management of part of the catchment covering Kabale, Rukiga, and Rubanda districts. The current update of the CMP took care of the entire Maziba catchment, including Ntungamo district, with regard to climate change aspects, and also updated water resources information for the entire catchment.

The key issues mapped within the catchment include rapid vegetation loss, soil erosion and land degradation, wetland degradation, deteriorating water quality, population pressure, climate change and variability. The assessment undertaken indicates increasing climate related risks, associated with the increase in occurrence of extreme events, such as floods landslides, and prolonged droughts.

The report generates substantial evidence that the Maziba catchment is critically degraded, and immediate interventions ought to be implemented to enhance sustainable IWRM and livelihoods of the people in the catchment. The key proposed options for implementation are: Reducing soil erosion and land degradation; increasing adoption of improved farming technologies; reducing loss (while increasing amount) of vegetation cover; improving water quality & quantity; reducing wetland and riverbank degradation; reducing population pressure; supporting livelihood improvement; improving environmental sanitation and hygiene; addressing climate risks (drought and floods); strengthening natural resource governance and mainstreaming gender issues; addressing potential upstream-downstream conflicts; and building capacity for better catchment management.

Based on carefully selected criteria, critical micro-catchments that require immediate intervention were identified as Hamurwa, Rubaya–Kamuganguzi, Bubaare and Kyanamira-Buhara; and Maziba West (owing to the presence of the Maziba hydropower plant). It is estimated that implementation of the plan will require US$ 42,007,300 over the very short (2014-2016), short (2016-2019), medium (2019-2024) and long (2024-2040) terms.

It is apparent that the implementation process should be institutionalized and encouraged to build upon existing local expertise, technologies and innovations that are arrived at together with the beneficiaries. The effective engagement and participation of the beneficiaries will relieve emerging conflicts, accelerate implementation of the recommended actions, and promote local acceptability, ownership and sustainability. Interventions with tangible livelihood benefits to communities will particularly be popular and easily embraced.

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ACRONYMS AND ABBREVIATIONS

AMCOW	African Ministers' Council on Water
CbWRM	Catchment-based Water Resources Management
CFR	Central Forest Reserve
CMC	Catchment Management Committee
CMIP5	Coupled Model Inter-comparison Project phase 5
CMO	Catchment Management Organization
CMP	Catchment Management Plan
CMS	Catchment Management Secretariat
CSF	Catchment Stakeholder Forum
CTC	Catchment Technical Committee
DANIDA	Danish Development Agency
DEA	Directorate of Environmental Affairs
DEM	Digital Elevation Model
DESS	Department of Environmental Support Services
DGPS	Differential Global Positioning System
DLG	District Local Government
DOM	Department of Meteorology
DRC	Democratic Republic of Congo
DSOER	District State of Environment Report
DWD	Directorate of Water Development
DWRM	Directorate of Water Resources Management
EAC	East African Community
EIA	Environmental Impact Assessment
EQO	Environmental Quality Objectives
EVA	Extreme Value Analysis
FAO	Food and Agriculture Organization
FGD	Focus Group Discussions
GLASOD	Global Soil Assessment Deterioration
GW	Groundwater
HH	Household
ICRAF	International Centre for Research in Agro-forestry
ICT	Information and Communication Technology
IEC	Information, Education and Communication
IGAD	Inter-Governmental Authority for Development
IUCN	International Union for Conservation of Nature
IWRM	Integrated Water Resources Management
KBO	Kagera Basin Organization
KIIs	Key Informant Interviews

KIRBMD	Kagera Integrated River Basin Management and Development Strategy
KRBMP	Kagera River Basin Management Project
LVBC	Lake Victoria Basin Commission
LVFO	Lake Victoria Fisheries Organization
MAAIF	Ministry of Agriculture, Animal Industry and Fisheries
MCA	Multi-Criteria Analysis
MCM/Yr	Million Cubic Meters Per Year
MDGs	Millennium Development Goals
MEMD	Ministry of Energy and Mineral Development
MERRA	Modern Era-Retrospective Analysis for Research and Applications
MES	Ministry of Education and Sports
MoFPED	Ministry of Finance Planning and Economic Development
MOH	The Ministry of Health
MoLG	The Ministry of Local Government
MoU	Memorandum of Understanding
MTIC	Ministry of Tourism and Industry and Cooperatives
MUIENR	Makerere University Institute of Environment and Natural Resources
MW	Megawatt
MWE	Ministry of Water and Environment
NARO	National Agricultural Research Organisation
NASA	National Aeronautics and Space Administration
NBI	Nile Basin Initiative
NDA	National Drug Authority
NDP	National Development Plan
NDVI	Normalized Difference Vegetation Index
NELSAP	Nile Equatorial Lakes Subsidiary Action Program
NEMA	National Environment Management Authority
NFA	National Forestry Authority
NGOs	Non-Government Organizations
NPHC	National Population and Housing Census
NWSC	National Water and Sewerage Corporation
OPM	Office of The Prime Minister
Pax	Participants
RCP	Representative Concentration Pathways
RUSLE	Revised Universal Soil Loss Equation
RWHTs	Rainwater Harvesting Tanks
SACCO	Savings and Credit Cooperative Organization

SLM	Sustainable Land Management
SRTM	Shuttle Radar Topography Mission
SSEA	Strategic Social and Environmental Assessment
SWAT	Soil and Water Assessment Tool
SWOT	Strength, Weaknesses, Opportunities and Threats
TAMP	Trans-boundary Agro-Ecosystems Management Project
TSU	Technical Support Units
TSWR	Toro-Semliki Wildlife Reserve
UBOS	Uganda Bureau of Statistics
UNADA	Uganda National Agro-Input Dealers Association
UNBS	Uganda National Bureau of Standards
UNCED	United Nations Conference on Environment and Development of 1992
UNMA	Uganda National Meteorological Authority
UNRA	Uganda National Roads Authority
UO	Umbrella Organizations
USD	United States Dollar
UWA	Uganda Wild Life Authority
UWAS-NET	Uganda Water and Sanitation NGO Network
VIP	Ventilated Improved Pit
VWMZ	Victoria Water Management Zone
WCRP	World Climate Research Program's
WMD	Wetlands Management Department
WMZ	Water Management Zone
WPC	Water Policy Committee
WRM	Water Resources Management
WSDF	Water and Sanitation Development Facility
WSSBs	Water Supply and Sanitation Boards
WUC	Water User Committee
WWF	World Wide Fund

1. INTRODUCTION

1.1 Background to the Assignment

The Government of Uganda through the Directorate of Water Resources Management (DWRM) of the Ministry of Water and Environment (MWE) is implementing a series of major policy reforms. The reforms include the adoption of the principles of Integrated Water Resources Management (IWRM) through a participatory catchment based approach to water resources investment planning, development and management. In keeping with broader government policy and following the recommendations of the National Water Policy, the Water Sector Reform Study (2005), the Joint Sector Review (JSR), 2006 and other national and regional policies as well as steps already taken for implementation purposes, the country was delineated into four Water Management Zones (WMZs) along hydrological boundaries, *Figure 1-1*. These WMZs have been delineated further into smaller units known as catchments where implementation of IWRM is being undertaken.

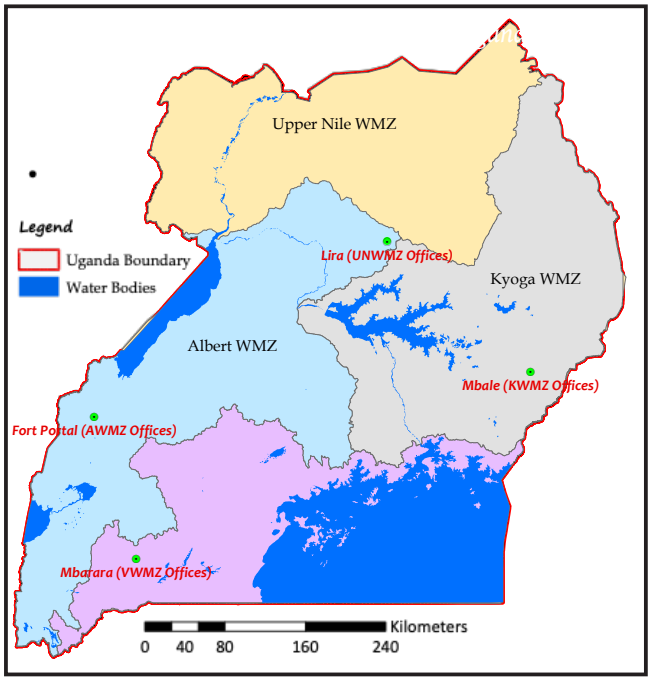


Figure 1-1: Water Management Zones in Uganda

In guiding water resources management and development roles, Catchment Management Plans (CMPs) for these catchments have been developed following the Catchment Management Planning Guidelines that were developed by DWRM in 2014 and later updated in 2018. These CMPs are important tools that guide the holistic management and development of the water resources in the catchment with the participation of all the stakeholders. The CMPs highlight the catchment's challenges (issues) and possible solutions (interventions) that can address the issues affecting the water and related resources to ensure sustainable social, economic and environmental benefits of the stakeholders in line with the vision and strategic objectives they have developed for their catchment. The CMPs are not static and can therefore be updated from time to time.

Based on the developed CMPs, MWE received funding from the Adaptation Fund for implementing the "Enhancing Resilience of Communities to Climate Change through Catchment Based Integrated Management of Water and Related Resources in Uganda" (EURECCCA) project. The project is being implemented by the Sahara and Sahel Observatory (OSS) and executed by MWE. The project is implementing some of the interventions in the CMPs for three catchments of Awoja in Kyoga WMZ, Maziba in Victoria WMZ and Aswa in Upper-Nile WMZ to support DWRMs' efforts in implementing IWRM by increasing the resilience of communities to the risks of floods, landslides, environmental pollution and droughts. However, development of these three CMPs was based on the 2014 CMP guidelines which had not adequately addressed climate change aspects, thereby necessitating an update of the CMPs to capture climate change aspects.

This report presents the Catchment Management Plan (CMP) for Maziba which was initially developed in 2014 with support from the Kagera River Basin Management Project (KRBMP) of the Nile Basin Initiative (NBI), and has been updated in 2020 under the EURECCCA project to included climate change aspects.

1.2 Purpose and Objectives of the CMP

The purpose of this CMP is to provide a set of agreed interventions and actions meant to help conserve and protect the catchment and its natural resources, and ensure equitable access to and use of water resources. While sets of interventions were provided in the CMP developed in 2014, the current CMP update purposes to identify and include climate change interventions.

Specific objectives are to:

(i). Assess the current status of the catchment regarding natural resources and socio-economic structure;

(ii). Identify the priority issues through a participatory process with the communities and reasons for degradation;

(iii). Through a participatory process, develop a Catchment Management Plan to address the priority issues;

(iv). Define arrangements (institutional, technical, financial) for implementation of the CMP, including a monitoring and evaluation framework.

1.3 Geographical Extent of the Maziba catchment

Maziba catchment is located in the south western part of Uganda, and is part of the Kagera basin which is shared between Uganda and Rwanda, making it a trans-boundary catchment. The entire Maziba catchment (both in Uganda and Rwanda) has an area of about 3680km^2, with 57% (about 2111km^2) in Uganda and the rest (1569km^2) in Rwanda. The Ugandan part of the Maziba catchment currently partially covers districts of Kabale, Rukiga, Rubanda, and Ntungamo but at the time of development of the Maziba CMP in 2014, Rukiga and Rubanda districts were counties within Kabale district. The Maziba CMP developed in 2014 covered a smaller section (40% which is about 844km^2) of the Maziba catchment in Uganda mainly for Kabale district, *Figure* 1-3 (currently Kabale, Rukiga, and Rubanda) while the remaining part (60% which is about 1267km^2) which is mainly in Ntungamo district was not covered. The updated (2020) Maziba CMP covers the entire extent of the Maziba catchment in Uganda, *Figure 1-2*. However, since the scope of the updating the CMP only captured climate change aspects, some information was not updated, thus some information from the old CMP was retained but where possible, updated data/information (non-climate change) has been provided in this CMP. Thus, information regarding water resources assessment has been updated to cover the entire extent of Maziba catchment in Uganda. Because of the differences in the geographical extent of the old CMP (2014) and the updated CMP (2020) and the inability to harmonise the information provided, reference is made to this section in those sections of the report that require taking note of the geographical extent considered.

Figure 1-2: Maziba Catchment in Uganda - Full Extent

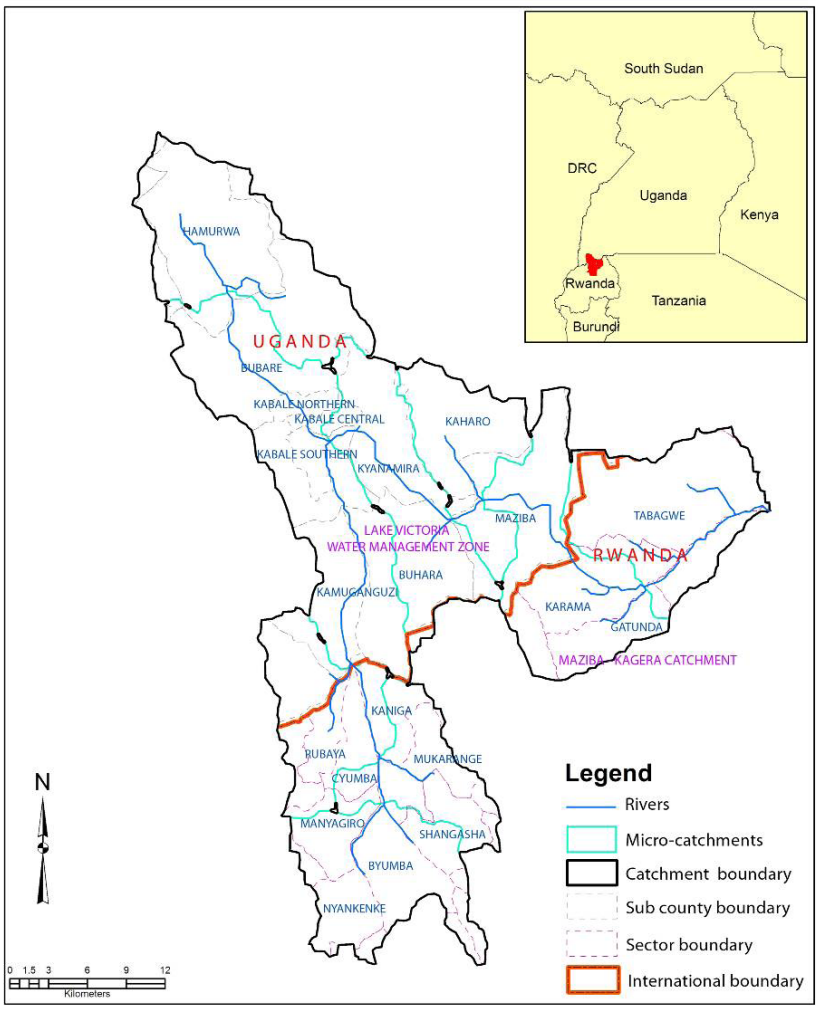


*Figure 1-3: Maziba Catchment - **Partial Extent***

1.4 Structure of the Report

The CMP is structured as follows:

Chapter 1: **Introduction**- Gives a general background to the assignment including the objectives and geographical extent of the Maziba catchment.

Chapter 2: **Approach to the CMP**- Outlines the major steps to Catchment Management Planning in accordance with the Catchment Management Planning Guidelines for Uganda.

Chapter 3: **Policy, Legal and Institutional Context**- Analyses the linkages between the relevant policy, legal, and institutional provisions with catchment management planning and implementation, as well as the existing gaps.

Chapter 4: **Status of the Catchment**- Profiles the characteristics of the catchment that were used in the identification of the major social, environmental, water resources and agribusiness issues that affect the catchment.

Chapter 5: **Catchment Vision, Objectives and Options Analysis**- This chapter presents the vision and strategic objectives of the catchment that were formulated from the identified issues/gaps. It further provides options and sub-options for solving the identified issues.

Chapter 6: **Implementation, Investment and Financing Plan**- Provides a schedule of costed activities for specific interventions as well as probable options for financing the plan. It also presents the Monitoring and Evaluation Framework which outlines monitoring indicators and targets to be used for evaluating progress of the CMP.

2. APPROACH TO THE CMP

The Uganda Catchment Management Planning Guidelines, 2018 provides direction on the catchment planning process in Uganda which is outlined in a series of steps, of which each contains a number of tasks as illustrated in *Figure 2-1*. However, the original CMP for Maziba was developed in 2014, and followed the process which was in the draft stages. As such, some steps stipulated in the current CMP guidelines were not systematically followed though information was generated. Thus, thematic reports for the steps were not developed in 2014 but the current update of the CMP has comprehensively undertaken the Water Resources Assessment and the impact of climate change on water resources as well as stakeholder engagement to identify the climate change impacts in the catchment.

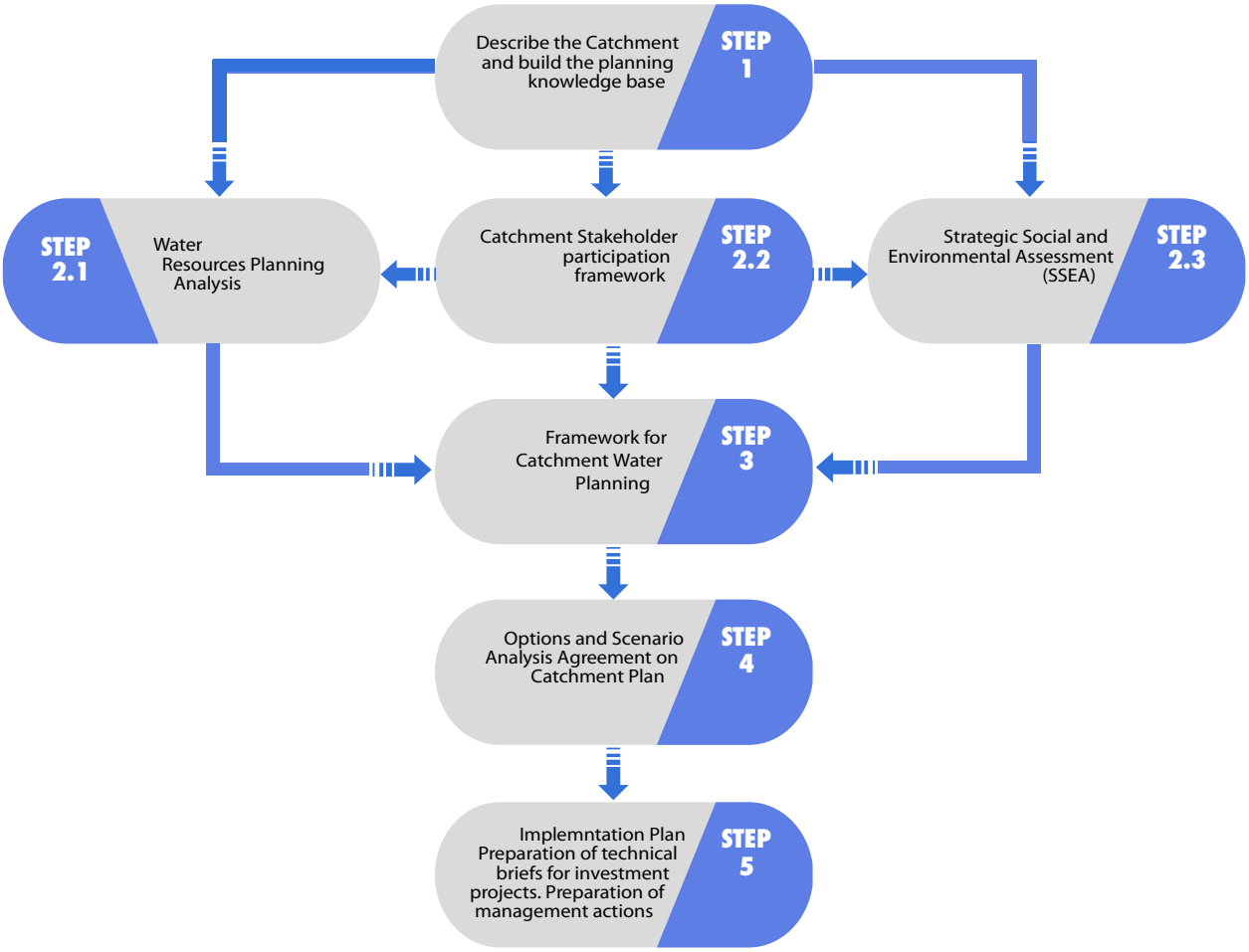


Figure 2-1: Catchment Management Planning Process

The description of tasks in the catchment management process are described below:

Step 1.0: **Catchment Description and Building a Planning Knowledge Base**, from which a wealth of information emanating from all available Policies, Strategies and Plans, Water Sector data and information on existing and planned water resources development and management, water infrastructure, institutional arrangements all of which will inform, influence, and drive sustainable catchment management and development.

Step 2.1: **Water Resource Planning Analysis**, which presents an analysis of current and projected water availability, uses, and demand and related projections to 2030 and 2040 for three key sub-sectors; water for people, water for production and water for energy. Water for environment was evaluated considering low flow and dry season flow in order to estimate environmental flow.

Step 2.2: **Stakeholder Engagement**, which highlights the stakeholder participation framework and interactions at all levels in the process of developing the CMP. Field visits, informal and formal meetings as well as the proceedings of joint stakeholder forum workshops were highlighted and their input of water resources issues captured.

Step 2.3: **Strategic Social and Environmental Assessment**, which presents the identified social and environmental issues and were taken into account in the planning process to ensure their integrated into the plan and for which sound measures for social and environmental protection were proposed.

Step 3.0: **Framework of Catchment Water Planning** sets the scene for options by identifying all the issues and conditions in the catchment related to water and natural resources that are likely to be a major influence, or present themselves as risks, needs or opportunities. These mainly come from the Strategic Social Environmental Assessment and the Water Resources Assessment

Step 4.0: The **Options and Scenario Analysis** provides an analysis of the options and the alternative sets of options that form scenarios. These scenarios are evaluated to get the best scenario which informs the investment and management interventions or agreed infrastructure investments and interventions within the catchment management plan.

Step 5.0: The **Implementation Plan** provides a set of agreed investments together with the associated implementation timelines as well as the costing. Implementation arrangements, including the institutions and financing mechanisms are also included in here.

3. POLICY, LEGAL AND INSTITUTIONAL CONTEXT

3.1 Introduction

The legal context under which IWRM is implemented and managed in Uganda is provided for in The Constitution of the Republic of Uganda, National Policies, National Legislation, Trans-boundary considerations, and International Conventions. Uganda follows a decentralised government structure, which implies that public service delivery such as water, education and health are to be implemented through the local government.

The institutional arrangement for catchment management in Uganda is a decentralized model. The approach was a core recommendation of the Water Resources Management Sub-Sector Reform Study completed in 2005, with the aim to decentralize Water Resources Management (WRM) in Uganda. The principles for decentralized water resources management in the country are based on:

- Agenda 21 which recommended that water should be managed at the lowest appropriate levels where the catchment is the desired level. This is otherwise known as the subsidiarity principle, which is formally acknowledged in Uganda's National Water Policy (of 1999) as well as in several regional accords including the East African Community (EAC) Development Strategy (2006-2010) and the Protocol for Sustainable Development of the Lake Victoria Basin (2003);
- Uganda's National Water Policy (1999) specifically encourages decentralization of those WRM functions that can best be performed at the district or community level; and
- The Local Government Act (1997) provides for creation of multi-district administrative instruments where clusters of districts cooperate administratively.

This Chapter presents a summary of the legal, policy and regulatory, as well as the institutional context under which IWRM in the Maziba Catchment Management Plan will be implemented.

3.2 The Constitution of the Republic of Uganda (1995)

The Constitution of the Republic of Uganda sets a number of national guiding principles relating to, and supporting the principles of sustainable development including having balanced and equitable development, which requires that the State adopts an integrated and coordinated planning approach. It further stipulates that the State ensures balanced development between different areas of Uganda and between the rural and urban areas with special measures employed to favour of the development of the least developed areas.

Through the constitution, the State is entrusted to protect important natural resources including land, water, wetlands, minerals, oil, and fauna and flora on behalf of the people of Uganda. The state must further endeavour to fulfil the fundamental rights of all Ugandans to social justice and economic development, with all developmental efforts directed at ensuring the maximum social and cultural well-being of the people. In terms of the Constitution, all Ugandans have a right to education, health services, clean and safe water, work, decent shelter, adequate clothing, food security, and pension and retirement benefits.

The State must promote sustainable development and public awareness of the need to manage land, air, water resources, as well as use of natural resources, in a balanced and sustainable manner for the present and future generations. All possible measures must be taken to prevent or minimise damage to land, air, and water resources

resulting from pollution or other causes. The Constitution entrusts the State to ensure the conservation of natural resources and promote the rational use of natural resources to safeguard and protect the biodiversity of Uganda. Through all this, the Constitution sets the scene for Integrated Water Resource Management in Uganda.

3.3 National Policies

3.3.1 The National Water Policy, 1999

Overall policy outlines the roles played by different institutions at central, local and community levels and states the role of private sector in WRM. It promotes an integrated approach to managing the country's water resources sustainably. Preparation of Maziba catchment plan will promote an integrated approach to managing the country's water resources sustainably as provided for under this National Water Policy that clearly precedes the movement towards Water Management Zones and CBWRM.

3.3.2 The National Environment Management Policy, 1994

Maziba CMP will integrate key policy objective and provisions on water resources conservation and management which recognise the need to sustainably manage and develop the water resources in a coordinated and integrated manner to provide water of acceptable quality for all social and economic needs.

3.3.3 The National Forestry Policy, 2001

It also recognises the importance of catchment management and soil conservation. It pledges that the government will promote the rehabilitation and conservation of forests that will protect the soil and water in the country's key catchments and river systems.

3.3.4 The National Policy for the Conservation and Management of Wetland Resources, 1995

The Catchment Management Plan for Maziba is aimed at restricting the continued loss of wetlands and their associated resources and will ensure that benefits derived from wetlands are sustainably and equitably distributed to all people for improved livelihoods and wetland conservation. The policy calls for:

- No drainage of wetlands unless more important environmental management requirements supersede;
- Sustainable use to ensure that benefits of wetlands are maintained for the foreseeable future;
- Environmentally sound management of wetlands to ensure that other aspects of the environment are not adversely affected;
- Equitable distribution of wetland benefits and
- The application of environmental impact assessment procedures on all activities to be carried out in a wetland to ensure that wetland development is well planned and managed.

3.3.5 The Uganda National Land Policy, 2013

This Catchment Management Plan for Maziba seeks to ensure sustainable utilisation, protection and management of environmental, natural and cultural resources on land for national socio-economic development. Sustainable use and management of environment and natural resources for the present and future generations will be promoted during Maziba CMP implementation.

3.3.6 The Uganda Forestry Policy, 2001

The National Forestry policy provides for the establishment, rehabilitation and conservation of watershed protection forests. It aims at promoting the rehabilitation and conservation of forests that protect the soil and water in Uganda's key watersheds and river systems. Maziba CMP recognises the importance of catchment management and soil conservation.

3.3.7 The National Wetlands Policy, 1995

This policy aims at promoting conservation of Uganda's wetlands in order to sustain their ecological, social and economic functions for the present and future generations. Maziba CMP provides for no drainage of wetlands unless more important environmental management requirements supersede; sustainable use to ensure that

benefits of wetlands are maintained for the foreseeable future; environmentally sound management of wetlands to ensure that other aspects of the environment are not adversely affected; equitable distribution of wetland benefits; the application of environmental assessment procedures on all activities to be carried out in a wetland to ensure that wetland development is well planned and managed.

3.3.8 The National Agriculture Policy, 2013

The overall objective of the agriculture policy is to achieve food and nutrition security and improve household incomes through coordinated interventions that focus on enhancing sustainable agricultural productivity and value addition; providing employment opportunities, and promoting domestic and international trade. To ensure sustainable use and management of agricultural resources, Maziba CMP incorporates, promotes and supports the dissemination of appropriate technologies and practices for agricultural resources conservation and maintenance among all categories of farmers, including Sustainable Land Management and Conservation Agriculture; harvest and utilize rain water for agricultural production; enact and enforce ordinances and by-laws; land use and farm planning services among farmers.

3.3.9 The National Agricultural Extension Policy, 2016

This policy is in response to government's commitment to realize an agricultural revolution in the country in line with the National Agriculture Policy (2013) and the overall national policy framework articulated in Vision 2040 and periodic National Development Plans. Maziba CMP will contribute towards achieving this Policy's Area 2.2 on Strengthening Agricultural Education and Training; Policy Area 3.2 on Agribusiness Development Services and Market Linkages; Policy Area 3.3: Agricultural Knowledge Management and Information System and; Policy area 4.1: Farmer organizations and empowerment.

3.3.10 The Fisheries and Aquaculture Policy, 2018

The policy will ensure sustainable exploitation of fisheries resources while maintaining fish availability for both present and future generations, and without degrading the environment. Some of the policy strategies that will be promoted through Maziba CMP include: Supporting the private sector and other grassroots stakeholders and communities to standardize local and indigenous technologies; Establishment of the necessary infrastructure to facilitate the operations and management of fisheries and aquaculture; demarcate suitable ecological areas for ponds and cage development, and regulate aquaculture development within Maziba catchment.

3.3.11 The National Health Policy, 1999

This Policy emphasises prevention through Primary Health Care (PHC) including sanitation and hygiene. Some of the environmental objectives for Maziba CMP will promote sanitation and hygiene at the household level within the catchment thus improved water quality and reduction in disease incidences.

3.3.12 The National Gender Policy, 1997

It provides for equal participation in development activities including water supply and sanitation. It recognises women and children as the main carriers and users of water. It anchors the importance of gender responsiveness in terms of planning, implementation and management of water and sanitation initiatives. Preparation of Maziba CMP is part of planning, implementation and management of water and sanitation initiatives within the catchment.

3.3.13 Uganda Vision 2040

Maziba CMP will contribute towards the improvement of water security and mitigate adverse effects of floods and droughts, large and strategic water reservoirs will be constructed and maintained in appropriate areas within the catchment. Vision 2040 aims at ensuring optimal and sustainable utilisation of the water resources where Government will strengthen and manage water resources at the lowest appropriate levels. This will be at water management zones and water catchment zones.

3.3.14 National Development Plan 2015/16 – 2019/20

Maziba CMP aims at ensuring rational and sustainable utilization, development and effective management of environment and natural resources for socio-economic development. Examples of the proposed environmental objectives and interventions include:

- Restore and maintain the integrity and functionality of degraded fragile ecosystems;
- Increase the sustainable use of Environment and Natural Resources;
- Increase wetland coverage and reduce, wetland degradation;
- Increase afforestation, reforestation, adaptation & mitigate deforestation for sustainable forestry;
- Increase the resilience to impacts of climate change, etc.

3.4 National Legislation

3.4.1 The Water Act, Cap. 152

The Water Act Cap. 152 provides for use, protection and management of water resources and supply; to provide fro the constitution of water and sewerage authorities; and to facilitates the devolution of water supply and sewerage undertakings. Catchments or watersheds are not mentioned in the act, meaning that the policy to install a WMZ or a CMO is not yet part of the Water Act. However, the act establishes that the MWE may identify any area to be a water supply area and establish a protected zone on land to protect that water supply. Of note, is that the water policy, as well as the water act is currently under review to make it responsive to emerging issues and challenges such as CbWRM.

3.4.2 The National Environment Act, 2019

Establishes the National Environment Management Authority (NEMA) as the overall body, charged with responsibility of coordinating, and monitoring all environment management issues in the country. The Statute empowers NEMA, in consultation with lead agencies, to issue guidelines and prescribe measures and standards for the sustainable management and conservation of natural resources and the environment in general. The Statute also provides for mandatory Environment Impact Assessments (EIA) to be conducted for any activity likely to have a significant effect on the environment. Provides the framework for coordinated and sound management of the environment including environmental impact assessment of water resources related projects and setting water quality and effluent standards.

3.4.3 The Local Governments Act, Cap. 243

Provides for decentralization of service delivery including water services to local governments and for cooperation between and among districts. Districts are responsible for water supply outside the jurisdiction of NWSC, operation and maintenance of wells, dams and other water supply infrastructure, and protection and restoration of local water resources. The CMP should provide the guidelines to improve the sustainability, effectiveness and efficiency of these tasks, particularly with regards to the alignment of activities of different districts, and between districts and other implementers.

3.4.4 The Land Act, Cap. 227

Maziba CMP emphasizes that the government or local government holds land in trust for the people and protects environmentally sensitive areas such as natural lakes, rivers, groundwater, natural ponds, natural streams, wetlands, forest reserves, national parks and any other land reserved for ecological and tourist purposes for a common good of the citizens of Uganda.

3.4.5 The National Forestry and Tree Planting Act, 2003

It regulates and controls forest management in Uganda by ensuring forest conservation, sustainable use and enhancement of the productive capacity of forests for the benefit of all Ugandans, to provide for the promotion of tree planting and through the creation of forest reserves in which human activities are strictly controlled. Maziba CMP is in rhyme with this Act and provides for tree planting and ownership which should be undertaken in the catchment programs as part of environmental mainstreaming.

3.4.6 The Fish Act, Cap. 197

Maziba CMP will promote sustainable fishing activities and fisheries value chains for improved livelihoods but further promote control measures for improving on water quality and quantity.

3.4.7 The Investment Code Act, Cap 92

Priority areas under this law that have potential within Maziba catchment that are listed under Second Schedule include: Crop processing, Processing of forest products, Fish processing, Energy (such as Maziba mini hydropower

plant), several existing tea estates, Construction and building industry, Meat processing and Tourism industry. Water use and demand for these investments have been analysed and results are presented in the water resources report. Maziba CMP will provide interventions that are aimed at ensuring that the natural resources are managed sustainably.

3.4.8 The Water Resources Regulations, 1998

These provide for application for a water permit where a person who, (a) occupies or intends to occupy any land; (b) wishes to construct, own, occupy or control any works on or adjacent to the land referred to in regulation 10; may apply to the Director for a water permit. Maziba CMP will address activities that affect drainage and the environment including the applications of permits for controlling water abstraction and wastewater discharge, to promote sustainable and environmentally friendly development and use of water resources.

3.4.9 The Water (Waste Discharge) Regulations, 1998

This provides that "*no person shall discharge effluent or waste on land or into the aquatic environment contrary to the standards established under regulation 3 unless he or she has a permit in the format specified in the first schedule issued by the Director*" that require enforcement and these are: Surface water Abstraction Permit, Groundwater Abstraction Permit, Drilling Permit – Waste Water Discharge Permit and Easement Permit.

Types of Water Permits Issued

- Surface water Abstraction Permit,
- Groundwater Abstraction Permit,
- Drilling Permit – For persons involved in drilling of Boreholes,
- Construction Permit are issued to individuals or company who wishes to engage in construction of hydraulic structures,
- Waste Water Discharge Permit and
- Easement.

3.4.10 The National Environment (Hilly and Mountainous Area Management) Regulations, 2000

Maziba CMP promotes the management of hilly and mountainous areas through the proposed environmental and social quality objectives where every land owner or occupier shall while utilizing land in a mountainous and hilly area: *(a)* observe the carrying capacity of the land; *(b)* carry out soil conservation measures; *(c)* utilize underground and surface water resources; *(d)* carry out measures for the protection of water catchment areas; *(e)* use the best available technologies to minimize significant risks to ecological and landscape aspects; and *(f)* maintain such vegetation cover as may be determined by an agricultural extension officer or a local environment committee.

3.4.11 The National Environment (Wetlands; River Banks and Lake Shores Management) Regulations, 2000

Maziba CMP promotes some of the provisions of this regulation namely; wetland resources to be utilized in a sustainable manner compatible with the continued presence of wetlands and their hydrological functions and service; environmental impact assessment to be done for all activities in wetlands likely to have an adverse impact on the wetland; special measures essential for the protection of wetlands importance as ecological systems and habitat for fauna and flora species have been provided; and wise use of wetlands to be interpreted into the local approaches to the management of their resources through awareness campaigns and dissemination of information.

3.5 Transboundary Considerations

The trans-boundary nature of Uganda's water resources is such that there are a number of international conventions relating to management of water resources with which Uganda must comply. Currently, the key conventions/ organisations to which Uganda is party are; the Protocol for Sustainable Development of Lake Victoria Basin and Nile Basin Initiative.

3.5.1 Protocol for Sustainable Development of Lake Victoria Basin

The Lake Victoria Basin Commission which was established under article 33 of the "Protocol for Sustainable Development of Lake Victoria Basin" has a broad function of promoting, facilitating and coordinating activities of different actors towards sustainable development and poverty eradication of the Lake Victoria Basin.

These activities include catchment management interventions among others and since the Maziba catchment drains into Lake Victoria, coordinated development of activities within the catchment is crucial.

3.5.2 Legal Framework for the Sustainable Management of the Nile Waters

Treaties regarding the management of the waters of the Nile basin date back to 1929 when Great Britain and Egypt signed an agreement under which no irrigation, power works or other measures were to be constructed or undertaken on the Nile, and its branches, or on lakes from which it flows in the Sudan, or in countries under British administration except with the previous agreement of the Egyptian government. The Agreement was followed by the 1959 Agreement on the Full Utilisation of the Nile Waters, which was signed between Egypt and Sudan.

3.5.3 Nile Basin Cooperative Framework Agreement

The Nile Basin countries embarked on the process of negotiating and developing a new agreement for the sustainable management and development of the shared Nile water resources in the 1990s. This process is still on-going and it is envisaged that once these negotiations are successfully concluded, the resulting agreement will supersede all the existing Nile water agreements. (NELSAP, 2012).

3.6 International Conventions

3.6.1 Ramsar Convention (1971)

The Convention on Wetlands (Ramsar, Iran, 1971) is an intergovernmental treaty that commits member countries to maintain the ecological character of Wetlands of International Importance and to plan for the "wise use", or sustainable use, of all of the wetlands in their territories. The Convention's mission is "the conservation and wise use of all wetlands through local and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world.

3.6.1 UN Convention on Biological Diversity

The Convention has three main goals including: conservation of biological diversity; the sustainable use of its components; and the fair and equitable sharing of benefits arising from genetic resources.

3.7 The Institutional Context

3.7.1 National Level

3.7.1.1 The Ministry of Water and Environment (MWE)

The Ministry of Water and Environment (MWE) plans and coordinates all water and environmental sector activities and is the ultimate authority responsible for water resources and environmental management in Uganda. The MWE has the overall responsibility for setting national policies and standards, managing and regulating all water resources and determining priorities for water development and management. The MWE is divided into three directorates: Directorate of Water Resource Management (DWRM), the Directorate of Water Development (DWD) and the Directorate of Environmental Affairs (DEA).

The DWD has the responsibility for providing overall technical oversight for the planning, implementation and supervision of the delivery of urban and rural water and sanitation services across the country, including water for production. It is responsible for regulation of provision of water supply and sanitation and the provision of capacity development and other support services to Local Governments, Private Operators and other service providers. The Directorate comprises of three Departments: Rural Water Supply and Sanitation, Urban Water Supply and Sanitation and Water for Production.

The DEA is responsible for environmental policy, regulation, coordination, inspection, supervision and monitoring of the environment and natural resources as well as the restoration of degraded ecosystems and mitigating and

adapting to climate change. The DEA comprises of four departments of Environmental Support Services (DESS), Forestry Sector Support Department (FSSD), Wetlands Management (WMD), and the Department of Meteorology (DOM), recently turned into an Authority.

The MWE further works closely with the National Environment Management Authority (NEMA) mandated with the coordination, monitoring, regulation and supervision of environmental management, the National Water and Sewerage Corporation (NWSC), with the mandate to operate and provide water and sewerage services in the larger urban centers, and the National Forest Authority (NFA), whose mandate is to manage Central Forest Reserves and to supply high quality forestry-related products and services (*Figure 3-1)*. Uganda National Meteorological Authority (UNMA) is responsible for establishing and maintaining weather and climate observing stations network, collection, analysis and production of weather and climate information, (including warnings/advisories) to support social and economic development. Awareness raising is one of their key roles to be considered under the Maziba CMP.

3.7.1.2 Other National Entities

Other national entities significantly impacted by technical water management issues are the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF), the Ministry of Tourism and Industry (MTI), and the Ministry of Energy and Mineral Development (MEMD). The Ministry of Education and Sports (MES) is responsible for the implementation of Water and Sanitation in Schools, and the Ministry of Health (MOH) is responsible for sanitation via the environmental health department.

The Ministry of Local Government (MLG) oversees the implementation of Local Government Development Plans, which include water supply and programmes for the improvement of hygiene and sanitation in institutions and public places. There are a number of development partners, private sector and NGOs that also act in the water sector, providing services, advice and facilitation. A number of NGOs active in the water sector are coordinated at the national level through the Uganda Water and Sanitation NGO Network (UWASNET), an umbrella organisation largely funded by development partners including MWE.

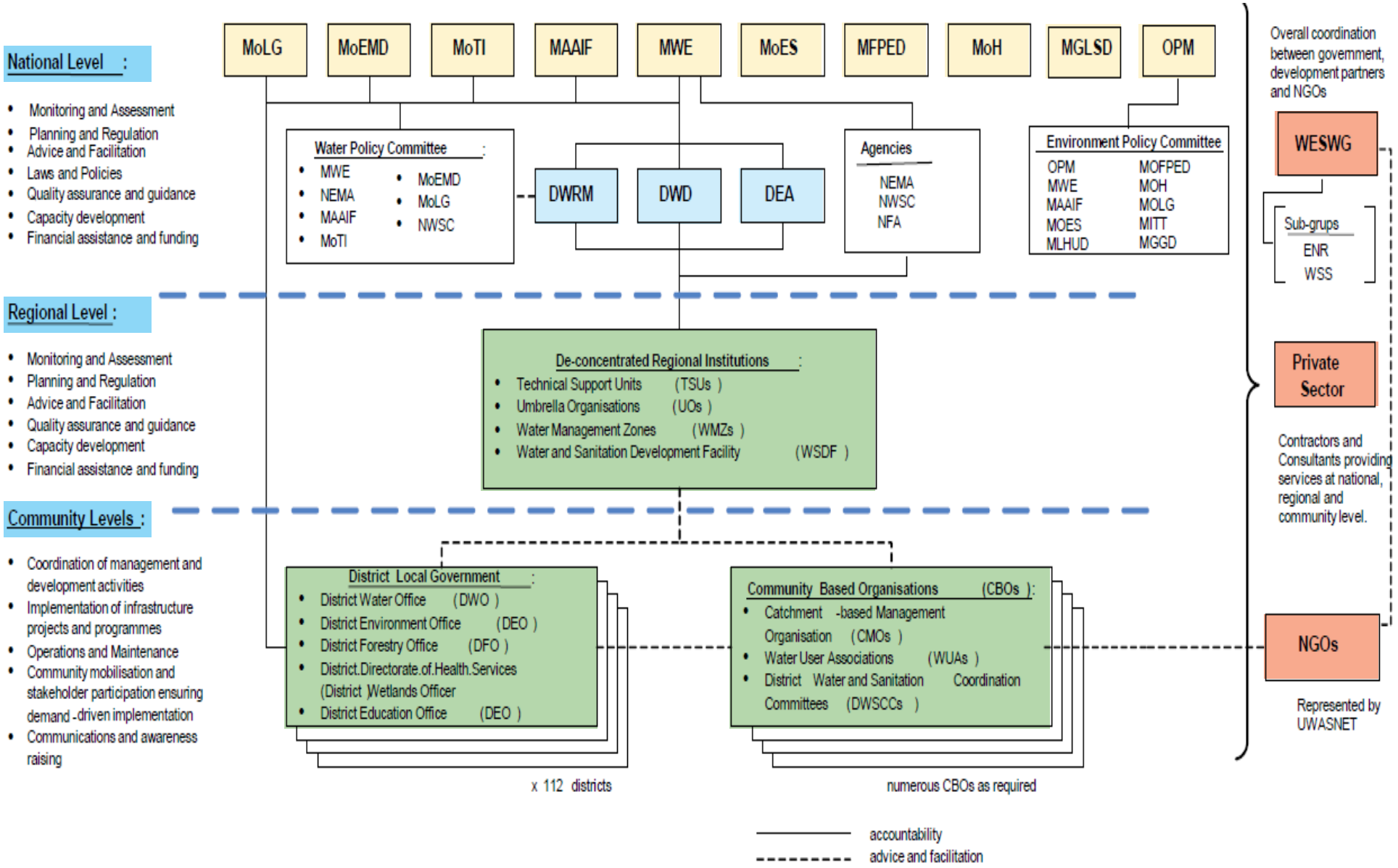


Figure 3-1: Institutional framework for Water and Environment Sector Support Programme (JWESSP, 2013 - 2018).

3.7.2 Regional Level

As a result of the deconcentration of the management of water resources, DWRM created four Water Management Zones (WMZ) following hydrological boundaries. They operate on regional level with the objective to bring the central services closer to the stakeholders. Their primary role is to facilitate sustainable development of the water resources for the economic and social benefit of the people in the catchment and to implement the water management measures needed to protect and conserve the catchment and its water resources, ensure sustainability, and reduce or resolve conflicts over resource use.

The DWD established the Water and Sanitation Development Facility (WSDF) as a mechanism for supporting water supply and sanitation facilities for rural growth centres and small towns, intended to promote a demand-responsive approach where Water Authorities/Town Councils or Town Boards apply for funding. The successful applicant is assisted by the WSDF to develop piped water supply systems.

Technical Support Units (TSU) established by DWD at the regional level have the mandate to support capacity building of district-based structures. This involves training, technical advice and support supervision of districts to enable them to effectively implement their roles in the rural sub-sector. The mandate also covers water for production.

Umbrella Organizations (UO) are also regional organisations constituted as associations of the local Water Supply and Sanitation Boards (WSSBs) with the principle objective of providing operation and maintenance (O&M) back-up support (training, technical, legal and organisational support, supervision of rehabilitation, and extension works as well as water quality monitoring).

The DWD has further deployed staff from its Department of Water for Production to the regions while DEA has also established offices for its Wetlands Management, Environmental and Forestry Support Departments at regional level.

These deconcentrated units in the regions are based together for improved cooperation and integration and represent the MWE on regional level.

3.7.3 Catchment Level

During the catchment management planning process, an institutional framework has to be created, which brings the stakeholders together to present and exchange their views and thus give the process legitimacy. Hence, the WMZ establishes Catchment Management Organisations (CMOs), which builds on and utilises to the maximum practicable extent, existing structures and relationships. The CMOs consists of several bodies *Figure* 3-2:

- **The Catchment Stakeholder Forum (CSF)** brings together all actors on catchment management. The CSF defines key issues related to water resources in the catchment that require consideration in order to effectively protect, manage, and develop water resources. It provides input to the CMP for coordinated, integrated and sustainable development and management of water and related resources in the catchment, including their implementation status.

- **The Catchment Management Committee (CMC)** is composed of representatives of all relevant stakeholder groups (government, politicians, and community-based organisations, NGOs, water users, media, academic institutions, and private sector) and collaborates with the WMZ during the formulation of a Catchment Management Plan and plays a steering role during its implementation. The CMC responsibilities include: coordination of stakeholder-driven definition of key issues related to water resources, promotion of coordinated planning, and implementation as well as stakeholder-driven decision-making related to integrated and sustainable development and management of water and related resources, development of plans for coordinated, integrated and sustainable development and management of water and related resources.

  It endorses the CMP and presents it to the Catchment Stakeholder Forum for information purposes. The CMC acts as an Executive Board for the Catchment Management Organisation.

- **The Catchment Management Secretariat (CMS)** provides support to the Catchment Management Committee in coordinating the planning and implementation of activities in the catchment as well as following up of recommended actions by the stakeholders. The CMS acts as an administrative secretariat for the Catchment Management Committee as well as the Catchment Technical Committee.

- **The Catchment Technical Committee (CTC)** forms the technical arm of the CMO and supports the CMC in their tasks. The CTC brings technical expertise and knowledge during the formulation of the Catchment Management Plan, operationalises and sometimes implements programmes and projects from the plan, and generally ensures that the different districts collaborate to implement the plan. It comprises of technical people from government, NGOs, private sector, development agencies, and other relevant organisations in the catchment.

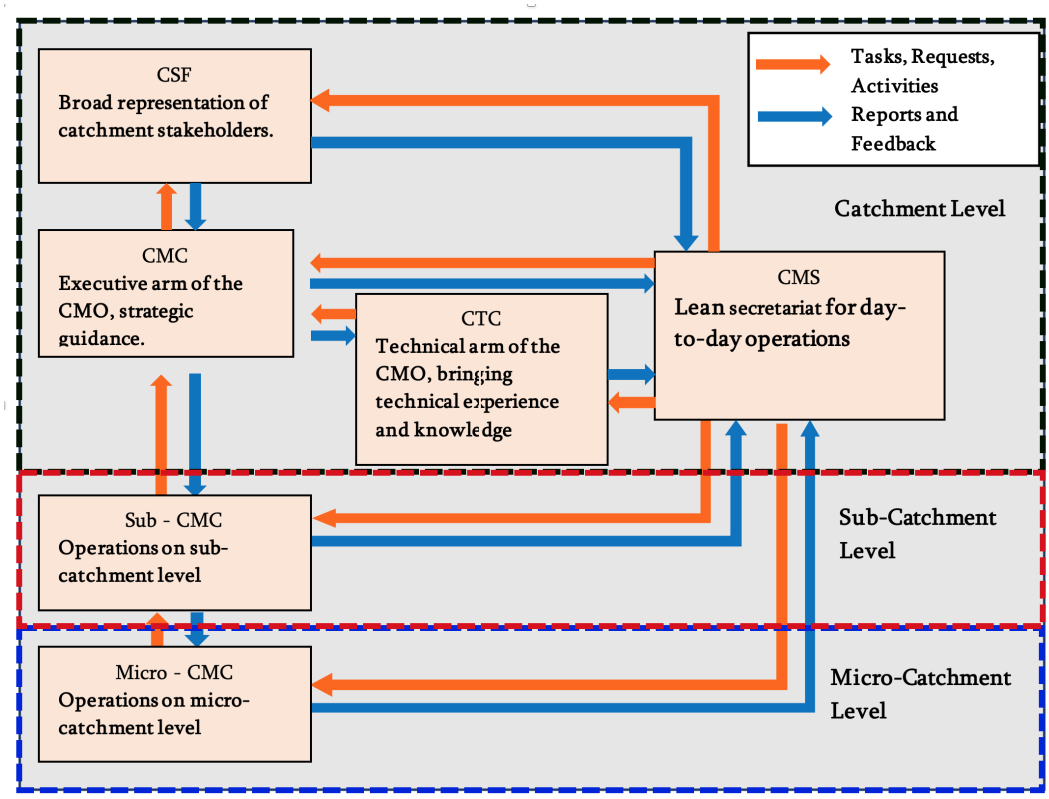


Figure 3-2: Catchment Management Organisation Structure (DWRM 2016)

Other relevant institutions at the catchment level include: The District Natural Resources Department, District Works or Engineering Department, District Production Department, District Planning Department, Department of Community Based Services, District Information Department, and District Health Department are key in the implementation of the CMP. However, the structure varies from district to district according to the natural conditions in the district. Most districts have 5-year district development plans in which all sector plans are integrated.

Based on all possible present stakeholders the Catchment Planning Guidelines (2014) envision roles as indicated in Table 3-1.

Table 3-1: Roles of Stakeholders in Catchment Plan Implementation

VWMZ	• Coordinate all implementation activities • Facilitate and support DWRM coordination of central level implementation and financial resource mobilization • Facilitate implementation of catchment management plan projects by central departments • Identify modalities for zonal and catchment level implantation among its public and private sector partners • Mobilize funds (Medium Term Expenditure Framework, budget, donors, private sector) with the assistance of DWRM for implementation of zonal and catchment level projects • Coordinate, manage and undertake project preparation for zonal and catchment level plan projects • Assess water use permit applications under existing regulations • Facilitate implementation and installation of upgraded and expanded monitoring network and WIS, and operate system within the zone • Monitor hydrologic and meteorological conditions, compliance with regulations, implementation of catchment plans and source protection plans • Support and facilitate the increasing role the CMC and other stakeholder groups including keeping all stakeholders informed of implementation progress • Undertake secretarial functions for the CMC.
CMC	• Facilitate and promote implementation of catchment management plans • Coordinate implementations from the CMP • Include interventions from the CMP into the respective District Development Plans • Monitor CMP implementation • Review the CMP regularly • Mobilise resources for the implementation of the CMP interventions • Carry out meetings with the CSF
MWE - DWRM	• Organize and coordinate the technical review of planned project proposals and assign implementation to the appropriate department • Mobilize funds for the implementation of the CMP and WMZ support • Review policy, identify needs for legal and regulatory revisions based on plan recommendations and manage the process for updating and revision
MWE - NEMA	• Review the environmental regulatory needs (actions, new or revised regulations) based on the adopted final CMP • Issue required regulations, notices, and permits in accordance with legal and regulation requirements
MWE – Line departments	• Undertake preparation of projects and investments within their area of responsibility that are proposed in the adopted final CMP (feasibility studies) • Supervise and manage project implementation (designs, tender documents, procurement, construction) • Operate the completed project in accordance with the permit and operating rules agreed with WMZ
Line departments in the concerned sector Ministries	• Undertake preparation of projects and investments within their area of responsibility that are proposed in the adopted CMP (feasibility studies) • Supervise and manage project implementation (designs, tender documents, procurement, construction) • Operate the completed project in accordance with the permit and operating rules agreed with WMZ

District government	• Facilitate and support implementation of the adopted CMP • Incorporate priority projects and programs into the District development plans as appropriate
Donor partners and NGOs	• Implement priority projects and programs in collaboration with WMZ and other stakeholders in accordance with agreements and Memoranda of Understanding (MOUs)
Private sector	• Facilitate and support implementation of the adopted CMP

Source: *Uganda Catchment Management Planning Guidelines (MWE/DWRM 2014)*

4. STATUS OF THE CATCHMENT

4.1 Catchment Description

Maziba catchment is located in the south western part of Uganda, and is part of the Kagera basin which is shared between Uganda and Rwanda, making it a trans-boundary catchment. The entire Maziba catchment (both in Uganda and Rwanda) has an area of about 3680 km^2, with 57% (about 2111 km^2) in Uganda and the rest in Rwanda. River Nyakijumba which originates from Rubanda district in Uganda flow into Rwanda, then back to the Uganda-Rwanda border where it is joined by River Kagitumba originating from Ntungamo district to flow downstream into Rwanda again, *Figure 4-1*. The river flows back to Uganda again and is monitored at "81223 - Kagera at Masangano" just before flowing into Lake Victoria. This description of the catchment is in line with the geographical extent described in section 1.3, (*Figure 1-2*), which is the entire Maziba catchment. However, it is important to note that some sections of this chapter and the report present information based on the smaller extent of Maziba (section 1.3, *Figure 1-3*).

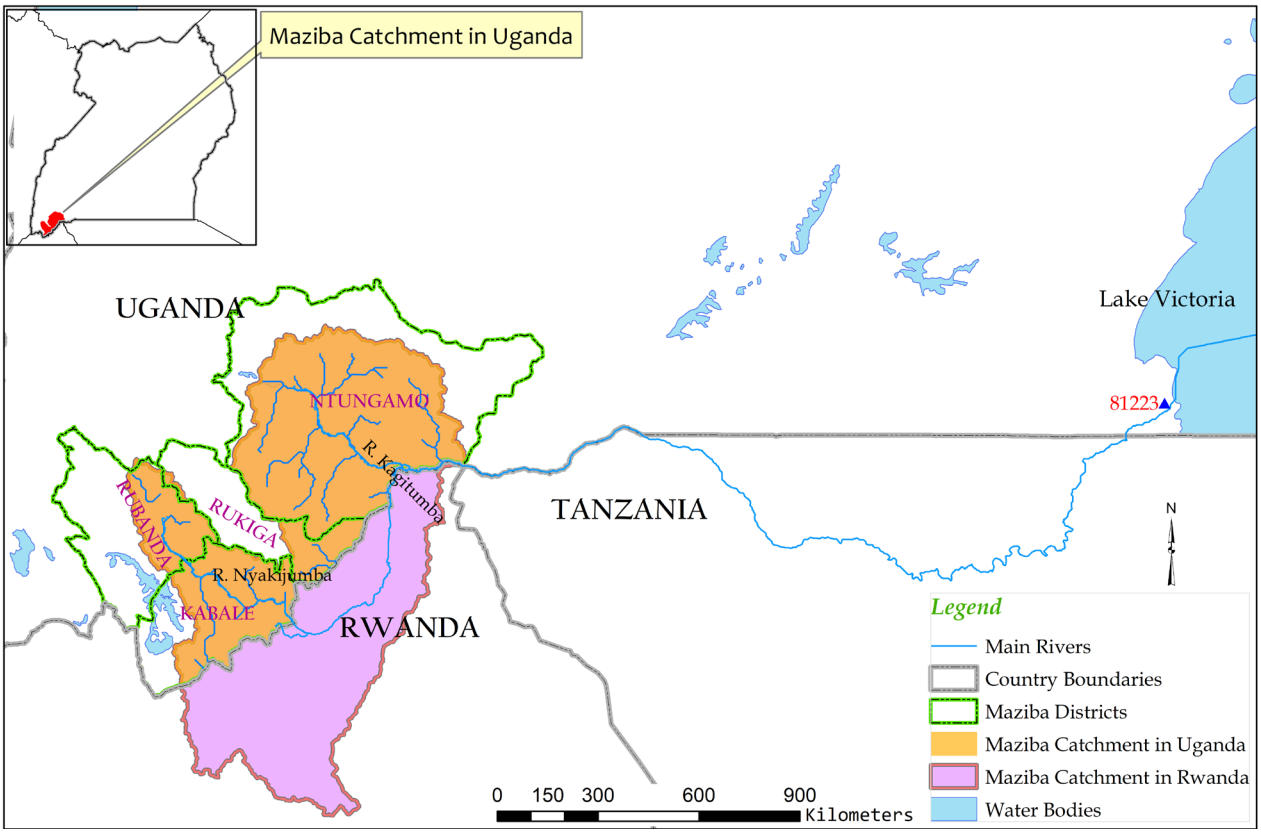


Figure 4-1: Location of Maziba catchment

In Uganda, the catchment partially covers four districts of Rubanda, Rukiga, Ntungamo, and Kabale, *Figure 42*, with Ntungamo district having the highest percentage contribution, 61% (in terms of area) to the catchment and Rukiga having the least, 7% contribution, Table 4-1. The weatern part of the catchment has streams and tributaries that flow through the sub counties of Hamurwa, Bubare, Kyanamira, Kitumba, Kamuganguzi, Buhara, Kaharo, Nyamweru and Maziba.

The Rwandan section of the catchment covers a number of sectors (administrative areas), namely Karama, Gatunda, Tabagwe, Rukomo, Kaniga, Rubaya, Cyumba, Manyagiro, Mukarange, Bwisige, Manyagiro, Shangasha, Byumba, Bwisige and Kisaro. The eastern part of the Rwandan side of the Maziba catchment is drier and lies in an area of grassy plains, and low hills in the Muvumba area. This kind of topographical configuration highlights an important potential for modern and mechanized agriculture. The land is not farmed as extensively as other areas of the country, and there is a large amount of cattle. Rice is grown in its large valleys. Small intermittent rivers and streams are the main water reserve for the people and the cattle. On the other hand, the western part of the Rwandan side of the catchment is wetter, characterized by many tea and banana plantations, and a number of towns and villages like Mulindi and agro-processing plants like the Mulindi tea factory in the Northern Province. The small streams and rivers present potential for developments in the river valleys that aim to increase irrigation, develop potable water, and hydropower generation in the area.

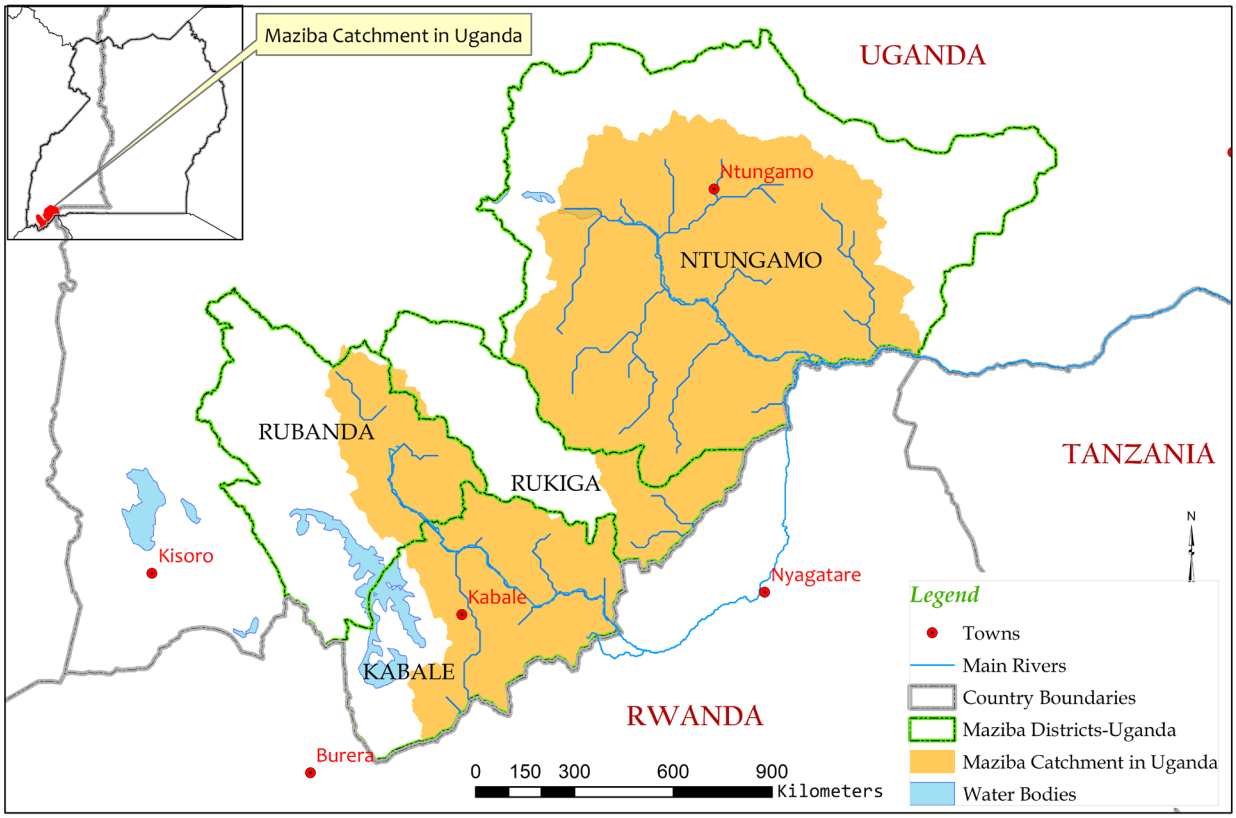


Figure 4-2: Districts in Maziba catchment

Table 4-2: Districts in Maziba catchment

SNo.	District	Area of District in Maziba (km²)	District Area (km²)	Percentage of District area in Maziba	District area contribution to Maziba (%)
1	RUBANDA	225.88	687.637	33%	11%
2	RUKIGA	140.70	429.121	33%	7%
3	NTUNGAMO	1298.20	2045.11	63%	61%
4	KABALE	446.15	618.122	72%	21%
Total		**2110.93**	**3779.99**		**100%**

The landscape of Maziba catchment contains small, fragmented landholdings on a mountainous terrain mainly in the western part (Kabale, Rukiga, and Rubanda districts) to fairly big landholdings in the eastern parts in Ntungamo district. The area has numerous streams and wetlands. It is densely populated with an estimated density of 281 persons per km² as of the 2002 census (Uganda Bureau of Statistics, 2002). Around 85% of the population is composed of subsistence farmers with an estimated average of 7.4 children per household. Population pressure has led to fragmentation of the farms into small sizes, which range from less than 0.08 ha to 3.2 ha, with an estimated average farm size of 0.72 ha (Kabale District Development Plan).

Maziba catchment area in particular has maintained a high population density. As a result, the pattern of agricultural land use includes intensive farming practices on the upland (hillside) fields and a combination of vegetable production and large and small-scale dairy farming in the wetland valleys. The most important crops are Irish potatoes, sweet potatoes, sorghum, beans and maize. The communities through necessity have carried out intensive soil management and intercropping purposely to prevent famine and not to protect water quality. Two rainy seasons, one short and one long, allow farmers to produce up to three crops per year on the upland fields and one crop a year in the wetland fields. Many farmers, especially those with low household incomes, try to plant a second crop of sorghum and maize in their wetland fields. Wetlands are also used for their natural raw materials.

4.1.1 Physiographic data

The natural characteristics of a catchment which influences the local hydrology in time and space is defined by the physiographic data. Thus, this data; topography, soils, surface and bedrock geology, land-use and land-cover, and wetlands are very important elements for a water resources assessment.

4.1.1.1 Topography

Topographic data is not only essential in determining the surface drainage area of a catchment but also in understanding the direction of flow of water within a catchment. From the DEM used, the minimum elevation within the Maziba catchment is 1277masl while the maximum is about 2485masl, *Figure 4-3*. The western parts of the catchment (Rubanda, Kabale, and Rukiga districts) are seen to have fairly high elevations as compared to Ntungamo district.

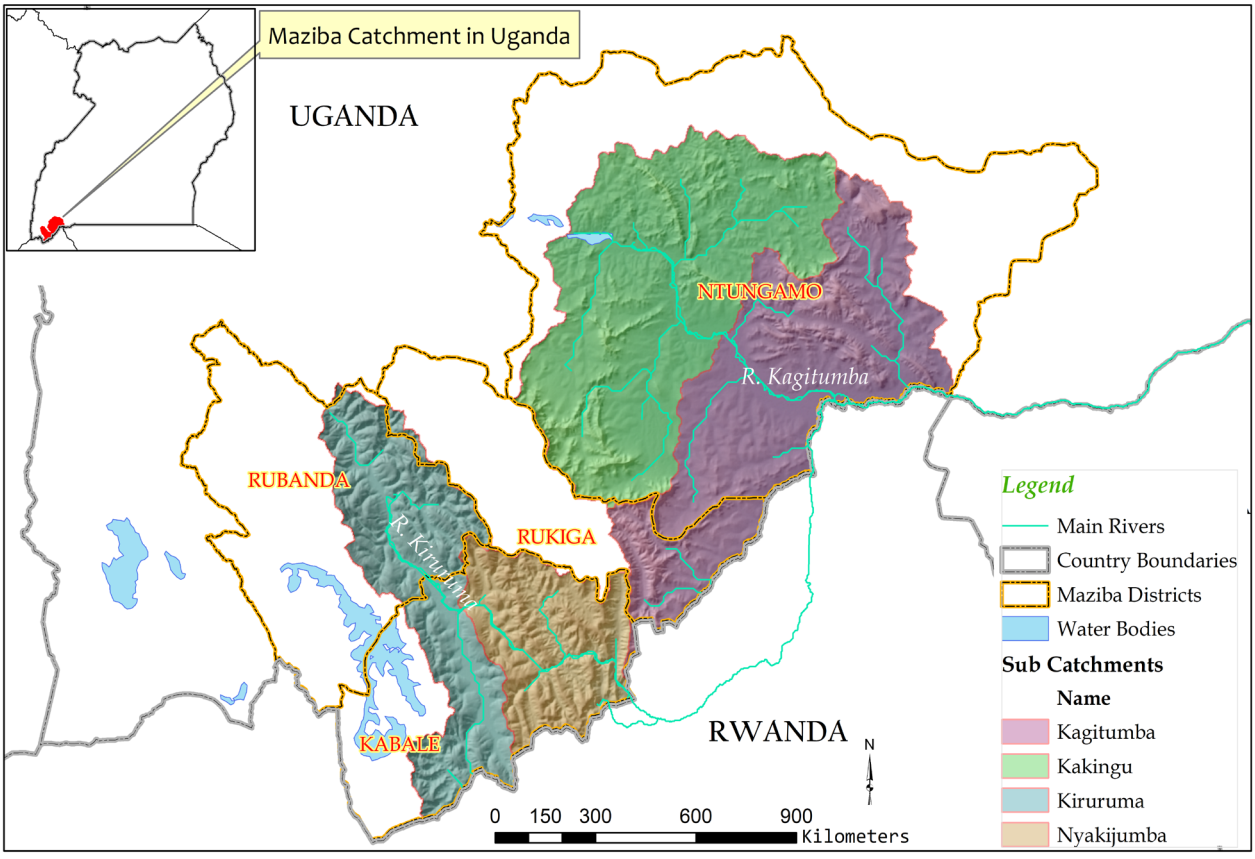


Figure 4-3: Relief map for the Maziba catchment

4.1.1.2 Rivers, Lakes, and Wetlands

There exists a network of rivers within the Maziba catchment with the main tributaries being Rivers Nyakijumba and Kagitumba. These rivers, however, change names as they traverse the different areas within the catchment. There are no big lakes within the catchment and the Kagitumba wetland is the main wetland, *Figure 4-4*.

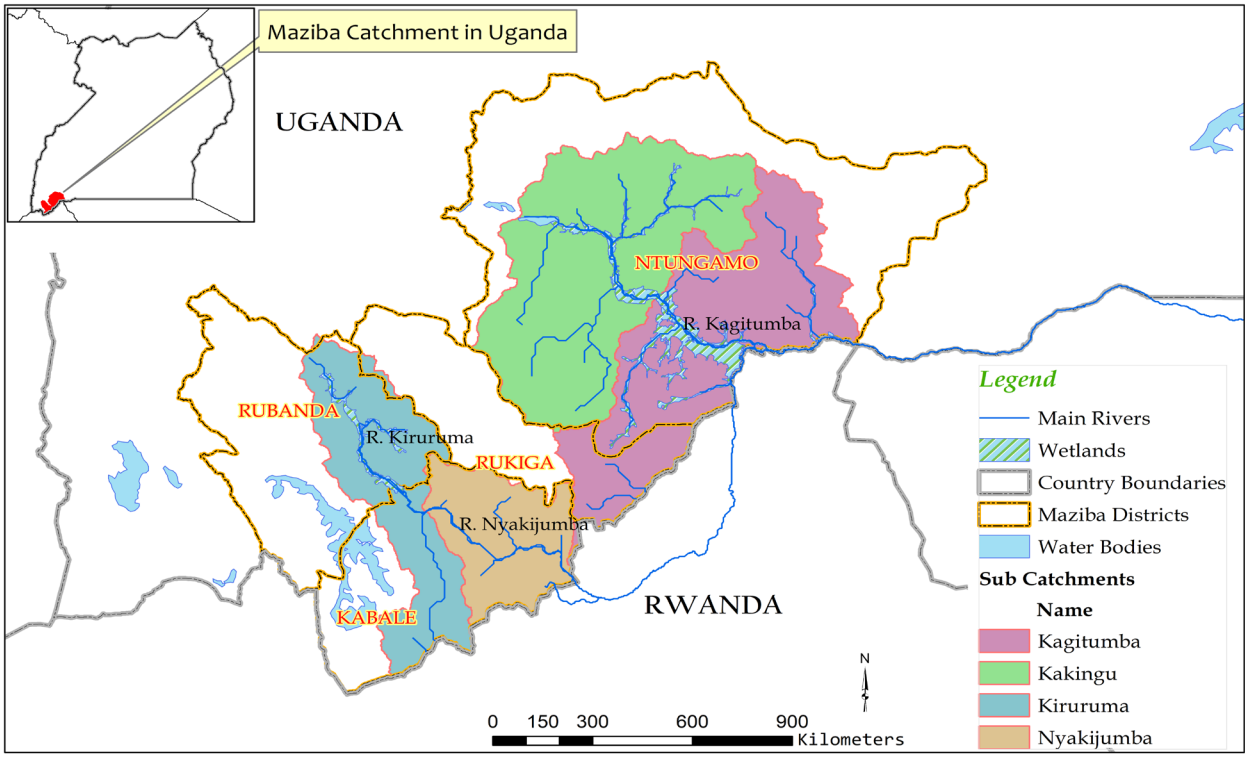


Figure 4-4: Rivers, Lakes, and Wetlands in Maziba

4.2 Bio-Physical Status and Delineation of the Catchment

4.1.1 Sub-Catchment Delineation

Delineation of Maziba Catchment and the sub-catchments was done using a 90m by 90m Shuttle Radar Topography Mission (SRTM Digital Elevation Model in a GIS environment and based on the river network, the hydrological stations, and the boarder as a point of interest. In total, four (4) sub-catchments were delineated within the Maziba catchment and are the focus of water resources analysis at a sub-catchment level.

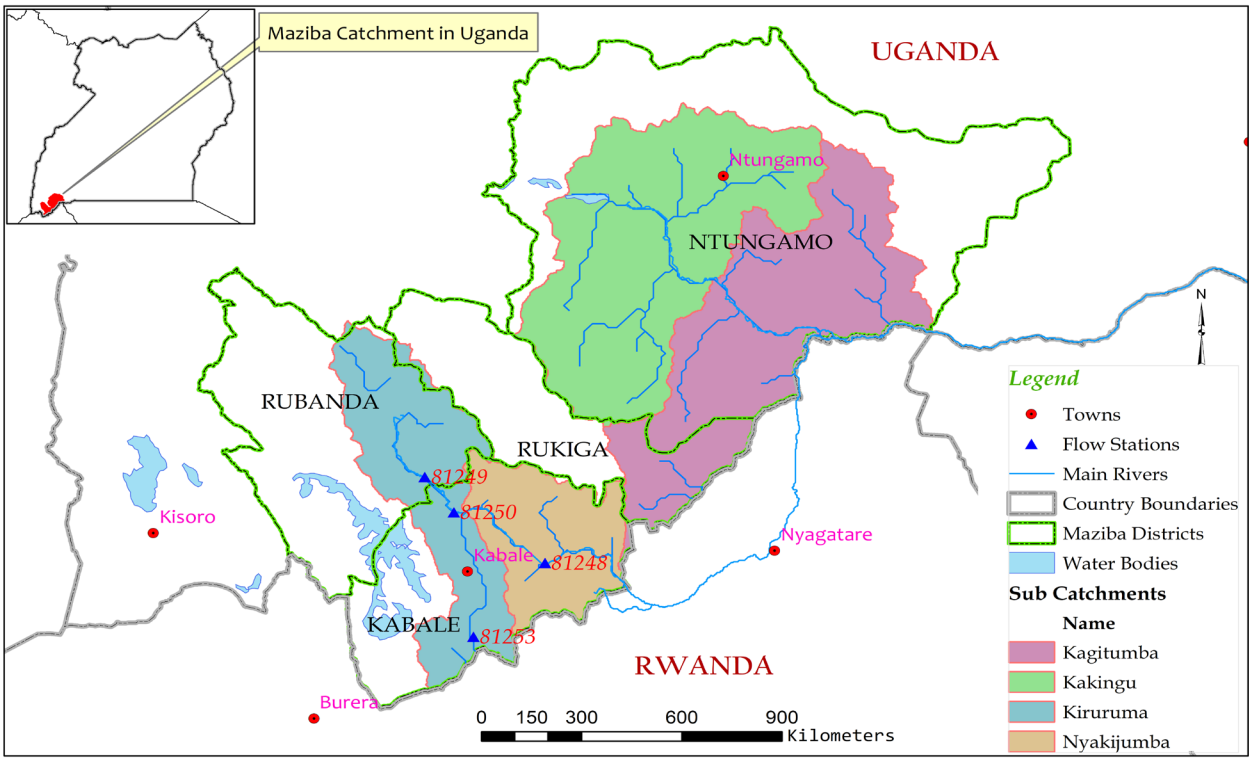
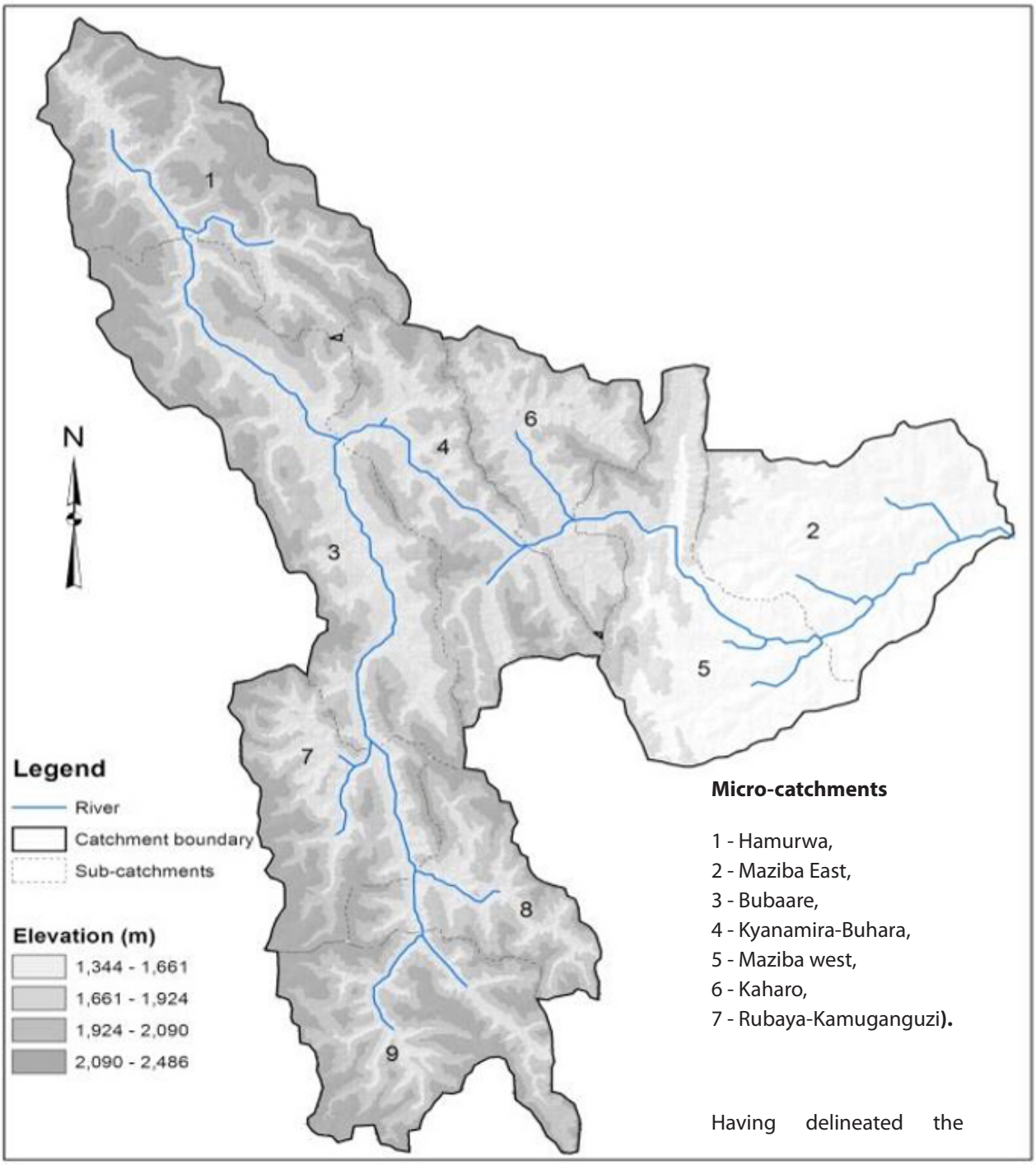


Figure 4-5: Sub-Catchments in Maziba

These sub-catchments were named based on the main river tributaries. *Figure 4-5* shows the delineated sub-catchments and their corresponding names.

4.1.2 Delineation and Description of the Hotspot Micro-catchments

Delineation of micro-catchments is presented as previously undertaken in Maziba CMP developed 2014, using the smaller geographical extent described in section, *Figure 1-3*. This micro-catchment delineation has not been updated in the current report due to scope limitations and data availability challenges. The delineation was done using ArcSWAT software integrated in ArcGIS 10.1 based on the generated DEM. The delineated catchment is shown in *Figure 4-6* below. Based on its tributary streams, the Maziba catchment was further delineated in 9 micro-catchments. Seven of these fall within the Ugandan section of the catchment; and details about each are discussed in the subsequent section.



Having delineated the

Figure 4-6: The seven (7) micro-catchments of Maziba

micro-catchments, land use analysis, soil loss analysis, vegetation cover change, population density, soil type, and slope were used to describe the hot spot micro-catchments. *Figure* 4-7 to *Figure* 4-11 show the characteristic layers for Maziba catchment (smaller geographical extent described in section, *Figure 1-3*. Description of the analysis done is presented in the following section.

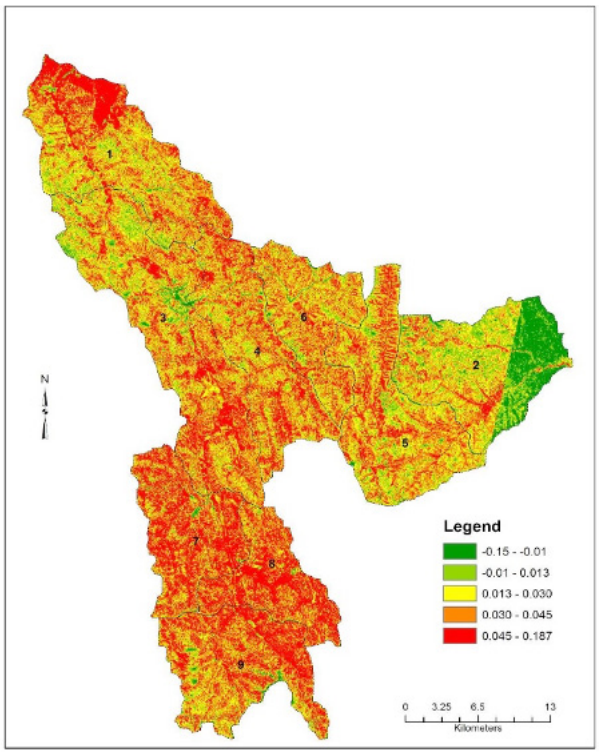


Figure 4-7: Maziba Land use/ cover by micro-catchment

NB: *Additional notes for Legend in Fig. above (Upper boundary of NDVI vegetation density categories) -0.25/-0.26 (Water body); -0.2 (bare/roads); 0.20 (Low vegetation density); 0.40 (Medium density); 0.63 (High density)*

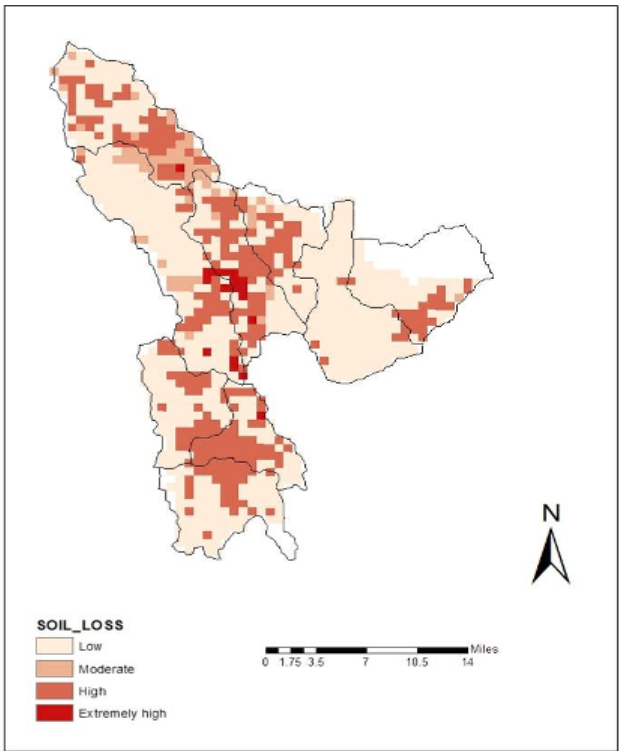


Figure 4-8: Maziba Soil loss by micro-catchment

Note: Low *(2 -10 t/ha/yr); Moderate (10-50 t/ha/yr); High (50-90 t/ha/yr); Very High (>90 t/ha/yr)*

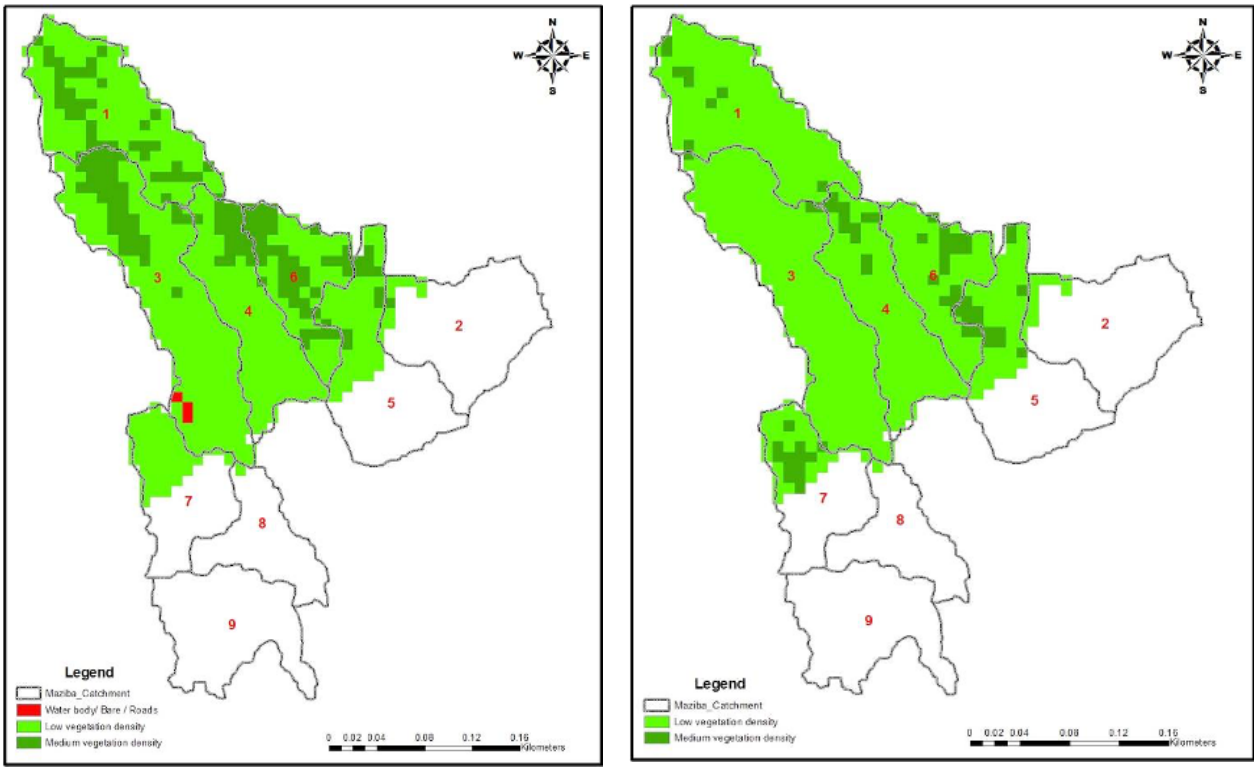


Figure 4-9: Vegetation cover in 2000 and 2010, by micro-catchment

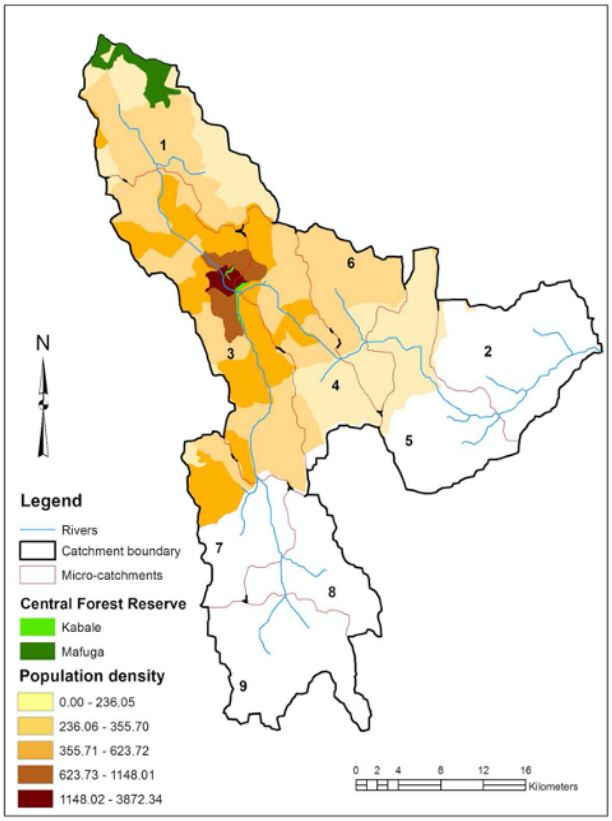


Figure 4-10: Maziba Population Density by micro-catchment

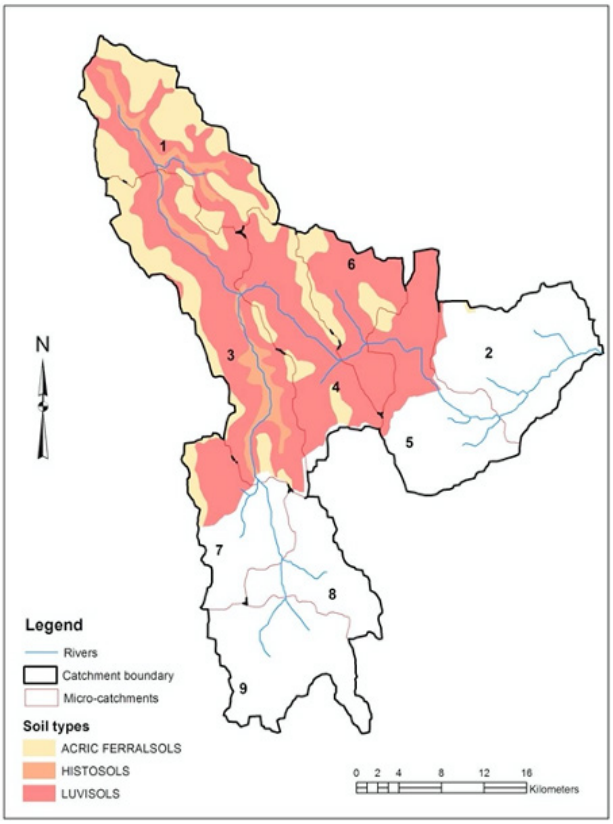


Figure 4-11: Maziba soil types by micro-catchment

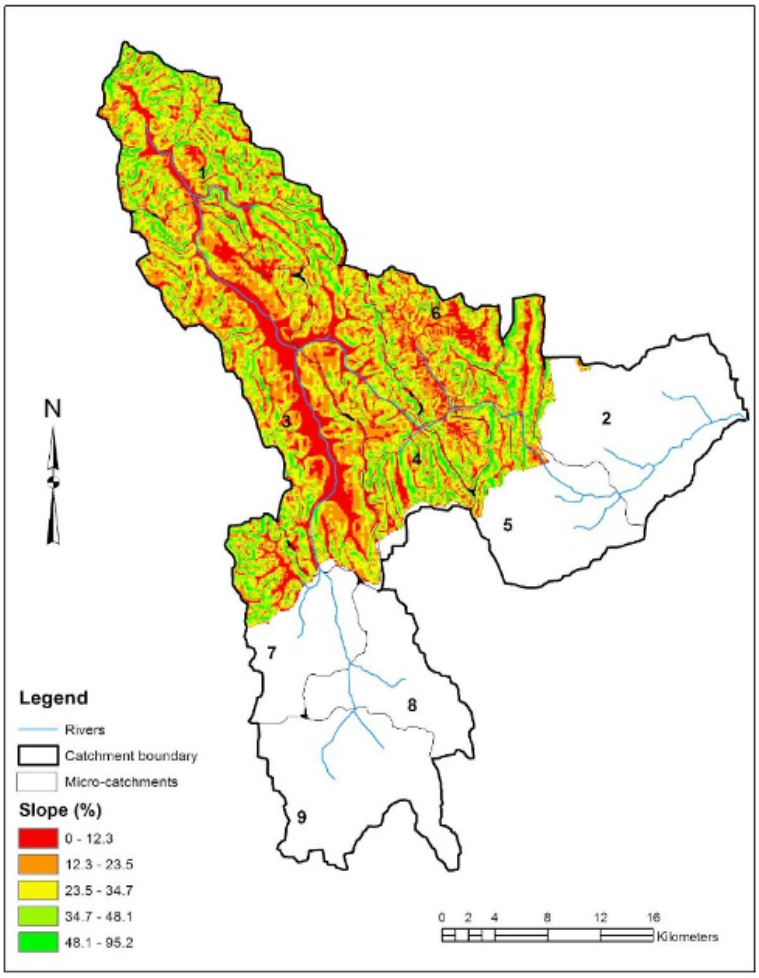


Figure 4-12: Maziba slope % by micro-catchment

4.2.2.1 Hamurwa micro-catchment

This micro-catchment covers an area of 159 km^2 and is located extremely upstream, north of the Maziba catchment. Its tributary streams originate from Mafuga Central Forest Reserve, swamps and hill slopes in Hamurwa, Shebeya and Igomanda parishes, draining through valleys in the center of the micro-catchment. Owing to soil erosion in the hill slopes, TSS load is quite high in the streams, standing at 1,072 mg/l (105^{0}C) and 974 mg/l (500^{0}C), with soil making up to 91% of inorganic matter in the TSS. The rest of the water parameters are fairly normal, with EC standing at 222 **µS/cm,** pH 6.7; DO 6.4 mg/l; and Temperature 19.6^{0}C.

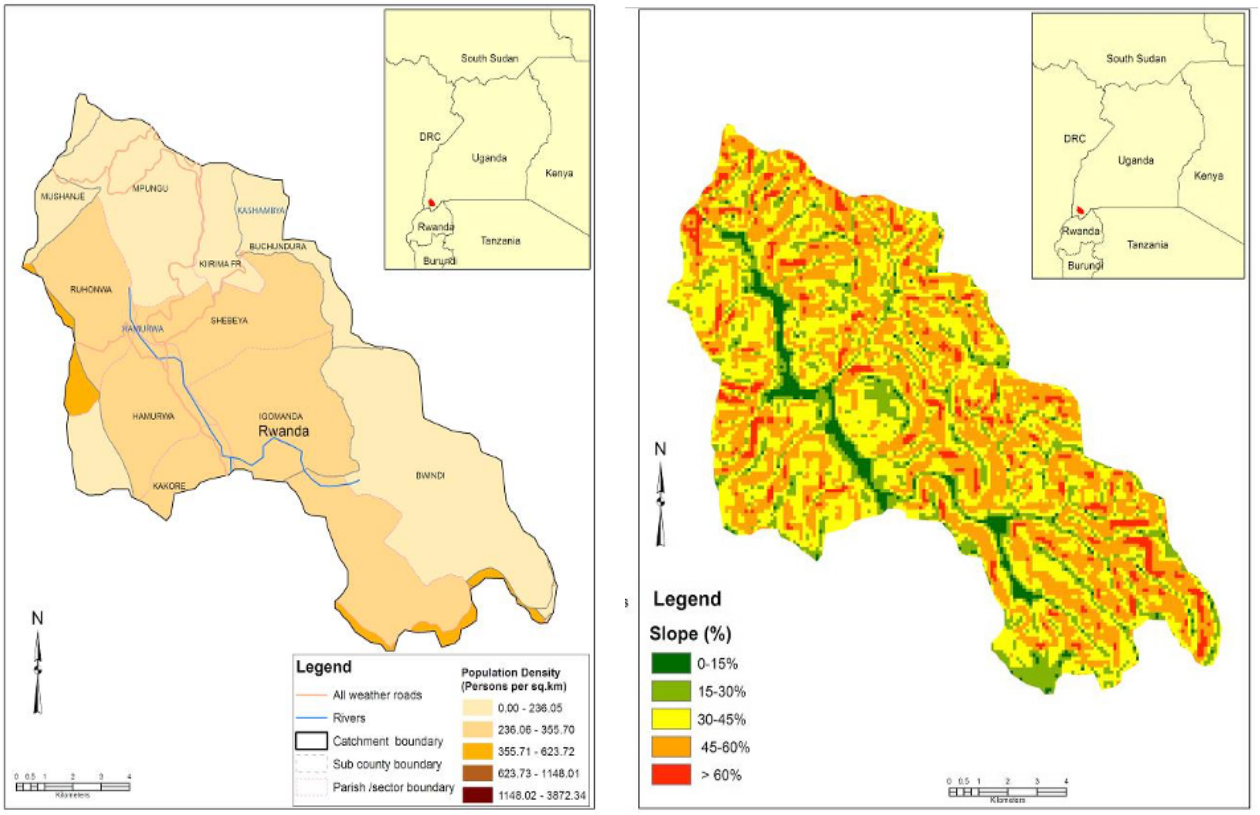


Figure 4-13: Population and Elevation, and slope of Hamurwa micro-catchment

In terms of topography, the landscape is quite steep, dominated by slopes ranging between 34.7 - 48.1%, and in some extreme cases between 48.1 – 95.2%. Only the valley bottoms have slope ranging between 0 and 12.3%, *Figure 4-13*. In the east and West, the micro-catchment is dominated by high elevation ranging between 1,661 and 2,486 meters ASL. In the valleys in the center, elevation ranges between 1,344 and 1, 661 m ASL. Along the steep slopes, the soils easily get eroded, especially where land cover is poor, or no soil erosion control measures have been put in place.

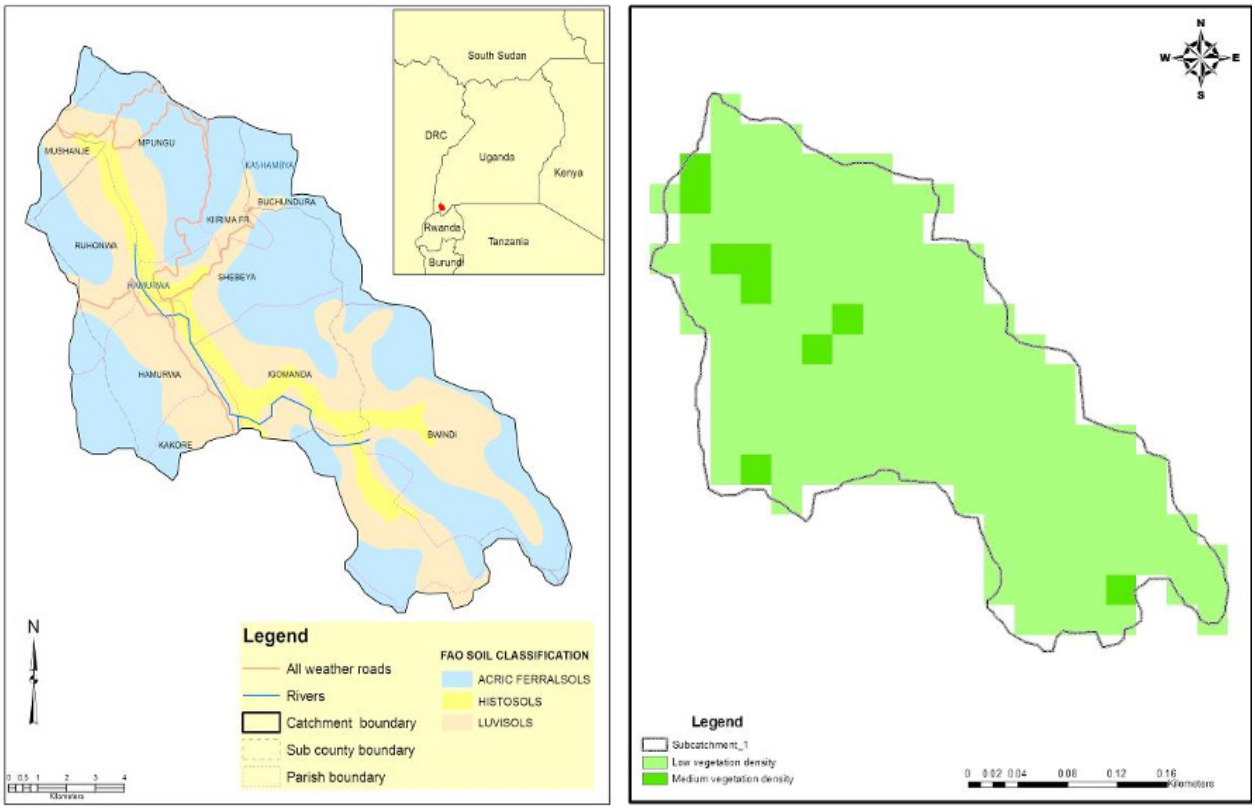


Figure 4-14: Soils and Vegetation density of Hamurwa micro-catchment

Mafuga CFR covers part of the North and NE of the catchment. This CFR has only managed to stay in place due to its conservation status. Otherwise, the rest of the land use / cover is dominated by low density vegetation, grass, annual crops with low tree density. Most of the southern and western part of the micro-catchment is almost bare, with grass underlain with laterite. The area lost almost all its medium vegetation density between 2000 and 2010. According to NDVI analysis, high vegetation density only appeared in 2002, increased up to 2004, and started declining up to its disappearance in 2010. Little land cover exposes the soils to erosion and further degradation. The average loss rate of vegetation cover is 2,000 m²/yr during 2000 and 2010.

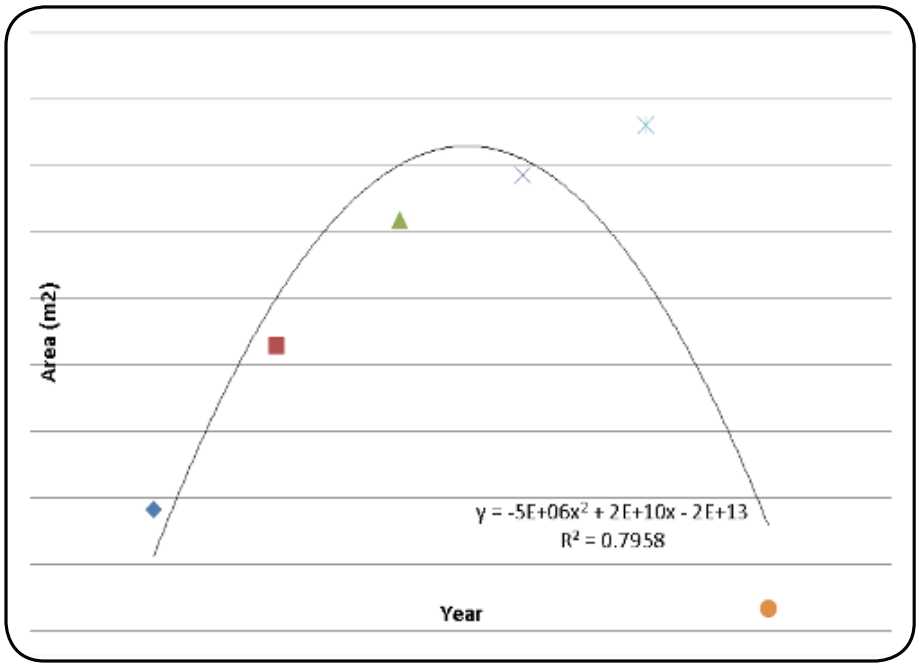


Figure 4-15: Annual change in vegetation cover in Hamura micro-catchment

In terms of soils, the valleys in the center & parts of the south are dominated by histosols and deposited alluvial soils (luvisols), whereas the steeper hill slopes in the southern, eastern and western parts of the micro-catchment are dominated by Acric Ferralsols. The ferralsols are more prone to erosion as they are located along steep slopes.

The southern, south-eastern & patches of the central and western sections of the micro-catchment experience high (50-90 t/ha/yr) to extremely high (> 90 t/ha/yr) rates of soil loss, accounting for the high loads of TSS in the streams. Population density is comparatively higher in central and western parts of the micro-catchment, ranging from 236 – 356 people/km^2. A small patch at the western boundary registers even higher population density between 356 and 624 people/km^2. High population density places pressure on the land, which is not allowed to fallow and therefore quickly loses fertility.

Highlight of key issues identified in Hamurwa micro-catchment & proposed solutions

The steep slopes in Hamurwa micro-catchment increase erosivity and erodibility. This is exacerbated by the rapid removal of natural vegetation cover, which further explains the high to extremely high rates of soil loss. The eroded soils are deposited along streams to cause high TSS loads. Flood risk becomes higher where large volumes of sediment have been deposited along the valleys and stream beds. Four key issues are therefore specific to Hamurwa that need address, namely: loss of natural vegetation cover, soil erosion, and stream sedimentation and flood risk.
Farmers will need to be encouraged to adopt and plant agro-forestry and other preferred tree species e.g. fruit trees on their farms. This will support efforts to re-vegetate the micro-catchment. Combined with other tailor-made and already popular soil and water conservation technologies based on lessons from on-going and past projects, these could reduce the rates of soil erosion and stream sedimentation and flood risk. Enabling local policy, legal and agricultural extension frameworks will spur the proposals to potential success. Additionally, technologies like embankments need to be introduced to protect key infrastructure and farms against floods. A more sustainable approach would be to apply nature-based solutions – protecting stream banks from encroachment and allowing them to naturally regenerate.

4.2.2.2 Maziba East micro-catchment

This covers a total area of 141 km^2, with only a very small part of it found in Kabale, and the rest in Rwanda. It is located extremely downstream of the Maziba. All other micro-catchments of the Maziba drain water through this micro-catchment, before draining into Rwanda. The small patch in Kabale has small streams that originate from hills which form the drainage divide with Kaharo micro-catchment. Considering its downstream location, elevation is lower than in many other parts of Maziba catchment, ranging between 1,666 and 1,924 m ASL. Slope ranges from 0 – 48%.

The small part of this micro-catchment found in Kabale is principally dominated by deposited luvisols, again owing to its downstream location. It experiences low to moderate rates of soil loss. Population density is also not as high as in Hamurwa, ranging from 0 – 236 people/km^2, *Figure* 4-16 and *Figure 4-17*.

Land surface is almost bare, characterized by grass underlain with laterite. In 2002 up to 2008, it had basically medium to high vegetation density. From 2010, it was entirely under low vegetation density, showing that the medium and high ones were lost between 2002 and 2010, especially the little medium vegetation density area initially located at the border with Maziba West micro-catchment. This makes the land prone to soil erosion and further degradation. It has no protected area, forest reserve or major urban area. Average loss of vegetation cover from 2000 – 2010 was 1,800m^2/yr during 2000 – 2010.

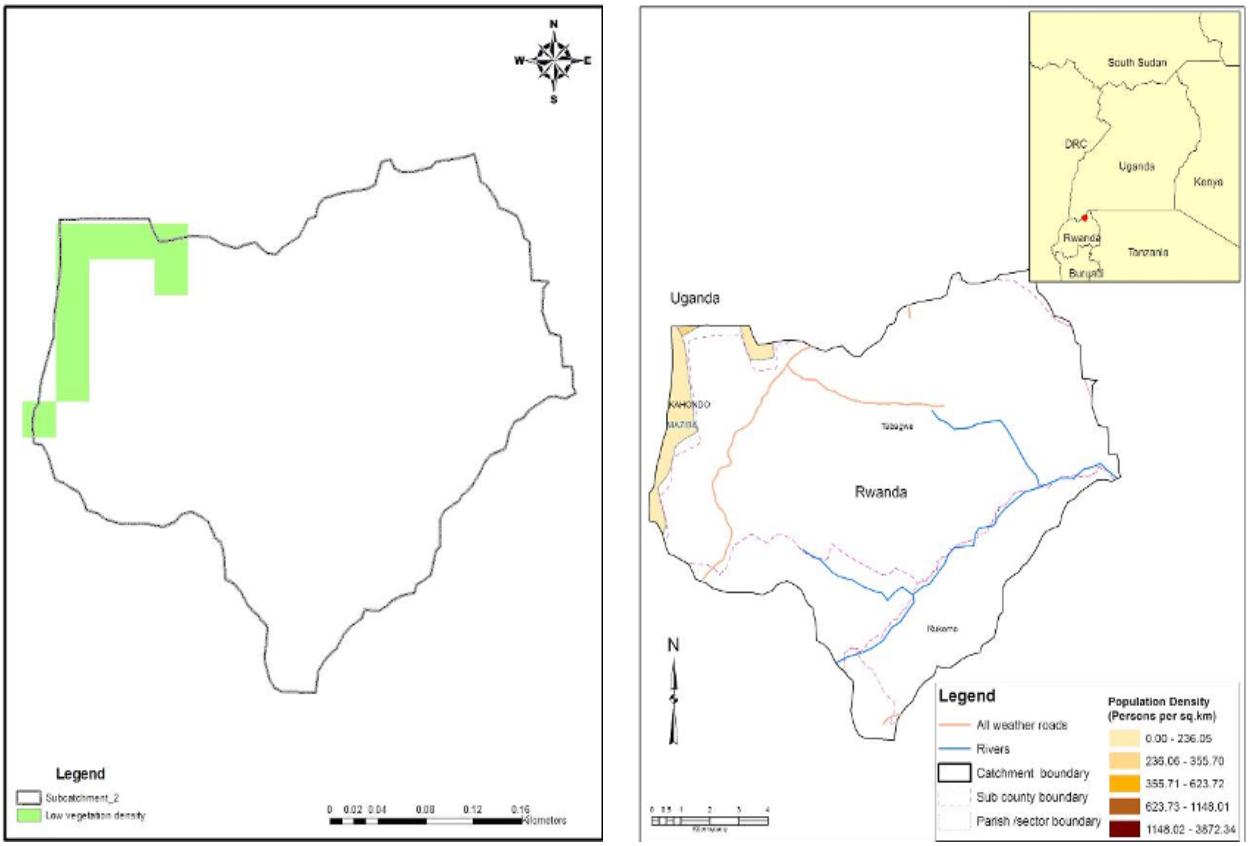


Figure 4-16: Vegetation density and Population of Maziba East micro-catchment

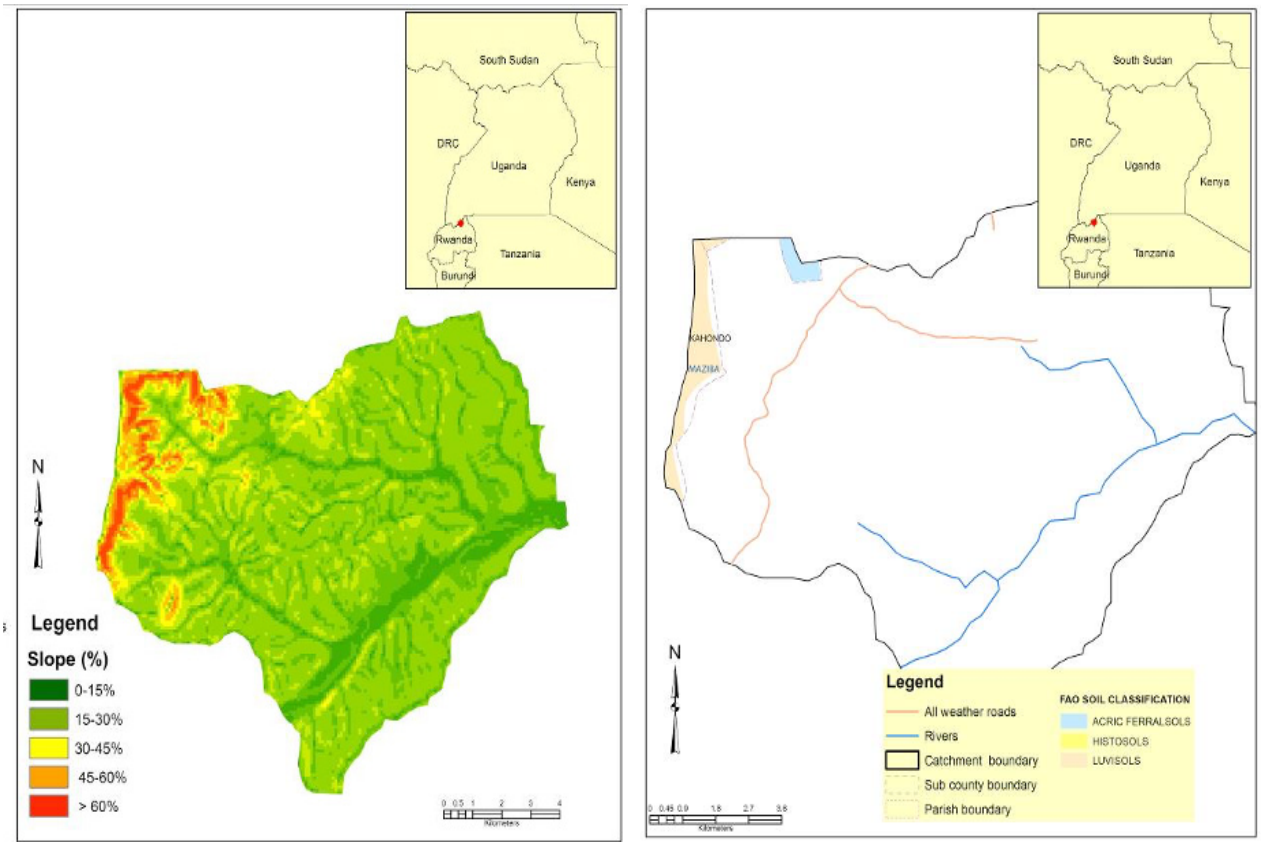


Figure 4-17: Elevation and Soils of Maziba East micro-catchment

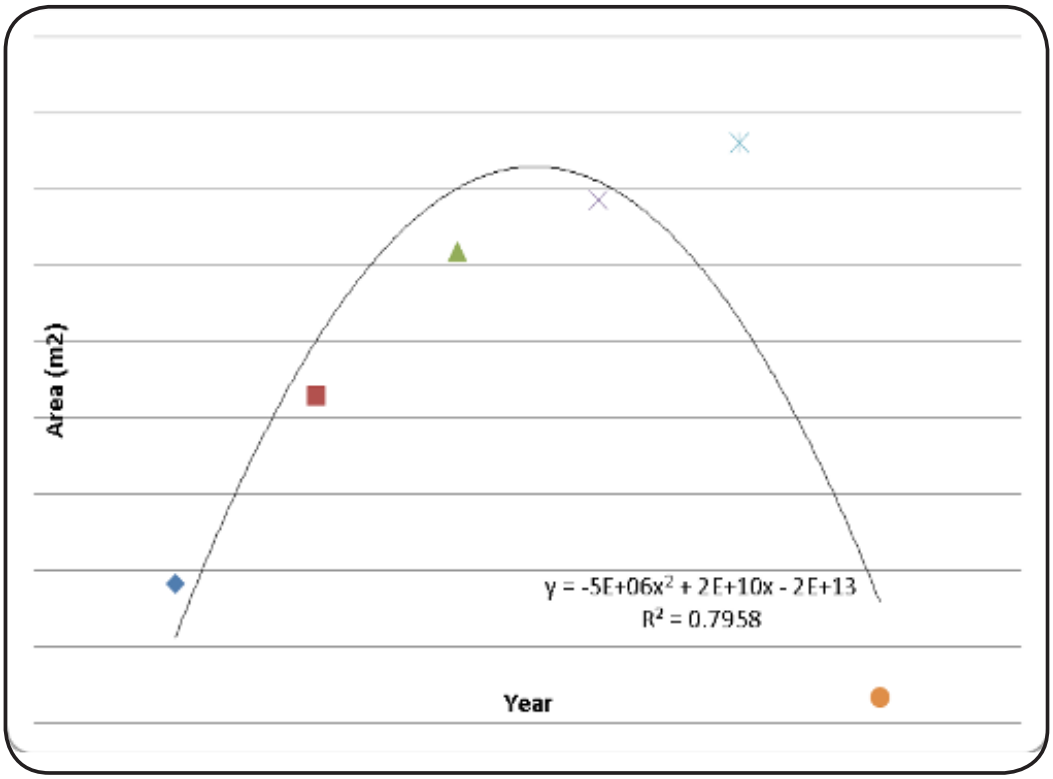


Figure 4-18: Annual change in vegetation cover in Maziba East micro-catchment

Highlight of key issues identified in Maziba East micro-catchment and proposed solutions

Principally, the land surface is almost bare, and therefore prone to soil erosion and further degradation. Considering its downstream location, sediment from upstream also has potential to cause reservoir sedimentation and flood risk.

Just as proposed for Hamurwa above, solutions that seek to re-vegetate the micro-catchment will contribute to reducing rates of soil loss, if done concurrently with other soil and water conservation technologies, e.g. trenches, grass strips, etc. Flood control measures will also need to be considered for this downstream micro-catchment, including protecting the buffer zones and wetlands along stream banks so as to allow them naturally filter the water of its sediments.

4.2.2.3 Bubaare micro-catchment

This covers parts of Bubare and Kamugangizi sub-counties, and Kabale Municipality. The Micro-catchment covers a total area of 215 km^2. It is drained by various streams that originate from Rwanda, Rubaya and Kamuganguzi. It has a confluence of the major streams from both north and south of the Maziba catchment. Water samples taken from the northern tributary at Bubaare showed fairly good results, with EC at 219 **µS/cm**, pH 6.7, DO 7.1 mg/l, Temperature 18.5^{0}C, TSS 57 (105^{0}C) mg/l, TSS 38 (500^{0}C) mg/l; with soil making up 67% of inorganic matter in TSS. However, at the second sampling point along the southern stream at Kitumba, TSS was quite high, recorded at 302 mg/l (TSS 105^{0}C); and 256 mg/l (500^{0}C), with soil making 85% of inorganic matter in TSS. The other parameters were normal at this point. EC was 120 **µS/cm**, pH 7, DO 7.7 mg/l and temp 18.4 ^{0}C.

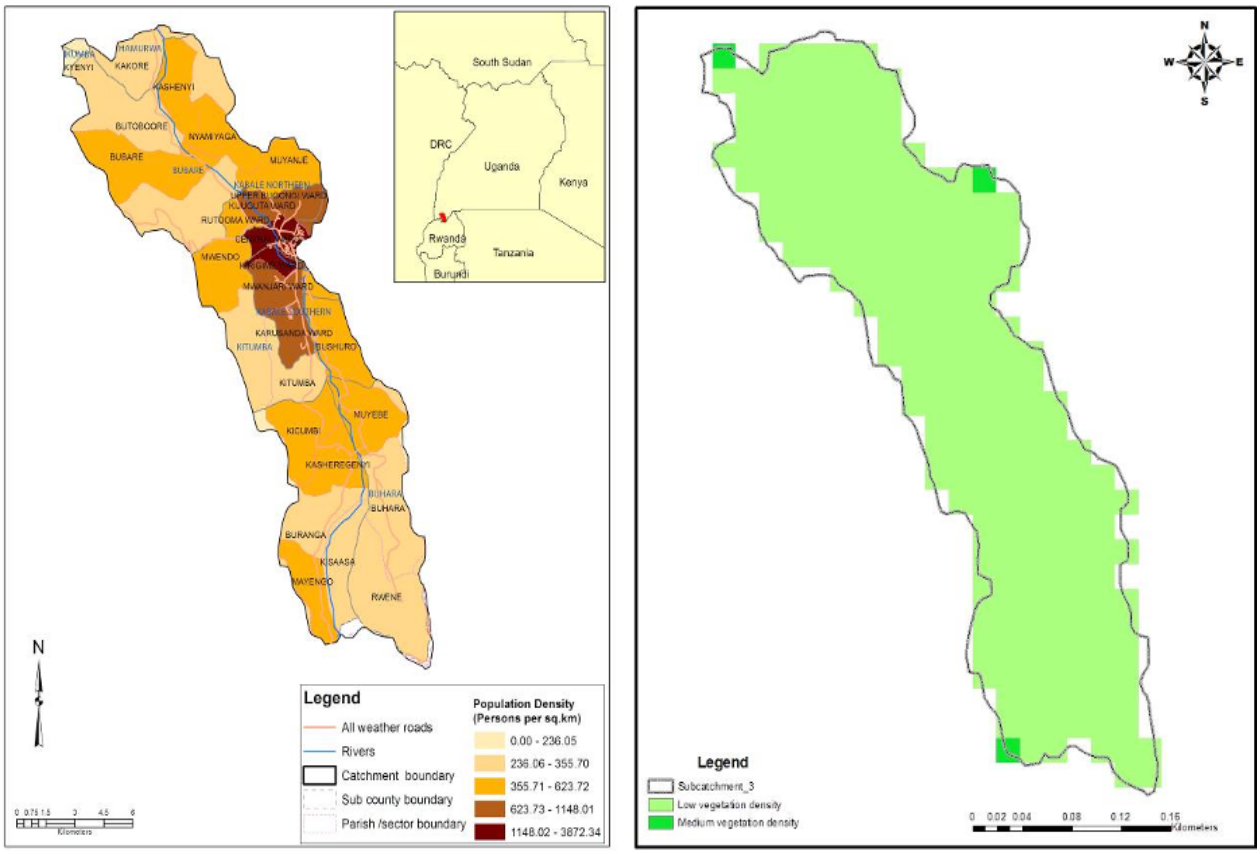


Figure 4-19: Population and Vegetation of Bubaare micro-catchment

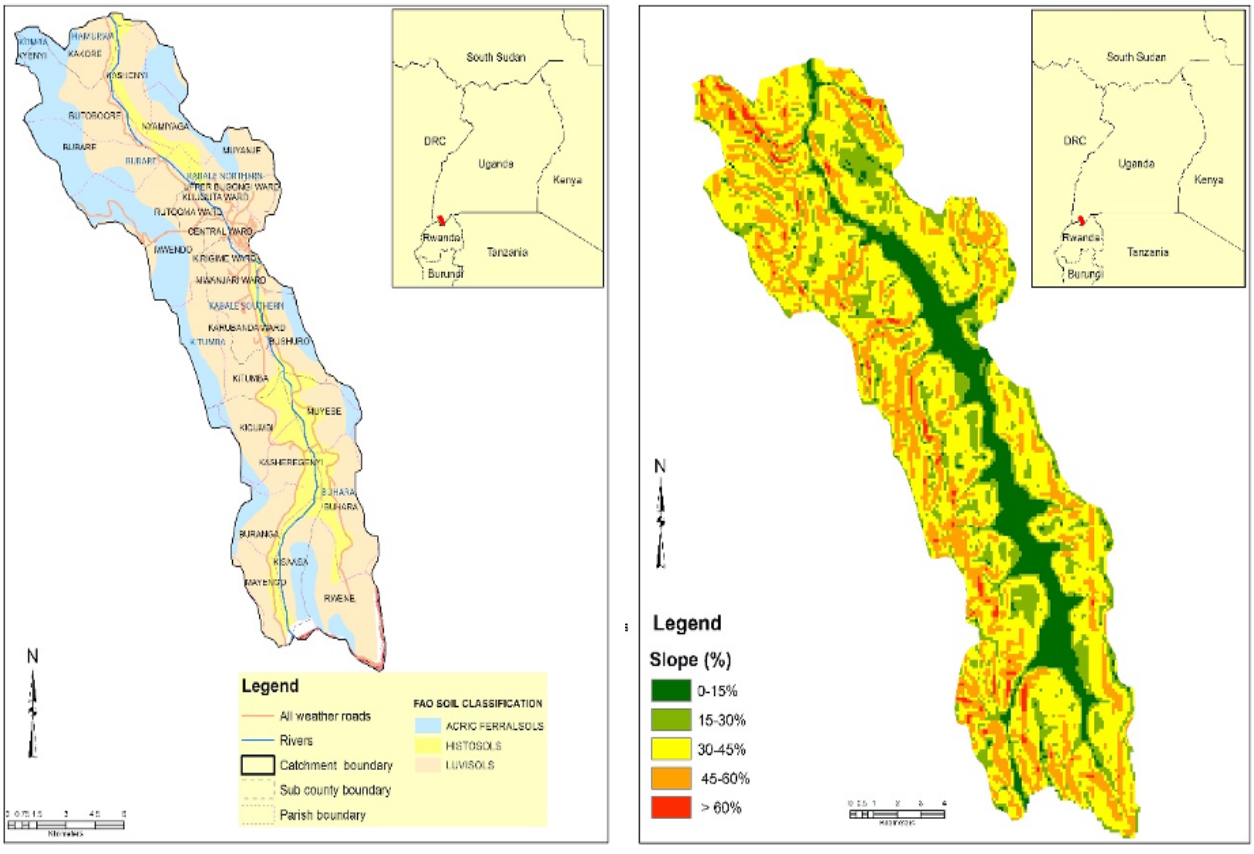


Figure 4-20: Soils and Elevation of Bubaare micro-catchment

The landscape is dominated by slope ranging between 35 – 48 % and in some extreme cases 48-95%; except in valley bottoms where it ranges from 0-12%. Dominantly, elevation is quite high in the east and west, ranging from 1661 – 2486 m ASL. In the valleys in the centre, it ranges from 1,344 – 1,661 m ASL.

The soils in the micro-catchment are dominated by luvisols, with patches of histosols occurring in valley bottoms. Acric Ferralsols dominate a thin patch of the western & eastern hills that form the drainage divide. The ferralsols are more prone to erosion as they are along hill slopes. Parts of the center and south-east experience high (50-90 t/ha/yr) to extremely high (> 90 t/ha/yr) rates of soil loss, *Figure 4-20*. This explains the high TSS loads in the streams.

To the east of the micro-catchment is Kabale Municipality, with a high population density ranging between 624 and 3,872 people/km^2. The density is equally high in other parts of the micro-catchment ranging from 236-624 people/km^2 because of proximity to the urban area. The high population density exerts a lot of pressure on the land, further exposing it to degradation.

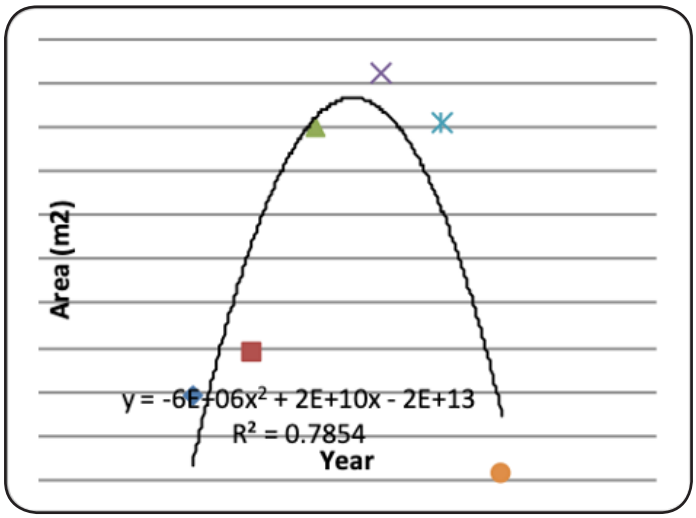


Figure 4-21: Annual change in vegetation cover in Bubaare micro-catchment

The northern part is almost bare, with grass underlain with laterite and just patches of low tree density; while southern part by dominated by low density vegetation, grass, and annual crops with low tree density. The urban area is purely built up. High vegetation somehow appeared in 2002, increased up to 2006 and dropped to disappearance in 2010. Bare ground is more vulnerable to degradation through soil erosion. The micro-catchment lost all its medium vegetation density from 2000-2010, including the small wetland area that initially existed. The micro-catchment has a small patch of Kabale Plantation Central Forest Reserve, but this has highly been encroached upon and is therefore highly threatened due to population pressure. However, the high vegetation density increased from 2000 up to 2006 due to agro-forestry programmes introduced by ICRAF in Bubaare sub-county, but most of this tree cover drastically declined from 2010. The converted wetlands are occupied by large cattle farms. Some sections are used to grow vegetables and Irish potatoes. The average loss rate of vegetation cover is 800m^2/yr during 2000 – 2010.

Highlight of key issues identified in Bubaare micro-catchment and proposed solutions

The high population density exerts pressure on the land. Quickly, the land is cleared of its vegetation to open land for cultivation and settlement. The steep slopes then easily and quickly get eroded of their soils, especially in the absence of soil and water conservation structures. The eroded soils are deposited in the valleys, to cause high TSS load along streams. This increases flood risk along valleys where sediment has been deposited, as the water is displaced sideways to submerge farms, settlements and other infrastructure.

The micro-catchment is nearer to the major urban center, with very dense population and therefore unique issues. An integrated approach therefore needs to be adopted here, that incorporates population control measures in natural resources management – population control alongside micro-catchment re-vegetation, soil and water conservation, wetland and riverbank protection and/or rehabilitation, and other flood risk control and management measures.

4.2.2.4 Kyanamira-Buhara micro-catchment

This covers an area of 123 km^2. It is located midstream of the catchment, but downstream of the confluence between the 2 major streams from both north and south of the Maziba catchment. It is therefore characterized by higher volumes of stream flow. Part of it drains through Kabale Municipality. Water samples were taken at 4 different points in this micro-catchment and results tabulated as below, Table 4-2.

Table 4-2: Water quality in Kyanamira-Buhara micro-catchment

Village	Parish	Sub-county	EC (µS/cm)	pH	DO (mg/l)	Temp (°C)	TSS (105°C) mg/l	TSS (500°C) mg/l
Northern ward	Rwakaraba	Kabale town	218	7	9	18.2	78	57
Central ward	Kigonji	Kabale town	227	6.9	7.1	18.3	71	52
Rwakihirwa	Buhara	Buhara	117	6.6	13.6	17.9	120	98
	Kyanamira TC	Kyanamira	157	6.8	6.2	18.8	289	246

The results were normal for most parameters, except TSS which was quite high at Buhara (120 mg/l at 105°C) and Kyanamira Town Council (289 mg/l at 105°C and 246 mg/l at 500°C); with soil making up 82% of the inorganic matter in the TSS at Buhara and 85% at Kyanamira.

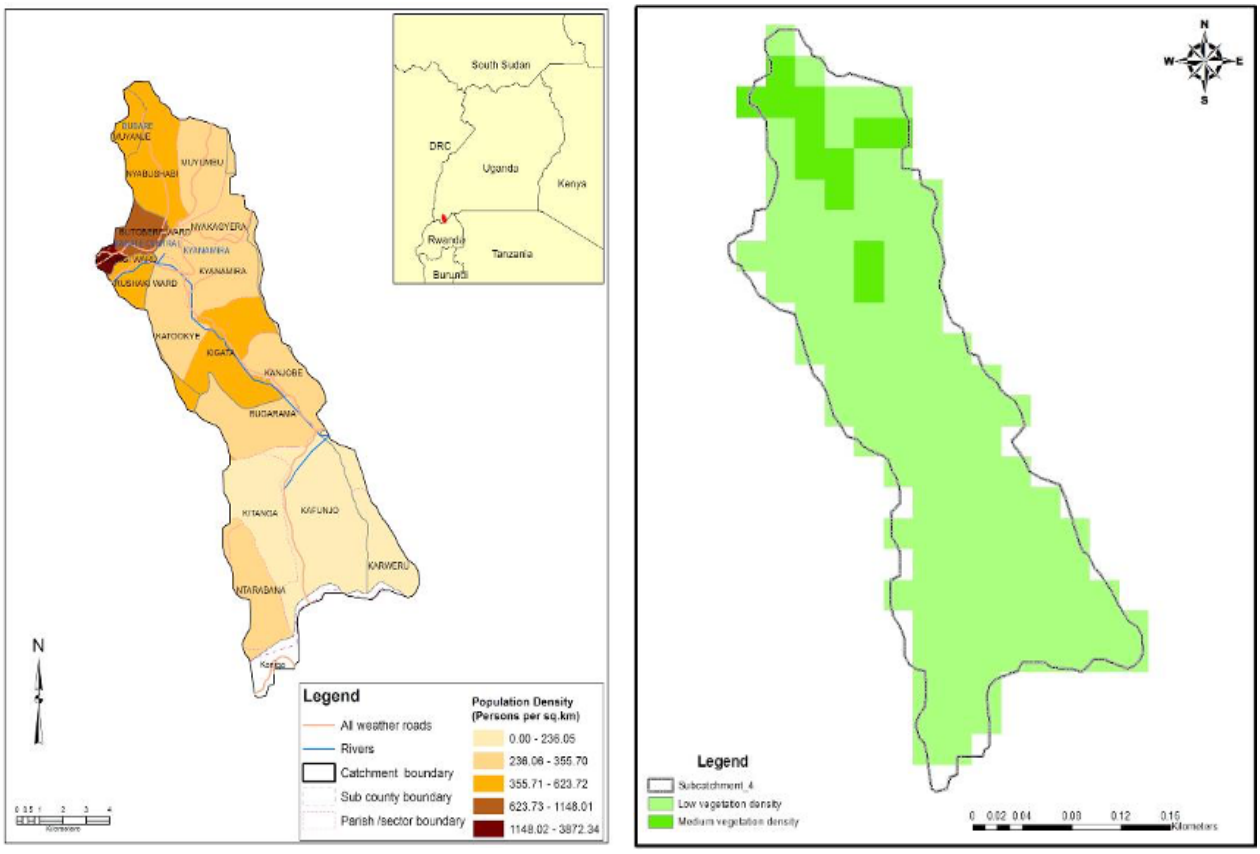


Figure 4-22: Population and Vegetation of Kyanamira-Buhara

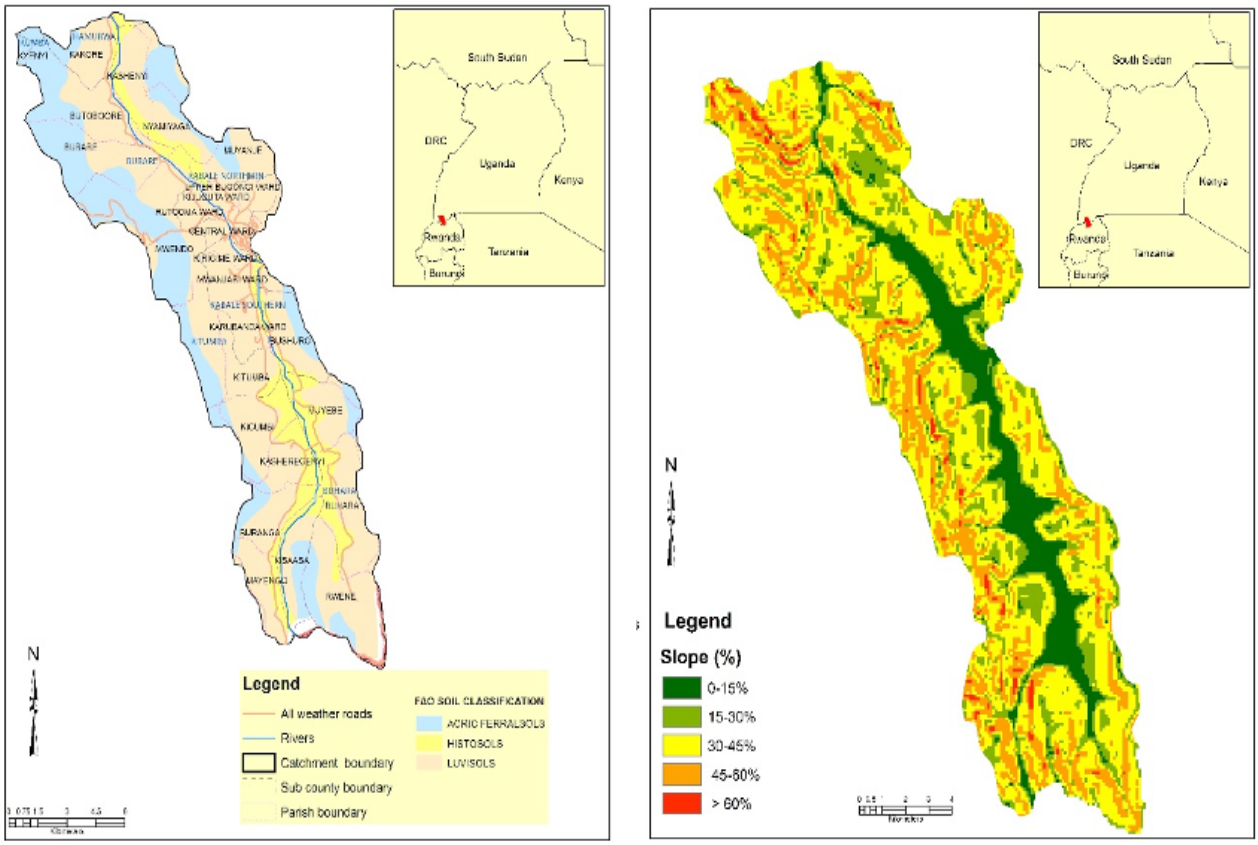


Figure 4-23: Soils and Elevation of Kyanamira-Buhara

Slope is dominantly fairly steep, ranging from 35 – 48%, *Figure* 4-23; except for valley bottoms where it ranges from 0 – 12%. Elevation in the eastern, western and northern boundaries of the micro-catchment is high, ranging from 1,661-2,486 m ASL, making the landscape here more prone to soil erosion and further degradation. In the valleys, it ranges from 1,344 - 1,661 m ASL. The dominant soil type is luvisols, except for thin patches of Acric Ferralsols which occur along hill slopes in the western and NE borders. A long stretch of over 75% of the landscape, extending from the north to south, experiences high (50-90 t/ha/yr) to extremely high (> 90 t/ha/yr) rates of soil loss, *Figure* 4-23. The ferralsols are more prone to erosion as they are found along hill slopes. The north western part of the micro-catchment is occupied by Kabale municipality, with very high population density ranging from 355 – 3,872 people/km^2. The southern part has a lower population density of 0 – 236 people/km^2.

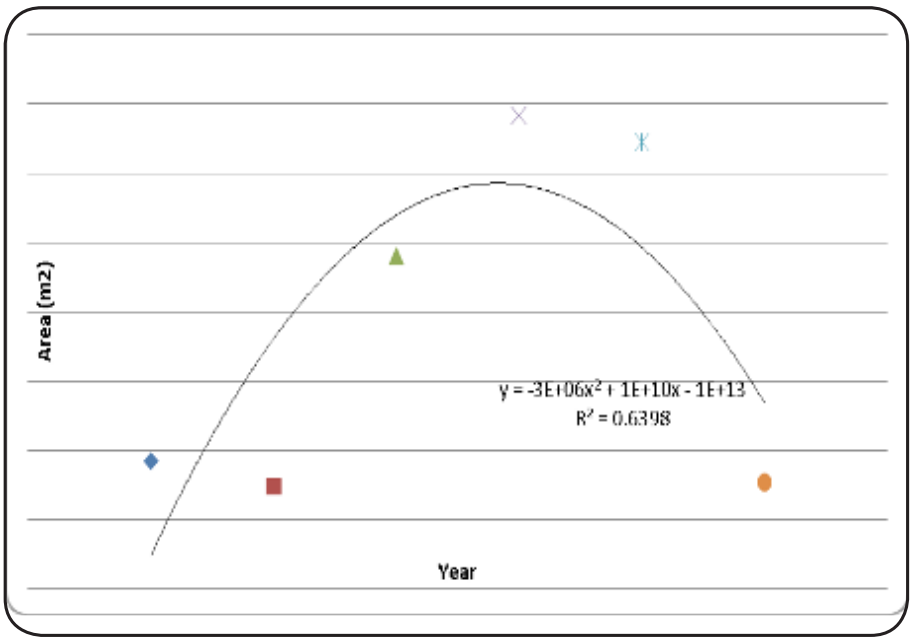


Figure 4-24: Annual change in vegetation cover in Kyanamira-Buhara micro-catchment

The northern and southern parts of the micro-catchment are dominated by low vegetation density, grass, and annual crops with low tree density, while the urban center is largely bare or built up. Owing to population pressure, the landscape lost most of its medium vegetation density between 2000 and 2010; including the now highly threatened remaining patch of Kabale CFR. Initially, it was dominated by low and medium vegetation in 2000 up to 2002. High vegetation started to appear in 2004. It increased up to 2006 and started declining until disappearance in 2010. The average loss rate of vegetation cover is 1,650 m^2/yr during 2000 and 2010.

Highlight of key issues identified in Kyanamira-Buhara micro-catchment

High population density has exerted pressure on the finite land resources. The steep slopes have been stripped of their vegetation cover to expose the soils to high rates of soil erosion. Even Kabale plantation CFR has been encroached upon, and is still threatened by population pressure. TSS is quite high along streams in Buhara and Kyanamira, owing to sediment eroded from hill slopes and deposited in valleys. Sediment deposition itself increases flood risk within the low-lying areas.
Proposed measures here will principally be similar to what is proposed for Bubaare, as the conditions are basically similar. The micro-catchment is also nearer to the major urban center, with very dense population. The integrated approach also best applies, that integrates population control combined with micro-catchment re-vegetation, soil and water conservation, wetland and riverbank protection, and other flood risk control and management measures.

4.2.2.5 Maziba West micro-catchment

Located downstream of the Maziba catchment, this micro-catchment covers a total area 144km^2. It is characterized by highly silted waters as it drains all waters from upstream, including sediments from the upper micro-catchments. It drains through Birambo, Kavu and Kahondo parishes, and subsequently into Rwanda where the larger section is found. Water quality tests were conducted for this micro-catchment based on samples taken at Maziba hydropower dam site in Birambo Parish. EC stood at 131 µS/cm, pH 6.8, DO 6.6 mg/l, Temperature 18.3 0C, and TSS 552 mg/l (105 0C) and 480 mg/l (5000C). Owing to the downstream location, the TSS loads were quite high, with soil making up 87% of inorganic matter in the TSS.

At Maziba hydropower plant, which is located on river River Kiruruma, Eastings 35M 0176094 and Northings UTM 9854762, Birambo Parish, Maziba sub-county, downstream from Kyanamira town council, the sediment load had built up and the river water was brown in colour, *Figure 4-25*. The plant is known to have silted and failed due to excessive soil loss and poor land use in the contributing micro-catchment.

Most areas in this micro-catchment have slopes ranging from 35-48%; except the valley bottoms where it ranges from 0-12%. Elevation in the west is comparatively higher, ranging from 1,661-2,486 m ASL. Over 90% of the area is covered by luvisols, except for a small patch in the north-west characterized by Acric ferralsols. Owing to the downstream location, the area principally experiences low rates of soil loss. Population density largely ranges from 0-236 people/km^2.

Figure 4-25: Silt and Vegetation growth at Maziba mini hydropower dam

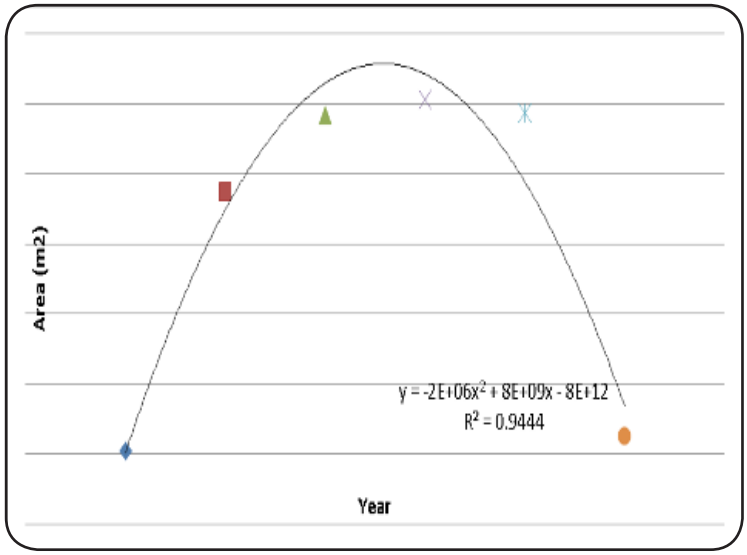


Figure 4-26: Annual change in vegetation cover in Maziba West micro-catchment

The north-east is dominated by low density vegetation, *Figure 4-27* grass and annual crops, with low tree density. The rest of the area is a mix of patches of bare ground and grass. In 2000, the micro-catchment was dominated by medium and low vegetation density. High vegetation density appeared in 2002, increased up to 2004, and gradually declined until it disappeared in 2010. The area has no major protected area, forest reserve or urban area. The average loss rate of vegetation cover is 2,000m^2/yr during 2000 – 2010.

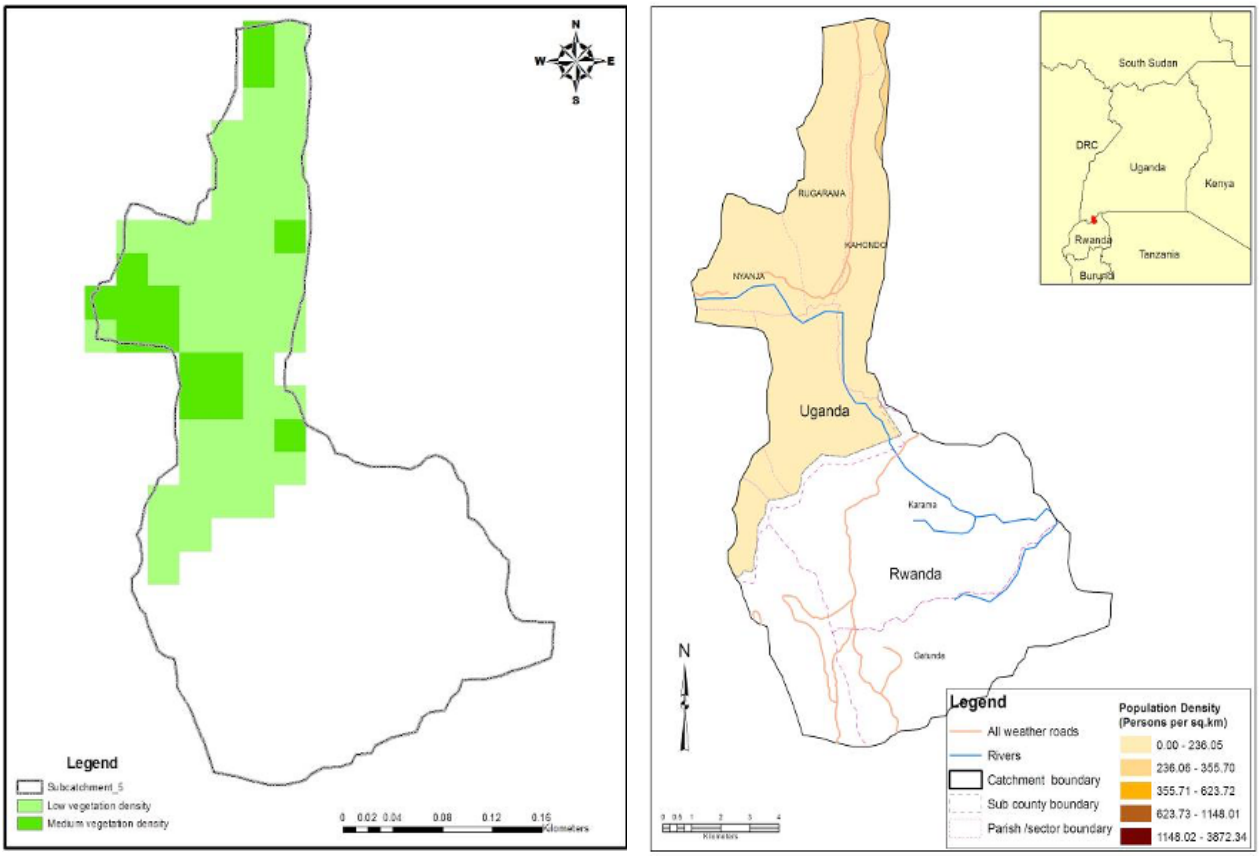


Figure 4-27: Vegetation and Population of Maziba west micro-catchment

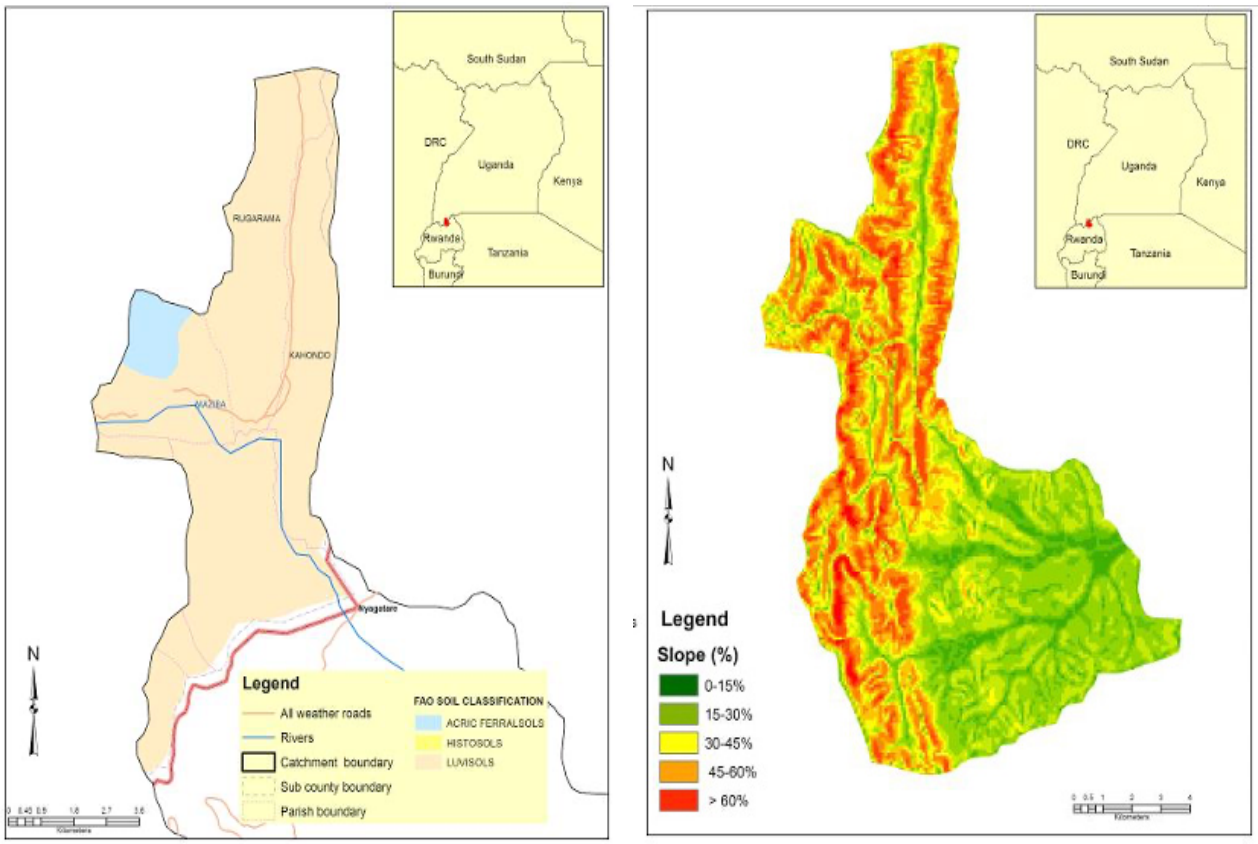


Figure 4-28: Soils and Elevation of Maziba west micro-catchment

Highlight of key issues identified in Maziba West micro-catchment and proposed solutions

Maziba West micro-catchment has rapidly lost its medium vegetation density, and is characterized by patches of almost bare ground in some areas. Its downstream location exposes it to flood risk, particularly due to the large volumes of water with high TSS load that drains through the area. Sedimentation along the stream beds further exacerbates flood risks.

Carefully agreed and selected micro-catchment re-vegetation measures, alongside other soil and water conservation technologies, will not only reduce the rates of soil loss, but also the rates of stream sedimentation. This should be complemented by measures that enhance the buffering and sediment retention capacity of wetlands that fringe along stream banks; and others that further control and manage flood risk.

4.2.2.6 Kaharo micro-catchment

This covers parts of Kaharo and Maziba sub-counties in Kabale. Covering a total area of 89 km^2, the micro-catchment is characterized by tributary streams that drain from the hills of Kaharo, through Nyakasharara to join the main Maziba stream around Birambo. The main tributary stream forms the boundary between Burambira and Nyanja parishes. Water samples were taken in Burambira Parish and results indicated that EC stands at 196 µS/cm, pH 6.9, DO 7.1 mg/l, Temperature 18.2 ^{0}C, and TSS 748 mg/l (105^{0}C) and 649 mg/l (500^{0}C). The recorded TSS loads were quite high in this micro-catchment, with soil making up 87% of the inorganic matter in TSS.

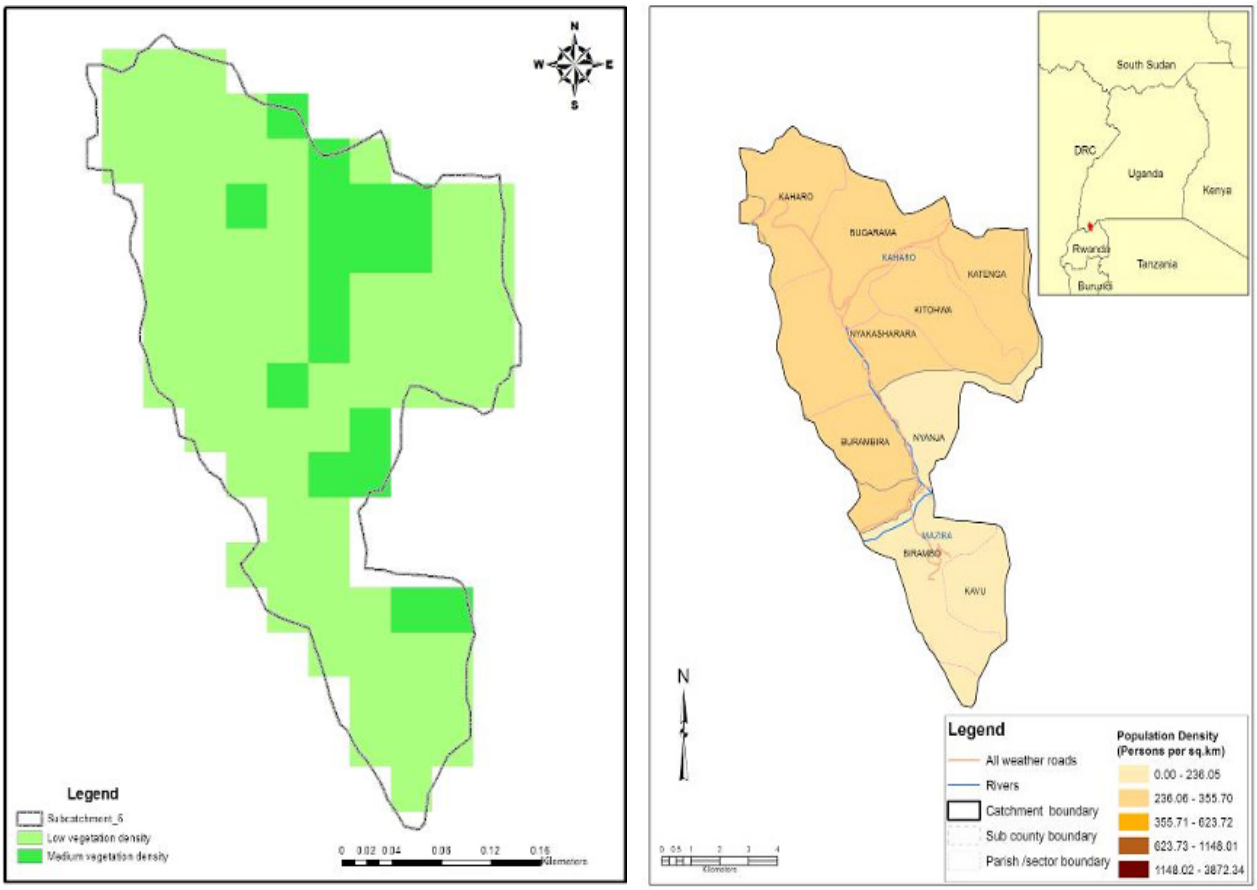


Figure 4-29: Vegetation and Population of Kaharo micro-catchment

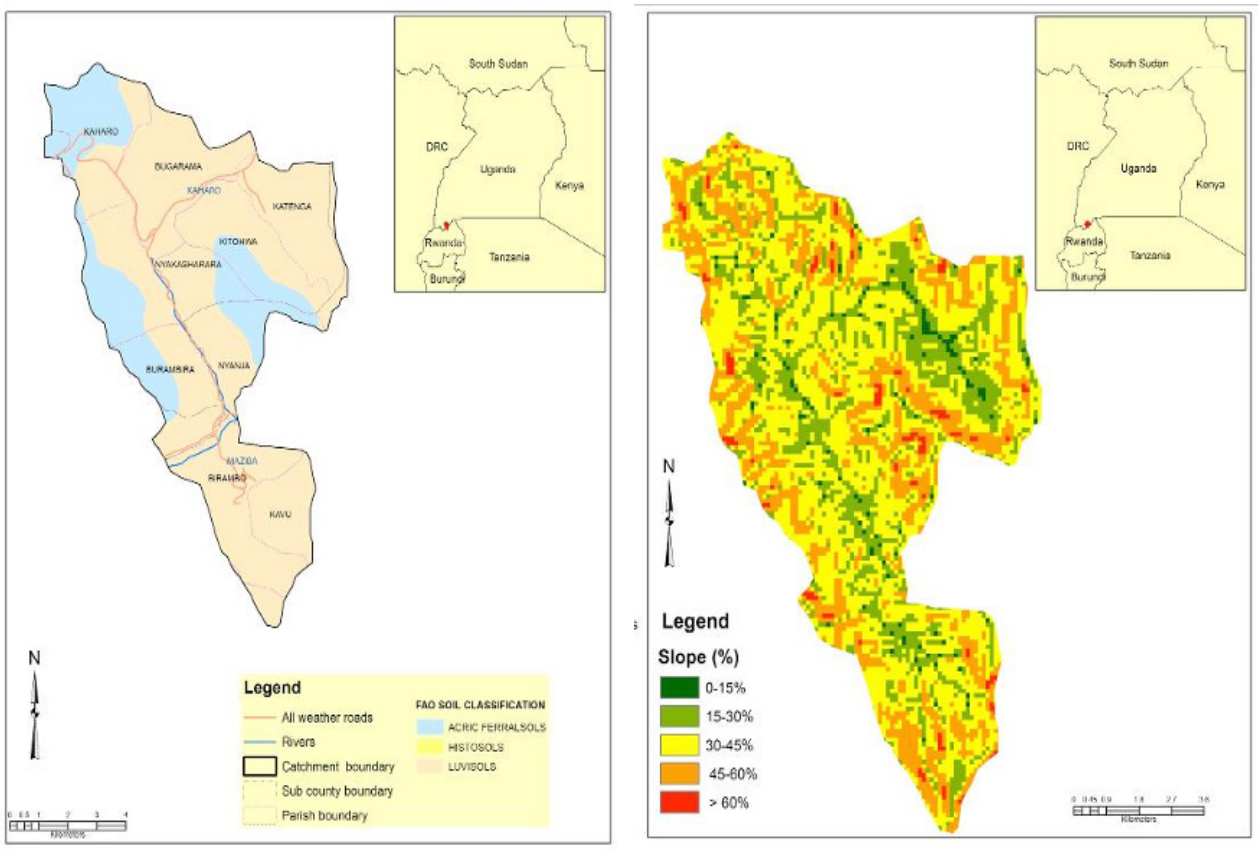


Figure 4-30: Soils and Elevation of Kaharo micro-catchment

The slopes in Kaharo are only gentle in the valley bottoms, ranging from 0-12%, *Figure 4-30* but comparatively higher in the rest of the landscape, ranging from 12-48%. Elevation is high all around the micro-catchment's boundaries, which form the drainage divides. It ranges from 1,661 – 2,486 m ASL.

Over 80% of the area is covered by luvisols, except a patch of the east and north-western boundary where Acric ferralsols occur. Most of the north-western and central parts of the micro-catchment experience high (50-90 t/ha/yr) to extremely high (> 90 t/ha/yr) rates of soil loss. Population density largely ranges from 236 – 356 people/km^2, except for the south and south-east where it ranges from 0 – 236 people/km^2.

Land cover is characterized by a fairly uniform mix of low density veg, grass, and annual crops with low tree density, and patches of almost bare land, with grass underlain with laterite.

The area lost its medium vegetation density in the North West and Centre between 2000 and 2010, especially that initially at the border with Kyanamira-Buhara micro-catchment. This micro-catchment also has no major protected area, forest reserve or urban area, except for small road-side trade centers.

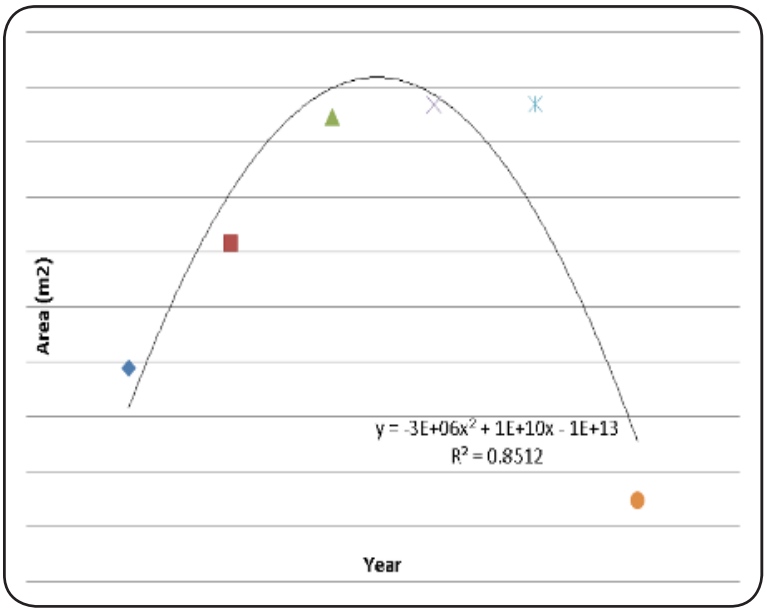


Figure 4-31: Annual change in vegetation cover in Kaharo micro-catchment

Highlight of key issues identified in Kaharo micro-catchment and proposed solutions

The elevation is quite steep along the hills that form the drainage divide. Rapid removal of natural vegetation cover has exposed the soils to high rates of soil erosion. The eroded soil is deposited along the valleys to cause high TSS loads along the streams. Sediment deposition in valleys quite often increases flood risk.
Based on lessons from past projects, soil and water conservation technologies that have been proved to work along the steep slopes of Kabale will need to be replicated here. These should be combined with measures to re-vegetate the micro-catchment too, as this combination will enhance reduction of stream sedimentation rates, and partly reduce flood risk too.

4.2.2.8 Rubaya-Kamuganguzi micro-catchment

This covers a total area of 100 km^2, with only a small patch of the northern section located in Uganda, and the south in Rwanda. It has tributary streams that originate from Rwanda and the Rubaya hills in Uganda, characterized by a dendritic drainage pattern. They flow to join major streams from Rwanda, to consequently drain through Bubaare micro-catchment. Water samples were taken at Kisasa village, Nyakyonga Parish in Kamuganguzi. Results indicated that EC stands at 119 µS/cm, pH 6.8, DO 6.9 mg/l, Temp 18 ^{0}C, TSS 70 mg/l (105 ^{0}C) and 57mg/l (500 ^{0}C). The results were normal for these parameters.

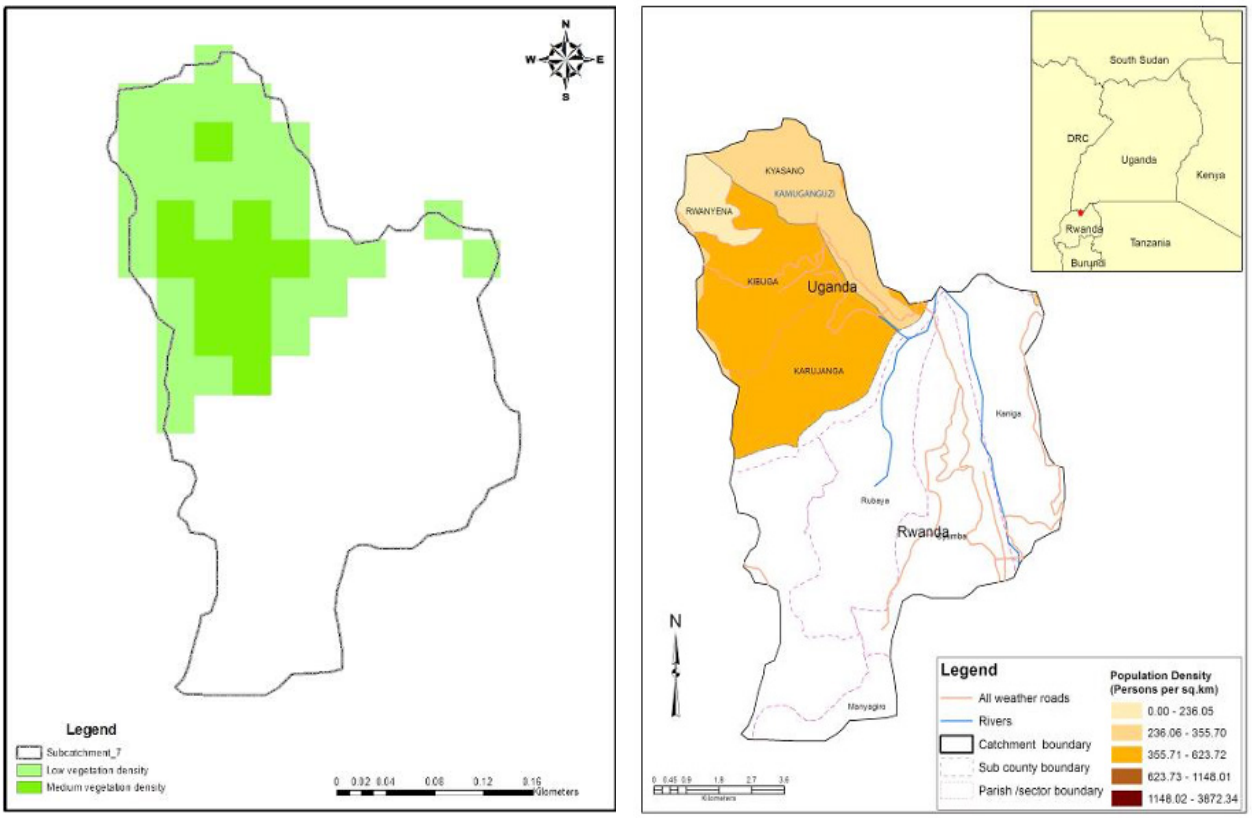


Figure 4-32: Vegetation and Population of Rubaya-Kamuganguzi

Dominantly, slope ranges from 12-48%, except in valleys where it ranges from 0-12%, *Figure 4-33*. Elevation is higher along the hills that make the drainage divide in the west, ranging from 1,661-2,486 m ASL. It lowers towards the center and east to range from 1,924-1,661 m ASL. The area is dominated by luvisols, except a thin patch of the west and north-west which has acric ferralsols. It is these ferralsols that are prone to erosion since they are found along hill slopes. Patches of the north-east and south-east experience high (50-90 t/ha/yr) to extremely high (> 90 t/ha/yr) rates of soil loss. Population density largely ranges from 356-624 people/km^2; except for the north-west where it ranges from 0-236 people/km^2 and the east 236-356 people/km^2.

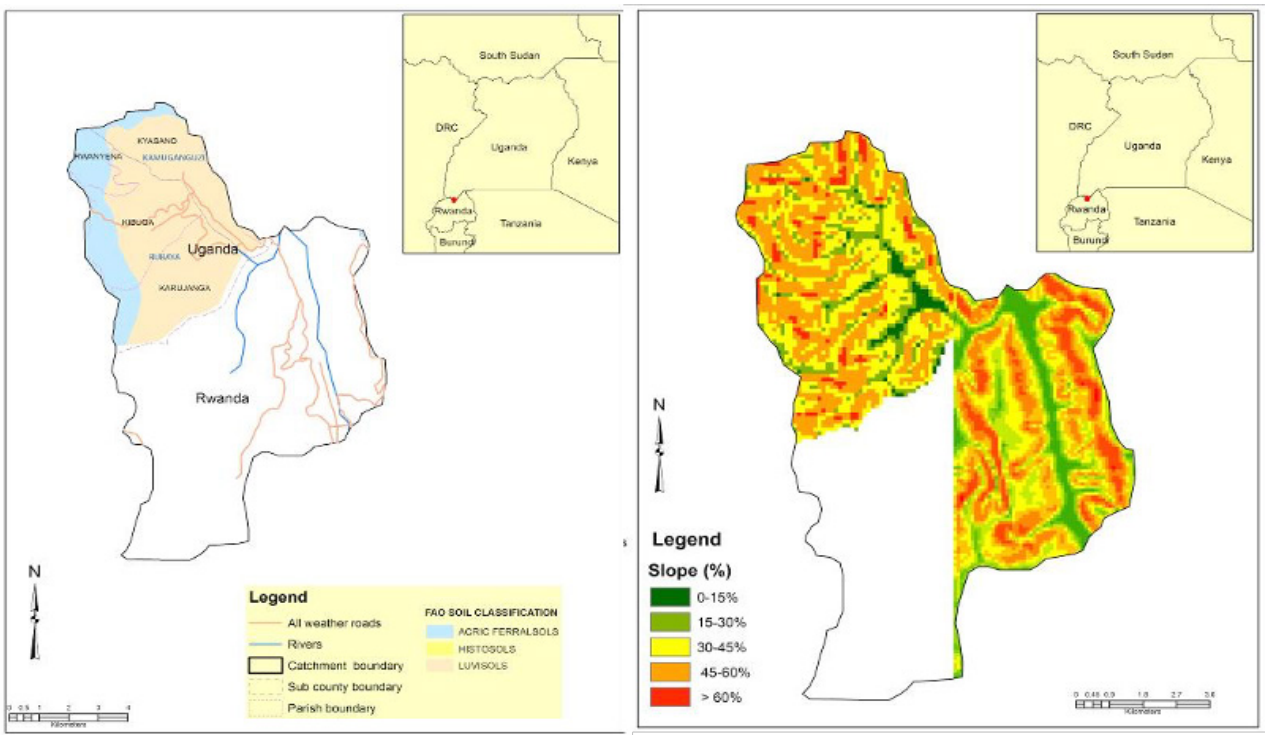
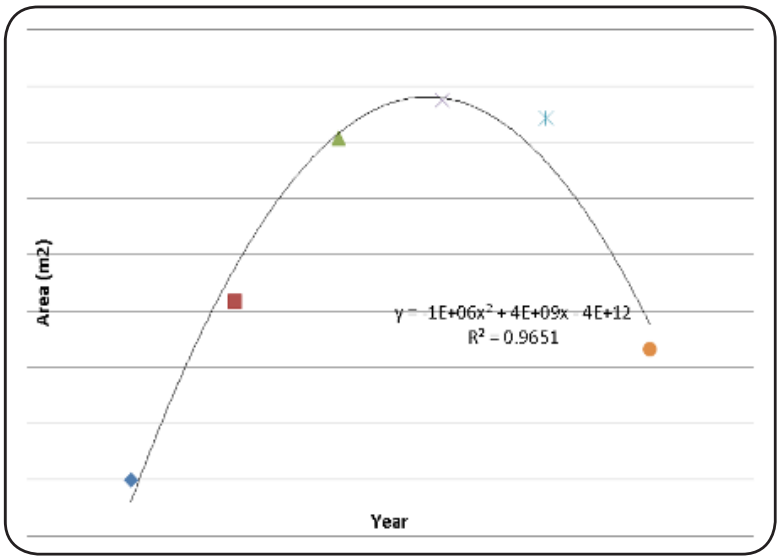


Figure 4-33: Soils and Elevation of Rubaya-Kamuganguzi

The landscape is dominated by low density vegetation, grass, and annual crops with low tree density, broken by patches of almost bare ground, with grass underlain with laterite. NDVI datasets indicate that the Ugandan section was initially in 2000 purely dominated by low vegetation density, but some tree planting increased the medium-high vegetation density between 2000 and 2008, due to soil and water conservation activities promoted by AHI/CIAT in the area then. The average loss rate of vegetation cover is 2,000 m^2/yr during 2000 – 2010.



However, this tree cover has since been lost. The area also has no major protected area, forest reserve or urban area, except for small road-side trade centers.

Figure 4-34: Annual change in vegetation cover in Rubaya-Kamuganguzi micro-catchment

Highlights of key issues identified in Rubaya-Kamuganguzi micro-catchment & proposed solutions

The micro-catchment rapidly lost its medium vegetation density, and some patches of land are almost bare. This has exposed the land to high and/or extremely high rates of soil loss. The soil and water conservation measures that have been proved as preferred by communities here will need to be adopted and replicated, including re-vegetating of the heavily degraded patches of the micro-catchment.

In all the micro-catchments, a clear cause-effect relationship is observable between loss of vegetation cover and soil loss. Where large patches of vegetation have been lost, especially along steep slopes, soil loss tends to be high, especially if no soil and water conservation measures have been implemented. The effect manifests in form of declining soil productivity and crop production, and high sediment loads once the eroded soils are deposited along streams. Based on this cause-effect relationship, criteria that consider the causal factors as key have been proposed to prioritize the micro-catchments. In this regard, rate of vegetation loss is considered the first/priority criteria to prioritize the micro-catchments. Other proposed criteria include rate of rate of soil loss, elevation, and the upstream/downstream location.

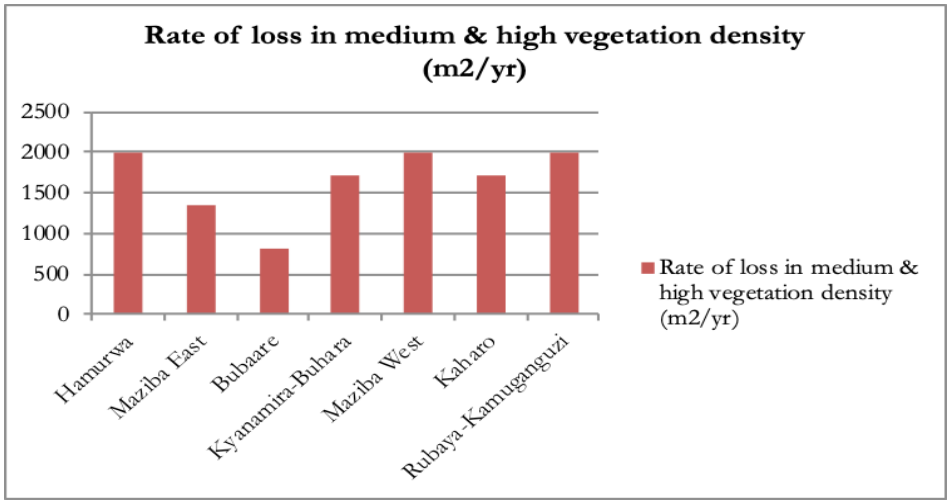


Figure 4-35: Annual rate of vegetation loss per micro-catchment (2000-2012)

Between 2000 and 2012, Hamurwa (upstream), Maziba west (downstream) and Rubaya-Kamuganguzi (upstream) micro-catchments registered the highest rates of loss of medium and high density vegetation i.e. 2,000 m^2/year; followed by Kyanamira-Buhara and Kaharo. The Bubaare (midstream) micro-catchment registered the lowest rate of vegetation loss, standing at approximately 800 m^2 per year. This is possibly associated with positive change in attitudes and practices among the farmers owing to the Agro-forestry programs implemented by ICRAF in the area between 2000 and 2006.

Looking at the other criteria, sections of Hamurwa, Bubaare and Kyanamira-Buhara micro-catchments register high to extremely high rates of soil loss. Large parts of Hamurwa, Bubaare and Rubaya-Kamuganguzi have elevation above 1924 m ASL. Hamurwa and Rubaya-Kamuganguzi are located in the upstream areas of Maziba catchment. The upstream location is critical in that whatever happens there is bound to adversely impact on downstream users and developments, and is therefore considered another important criterion.

4.2.3 Ranking and prioritization of Maziba's micro-catchments

Seven key criteria have been selected for ranking and prioritization of micro-catchments in Maziba, namely:

1. **Rate of vegetation loss**: This is considered criterion no. 1 (priority indicator) because it triggers other forms of land degradation e.g. soil erosion. Micro-catchments that register rapid vegetation loss (above 1,500 m^2/yr) are therefore ranked high and are a priority for intervention

2. **Rate of soil loss**: This is another major indicator of land degradation and is considered a key criterion. The soil loss is not only associated with erosion of soil particles, but also soil nutrients, which subsequently has adverse implications for agricultural production, productivity and livelihoods. Therefore, micro-catchments that register high to extremely high rates of soil loss (≥ 50 t/ha/yr) rank high and are a priority for action.

3. **Slope**: This is a key factor that affects the rate of soil loss and associated land degradation, and is, accordingly, considered a highly relevant criterion for prioritizing and ranking micro-catchments. Areas with steep slopes are more prone to soil erosion and degradation, and therefore need immediate response in form of soil and water conservation measures. Accordingly, micro-catchments dominated by slope above 1,924 are prioritized and ranked high in this study.

4. **The upstream location**: One key concern in catchment management is that whatever happens in the upstream often affects the downstream users. Therefore, better catchment management interventions in the upstream can bear benefits to downstream users. Accordingly, to guide better decision on locating catchment management interventions, micro-catchments located in the upstream of Maziba are prioritized and ranked high as compared to those located downstream.

5. **Population density and associated land pressure & water demand**: The population of Maziba principally depends on its finite water and land resources for livelihoods. A dense population is therefore bound to exert high pressure on these resources, and will most likely cause their degradation. For instance, the land cannot be left to fallow and therefore gets exhausted, and water availability will be exceeded by demand, creating an imbalance. This is also an indication of which micro-catchment is already or soon becoming water stressed/insecure. Accordingly, micro-catchments with population density above 355 persons/km^2 are prioritized and ranked a hot-spot.

6. **Pollution threat:** Areas characterised by key industrial establishments, large volumes of domestic sewage and other forms of waste are considered areas of major point and non-point potential sources of pollutants. Such micro-catchments are therefore ranked as hotspots in need of immediate intervention.

7. **Presence of major water development projects**: Poor catchment management practices can potentially cause failure of large water resources development projects e.g. HEP or water supply plants. Micro-catchments where such projects are located therefore need to be well managed to protect such large investments, and are therefore ranked high and prioritized as a hotspot.

Table 4-3: Ranking of Maziba's micro-catchments

No.	Name of micro-catchment	Vegetation loss (above 1,500 m^2/yr)	Soil loss (High to extremely high)≥ 50 t/ ha/yr	Slope (Above 34.7%)	Up-stream location	Pop. density	Pollution threat	Total score out of 6
1	Hamurwa	1	1	1	1	0.5	0.5	**5**
2	Maziba East	0	0	1	0	0	0	**1**
3	Bubaare	0	1	1	0.5	1	1	**4.5**
4	Kyanamira- Buhara	1	1	1	0	1	1	**5**
5	Maziba west	1	0	1	0	0	0	**2**
6	Kaharo	1	1	1	0	0.5	0	**3.5**
7	Rubaya- Kamuganguzi	1	0.5	1	1	0.5	0	**4**

Scores: *0= No/Low, 0.5=Medium, 1=High*

Based on the criteria discussed and scoring in the matrix above, Table 4-3, the following micro-catchments are proposed as hotspots that need immediate intervention, beginning with the most critical:

1. Hamurwa
2. Kyanamira-Buhara
3. Bubaare
4. Rubaya –Kamuganguzi
5. Maziba West. This micro-catchment has been specially included among the hotspots owing to the presence of a major water development project – the Maziba mini hydropower plant - which is known to have silted and failed due to excessive soil loss and poor land use in the micro-catchment. Better catchment management to enhance functionality of the plant so as to meet the development needs of the catchment needs immediate intervention.

   NOTE: Stakeholders strongly argued that the hydropower developer should take a lead role to invest in the management of this micro-catchment, and that a PES (Payment for Ecosystem Services) scheme be established for the developer to support communities involved in managing the hotspot catchments further upstream for the benefit of this downstream hydropower plant.

4.3 Socio-Economic Status of Maziba

The social economic status of the Maziba catchment is presented as previously analysed in the CMP 2014, geographical extent described in section, *Figure 1-3*. In this section, special attention is given to the socio-economic aspects of part of the Maziba catchment included in the smaller geographical extent. The reason is that quite often, poverty is partially responsible for mis-management of land, water and other resources in the catchment. The poor barely mind about sustainability issues, for what matters most is their immediate livelihoods. Any attempts to promote sustainable IWRM therefore have to address socio-economic and livelihood aspirations of the people. The information also presents an important baseline against which the impacts of the proposed interventions will be evaluated in terms of livelihood improvement.

4.3.1 Demography

The 2014 population for Kabale district as a whole is projected to be 505,500, with 237,400 males and 268,100 females (UBOS, 2014), and is projected to reach 514,200 by 2017, Table 4-4.

Table 4-4: Kabale's population 2002-2017

2002			2014			2017		
Male	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**
214,552	243,766	458,318	237,400	268,100	505,500	242,700	271,500	514,200

Source: *UBOS 2014*

The Population density is 307 people per km^2 compared to 281.1144 persons per km^2 in 2002. (DDP, 2011/12). In Kabale Municipality, the density is higher, ranging between 1,148 and 3,872 persons/km^2. The population distribution is 9% urban and 91% rural (District Statistical Abstract, 2011). In the Kabale-Kisoro highlands agro-ecological zone, west of the Hamurwa micro-catchment, the male-female ratio is low, standing at 0.90:1, possibly due to outmigration of males in search of jobs and land elsewhere.

4.3.2 Education

The 3 counties traversed by Maziba catchment have a total of 246 primary schools, with Pupil/Teacher ratio of 45:1; Pupil/Class ratio of 81:1; a dropout rate of 22.7%; VIP stance/pupil ratio of 1:101 (ideal is 1:40); Desk/pupil ratio of 1:6 (ideal is 1:3). Male teachers dominate the females by almost half. This has an effect on learning of pupils especially the girls. Pupil to facilities ratio is also an issue, especially VIP stance/pupil ratio which 1:101 and Desk/pupil ratio 1:6. These ratios are high as compared to national standards. Enrolment of females is always high at lower levels of education but the situation changes in secondary and other post primary education. The dropout rate which stands at 22.7 percent is dominated by girls going for domestic work, marriage and other to mention but a few (KDDP, 2008-2013).

4.3.3 Land use and tenure

The landscape of Maziba catchment contains small, fragmented landholdings on a mountainous terrain. As already mentioned, the area is densely populated such that population pressure has led to fragmentation of the farms into small sizes. The average land area for agriculture is 2.06 ha or 5.08 acres per household. The per capita land holding is 0.3 ha/0.8acres (KDLG, 1995). Land is seriously fragmented and an average household has 6-7 plots of land on different hillsides. Each plot measures between 0.1 and 0.7 of an acre.

Row crop production is the primary land use in the sub catchment. About 75% of arable land is largely owned according to customary laws. However, some land is held by freehold and leasehold of about 41.1 km^2 (2.4%) and 391.2 km^2 (22.6%) respectively.

As a result of the high population density, the pattern of agricultural land use includes intensive farming practices on the upland (hillside) fields and a combination of vegetable production and large and small-scale dairy farming in the wetland valleys. The communities through necessity have carried out some intensive soil management and intercropping purposely to prevent famine and not necessarily to protect the catchment.

The area experiences two rainy seasons; one short and one long and these allow farmers to produce up to two crops per year on the upland fields and one crop a year in the wetland fields. Many farmers, especially those with low household incomes, try to plant a second crop of sorghum and maize in the wetland fields. Wetlands are also used for other natural raw materials like craft and building materials. The majority of farms in the area are family owned and operated.

Consultations revealed that small farm holders and the landless were the most likely to express dissatisfaction with certain catchment development and management initiatives. They expressed fear that the initiatives may seal off access to marginal areas which serve their livelihood requirements. For example, they indicated that many landless people depend on these lands for their survival, particularly for grazing goats, or wetlands for growing Irish potatoes and vegetables.

4.3.4 Major sources of livelihoods

Agriculture is the main occupation of the population with 82% producing at subsistence level and the rest on semi commercial agriculture. The main crops grown are maize, Irish potatoes, sweet potatoes, bananas, beans, tobacco, Arabic Coffee, Fruits, Pyrethrum, Peas, Sorghum, Finger millet, Wheat and vegetables. The main cash crops are Wheat, Sorghum, Tobacco, Vegetables, Beans, Peas and Irish potatoes. Pyrethrum, Mushrooms and temperate fruits are being developed as cash crops. However, a small pocket of the population also derives their livelihood from non-farming related activities like wage employment, trade, transport, motor/bicycle repair, tourism and small-scale industries. The variety of small-scale industries that are a source of livelihood include metal fabrications, sow milling, woodwork, handicrafts, brick making, agro-processing, ceramics/pottery, tailoring, shoe making (foot wear), local beer brewing, carpentry & joinery, stone quarrying, honey processing, soap making, mining (Iron ore),

hair dressing, black smith, charcoal burning, and concrete/block making. About 84% of the population in Maziba depends only on agriculture, and about 19% of the households get an income from the formal sector (wage employment, major trade or transport business etc.) (KDDP 2008-2013).

A livelihoods analysis was conducted during stakeholder consultation meetings. Maziba catchment is characterized by smallholder farmers who have limited resource endowment with respect to land, labor, and capital. Due to population increase, land becomes a limiting resource and has lost fertility. Hence, marginal land is brought into production, leading to soil erosion and consequently sedimentation and floods along streams and rivers. The livelihood analysis also revealed the major income and expenditure areas of the various categories of the population as presented below, Table 4-5.

Table 4-5: Income sources by population category

Category of Population	Major Income sources	Major Expenditure areas
Rich h/hs	Farming, sale of animals, Salary earners and Business	Domestic equipment, School fees, Transport, Treatment (health care), luxury goods and Hiring labor
Poor h/h (male headed)	Casual labor, sale of crops and crafts	Clothes, Drinking alcohol, Buying food, Treatment and school Fees
Poor female headed H/h	Sale of sorghum, sweet potatoes and cultivating for money	Clothes, Tools/Equipment , health care, domestic needs (basic –soap, salt)
Child headed H/h	Casual Labor and help from well-wisher and relatives	Household needs, health care, Food and Clothes
Elderly	Sale of property, begging, gifts and help from children	Health care, Medical, Food, Clothes and Maintenance of house
PWDS	Handouts; Sale of crafts	Health care, Food and H/hold items

Source: *KDDP 2008-2013*

4.3.5 Crop and livestock yields and associated incomes

Crop yield information is scattered and limited at the district and sub county level. However, it is clear that the farmers are predominantly small holders using traditional technology for production and experiencing a number of challenges; including poor marketing infrastructure like roads and markets; low levels of technology and management skills, lack of credit facilities, and low adoption of new technologies, soil erosion, unpredictable weather and difficult terrain. The average land holding is also small, standing at 2 ha; with a per capital land holding of 0.3 ha. For most crops, yields are therefore quite low, as indicated in Table 4-6.

Table 4-6: Crop yields in Kabale

CROP	Yield (tons/ha)
Beans	1.0
Field peas	0.5
Maize	2.0
Sorghum	7.2
Irish potatoes	7.5
Sweet potatoes	5.0
Bananas	40
Cabbages	20
Tomatoes	1.2
Onions	1.2

Source: *KDDP: 2008-2013*

On the other hand, according to the district veterinary officer, the average milk production per cow per day for the local farmers is 2 liters while for dairy farmers, it is 7 liters. Livestock production is negatively affected by inadequate pasture; difficult terrain and improper land tenure systems. Milk production is poor due to the fact that cows walk long distances to watering points and farmers own on average one or two cows that are largely grazed alongside roads.

It should be noted that much of the agricultural output is consumed locally and little of the crops grown leave the catchment. Owing to this and the challenges enlisted above, the average income from agriculture for an average household is estimated at UGX 100,000/= per year. The southern part of Maziba sub catchment is the least prosperous area in Kabale based on household incomes. The sub counties in these areas have the highest poverty and unemployment rates and lowest levels of income and low farm sales in the district.

4.3.6 Access to and price of labour

The Smallholder farmers depend on family labor, including the extended family for agricultural activities. They cultivate small pieces of land, but labor shortages usually occur at critical weeding and harvesting periods due to migration and alcoholism. Nearly all agricultural processes are completed by hand, thus the need for more labor on the farm during critical times. Most of the labour force in the production sector is provided by women. The average labour cost for a casual worker is approximately US$ 2 per day.

4.3.7 Access to markets

The non- traditional agricultural commercial crops which like beans, peas, Irish potatoes and horticultural crops find their way to markets through local traders. However, these exploit farmers by offering them very low prices. Some farmers have therefore formed cooperatives to aid marketing their produce e.g. Maziba Pineapple Growers Cooperative Society. Co-operative societies are also involved in growing and marketing of Irish potatoes and cabbages, beans, pyrethrum, and maize. Vegetables and Irish potatoes are sold to urban markets in Uganda and Rwanda. The large-scale farmers access bigger markets in those areas. The dairy farmers sell their milk locally and also export to neighboring Rwanda.

4.3.8 Energy

Fuel wood is the commonest source of energy for cooking utilised by constitutes 96.8% of the households. The local kerosene lamp *(tadooba)* is the main source of lighting. Very few households use electricity. According to the National Biomass Study of National Forestry Authority, most of the sources of biomass energy are farmland, woodlands, grassland vegetation and bush land outside protected areas. Although the use of biomass energy is the cheapest option within the catchment, there are implications in depending on their use without restocking the resource. The other problem associated with the use of biomass energy is the time taken to collect the fuel wood and the effect of smoke on the users. There is therefore a need to develop a technology that is environmentally friendly while at the same time help in enhancing the health of people cooking. The supply of biomass energy from forest resources from within the catchment is not feasible over a period of time.

4.3.9 Access to capital and credit

Capital, especially cash, is limited. Access to credit is constrained by the lack of assets to use as collateral, and when loans are obtained, they often carry high interest rates. The fields (land) are considered as the major resource for the community. The farmers consider these fields their major resource for several reasons: Ownership of the fields is generally passed through the family, and the land may be in the family for generations; one can produce a wider variety of crops- it may be possible to produce three crops per year on a field.

4.3.10 Poverty assessment

The UBOS 2011 Kabale district population profile indicated that 35% of the rural population lived below the poverty line (below $ 1/day) by 2005; and projects poverty headcounts for selected sub-counties that lie within the analysed part of the Maziba catchment to stand as follows: Bubare 29.9%, Buhara 17.9%, Hamurwa 22.2%, Kaharo 15.1%, Kamuganguzi 18.9%, Kitumba 16.3%, Kyanamira 18.8%, Maziba 22.1% and Rubaya 21.6%. The poor were analyzed and largely found to constitute the elderly, disabled, widows/widowers, orphans, and women who do not have significant land size and almost no crops. Poverty was perceived mainly as inadequacy of incomes

and wealth; while at the community level, as the inability to access social services and infrastructure adequately on top of the inadequacy of incomes and wealth. At an individual level, is perceived to mean limited access to basic necessities such as food, clothing and shelter. A poor person is said to have limited money as a result of having limited sources of incomes and thus resorts to borrowing from friends, relatives and neighbor.

At household level, poverty was perceived as lack of adequate access to basic necessities. Household members have inadequate food, put on dirty and torn clothes live in poor shelter, lack adequate utensils such as bedding and furniture asset base such as land and livestock. They have few or no members who have attained a high level of education. The causes of poverty in a household were enlisted as follows:

- Lack of credit facilities to invest in income generating activities
- Lack of adequate education to allow one to be employed in better jobs
- Cultural practices such as payment of bride price and visiting of witch doctors
- Lack of community agricultural information
- Lack of adequate health services
- Land pressure caused by increase in population
- Lack of adequate market for agricultural produce
- Poor community roads to enable the buyers of agricultural produce to reach their villages
- Crop pests and diseases that attack the major cash crops. The crops pests and diseases identified in the crop were banana wilt
- Soil erosion, exhaustion and infertility which reduces quality and quantity of output per acre.

According to the Kabale DDP (2011), living standards have risen dramatically over the last years. The proportion of the rural community that has been living in extreme economic poverty -- defined as living on less than $ 1 per day, adjusted to account for differences in purchasing power across households. Substantial improvements in social indicators have accompanied growth in average incomes. Infant and maternal mortality rates are low. The area registered increased universal primary education enrolment, improvements in agricultural advisory services, and safe and clean water coverage. Life expectancy has also risen from 43 to 48 years.

4.3.11 Gender issues

During stakeholder consultations, key gender concerns were enlisted and discussed, Table 4-7. Women lack control over productive resources, and this is one of the main root of causes of poverty. They have less access to some resources & development opportunities because of discrimination; lack of information and multiple roles that do not allow them adequate time for business. In majority of families, women were said to have more responsibilities now than in the past e.g. being responsible for paying schooling costs – a responsibility that initially belonged to men. Stakeholders were concerned about men wasting time and family resources on alcohol. The women do less paying activities, and have heavy workload in gardens. Most decision making is done by men. In case of access to credit, women have no securities as they don't own most of the resources. Women and the youth are not involved in fish farming as an alternative because they don't own land and have no control over household land.

Table 4-7: Gender issues

ISSUE	CAUSE
Women paying fees and fines for their husbands	Alcoholism and idleness
Men go to work in other districts subjecting wives to risks of contracting disease like HIV/AIDS	Unemployment
Women do less paying activities; high women workload in gardens; most household decision making is done by men-production and reproduction	Cultural attitudes
More women in farming cooperatives societies and more men than women in savings & credit societies	Women are more interested in farming than men and women lack securities
Women and the youth are not involved in alternative livelihood activities like fish farming	Women don't own land and have no control over household land.
Less access for Women to resources & development opportunities; majority of women entrepreneurs are confined to the micro & small enterprises	Discrimination; Lack of information; Dual roles for women

The gender analysis, Table 4-8 below, is presented in respect of access, control and ownership of resources among men, women, boys and girls; and gives a picture of what happens at household and community level, and affects the performance of individuals in resources use, management and the development.

Table 4-8: Gender analysis in terms of resource access, control & ownership

RESOURCES	ACCESS				CONTROL				OWNERSHIP				COMMENT OR OBSERVATION
	M	W	B	G	M	W	B	G	M	W	B	G	
Land	4	2	4	4	5	5	4	2	5	1	4	4	Women are cheated terms of land ownership and control
Agricultural Tools	4	5	4	3	5	5	4	4	4	4	3	4	Women and girls mainly access and use Agric. tools
Livestock	4	3	2	2	5	4	4	2	5	3	4	3	Traditional for men and boys
Utensils	3	5	1	2	3	5	2	3	3	4	4	5	This is the responsibility of women in houses.
Furniture	4	4	1	1	5	5	4	3	4	4	4	4	Men & women share the control, access & use
Money	4	2	1	1	5	4	5	4	5	4	4	2	Is owned & accessed by men
Radio	5	4	2	1	5	4	3	3	4	3	4	2	Men & boys have the upper hand
Bicycle	4	4	4	0	5	3	3	2	5	3	3	1	Men & boys have the upper hand
Business	5	4	2	1	4	5	3	3	5	3	3	2	Men have the upper hand
Agricultural Produce	4	5	2	3	3	4	3	3	3	4	3	4	Women have the upper hand, especially for home consumption

Source: *KDDP 2008-2013. Scores (0=low; 5=High)*

The results of the analysis indicate that most of the productive resources are owned and controlled by men because there is a gender imbalance in the access, ownership and control of productive resources. Proposed IWRM interventions should therefore integrate creation of local alternative livelihood options that retain the male labour force in the villages and discourage idleness.

Affirmative action and targeted capacity building, training and gender mainstreaming in planning processes are also recommended to empower women to access, control and use productive assets like land, access and participate in economically viable enterprises.

4.4 Water Resources Assessment

The assessment of climate change impacts on water resources required an update of the water resources that was generated during the development of the Maziba CMP in 2014. Thus, a comprehensive Water Resources Assessment was undertaken covering the entire Maziba catchment as described in section, *Figure 1-2*. This assessment included surface and ground water availability, water demand, water balance as well as extreme events (floods and droughts). The assessment of climate change was covered in all these aspects.

4.4.1 Climate

The Maziba catchment experiences a bi-modal rainfall pattern, broken by the driest and coolest months of June and July. The catchment experiences high rainfall and cool temperatures with a major dry season occurring from June-August, and two rainfall peaks in April and November. The mean annual temperature is usually less or equal to 200C, *Figure 4-3*. Mean monthly data for two rainfall stations within the catchment; Bukinda and Kabale, were plotted to assess the monthly rainfall distribution *Figure 4-37*. Clearly, two distinct wet and dry seasons are vividly seen with the September-October-November being the main wet season. The annual average rainfall ranges from 1000mm to about 1850mm.

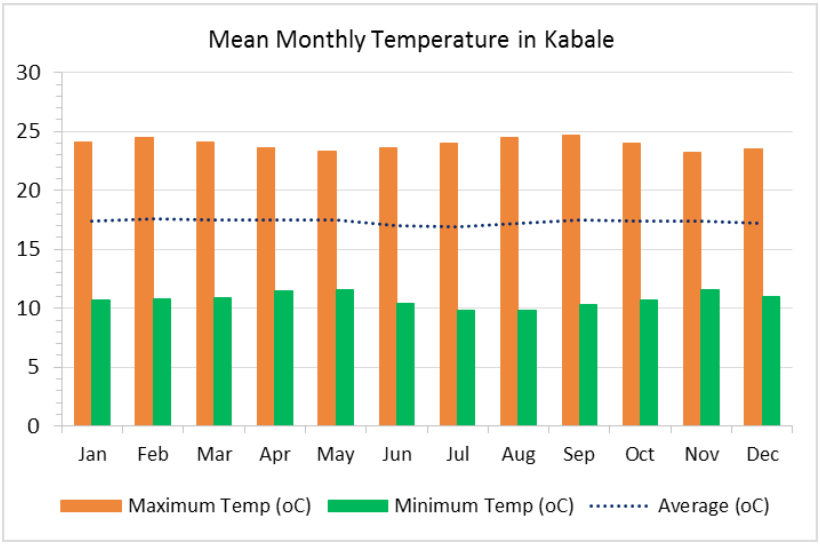
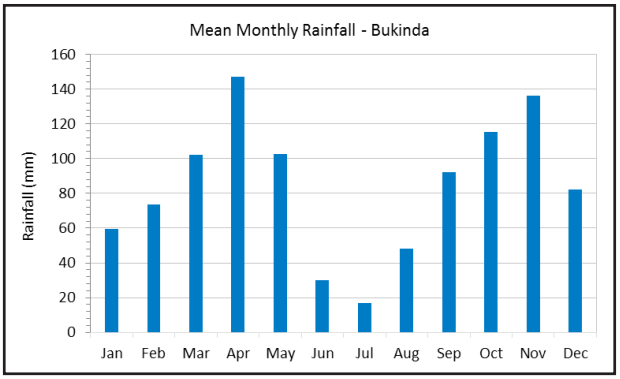


Figure 4-36: Mean Monthly Temperature for Kabale



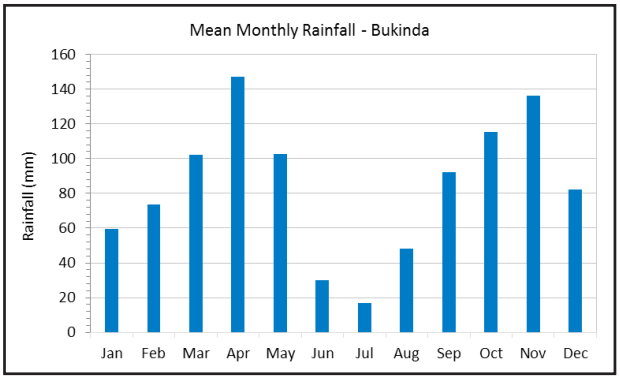


Figure 4-37: Mean Monthly Rainfall distribution in Maziba catchment

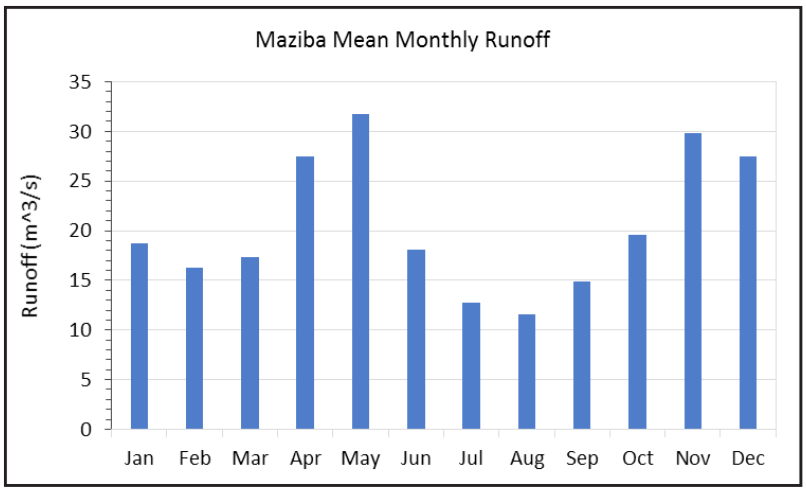


Figure 4-38: Mean Monthly Runoff distribution for Maziba catchment

4.4.2 Surface Water Availability

Surface water in the Maziba catchment is mainly available in rivers which comes from rainfall and baseflow. Having done the rainfall runoff modelling, the available discharge data was gap-filled and as such, available surface water determined. Due to limited data within the catchment to perform calibration at other locations, it was assumed that there is similar catchment response across the catchments, thus the area ratio method was used to obtain baseline runoff for the entire catchment, and sub-catchments, Table 4-9. The mean annual runoff for Maziba is seen to be 20.47 m^3/s, equivalent to about 646 million cubic meters per year (MCM/Yr). *Figure 4-38* shows the mean monthly flow distribution for the entire Maziba catchment.

Table 4-9: Sub-catchment surface water availability

Mean Monthly Flow (m^3/s)					
	Sub-catchment				Entire Maziba
	Kiruruma	Nyakijumba	Kakingu	Kagitumba	
Jan	3.590	2.342	6.802	6.018	18.752
Feb	3.117	2.033	5.905	5.224	16.279
Mar	3.326	2.170	6.302	5.575	17.374
Apr	5.266	3.435	9.977	8.826	27.505
May	6.077	3.965	11.515	10.187	31.745
Jun	3.460	2.257	6.556	5.800	18.073
Jul	2.432	1.587	4.609	4.077	12.706
Aug	2.207	1.440	4.182	3.699	11.527
Sep	2.844	1.855	5.388	4.767	14.853
Oct	3.753	2.449	7.112	6.291	19.605
Nov	5.711	3.726	10.822	9.573	29.832
Dec	5.253	3.427	9.952	8.804	27.436
Average	**3.920**	**2.557**	**7.427**	**6.570**	**20.474**

4.4.2.1 Impact of Climate Change on Surface Water Availability

The impact of climate change on water availability was assessed for two Representative Concentration Pathways (RCPs); one moderate emissions scenario (RCP 4.5), where temperatures stabilize in the second half of the 21st century, and one high emissions scenario (RCP 8.5), where temperatures continue to increase throughout the 21st century. Monthly anomalies for several Global Climate Models (GCMs) show different trends for precipitation anomalies, both in absolute monthly values and in the general behavior (increase or decrease) but generally agree with the projection for temperature. All models show an increase in temperature with the projected maximum temperature ranges between 1-1.5°C, 1.7-2.2°C; 1.7-2.1°C, 3.2-3.9°C for RCP4.5 (moderate emission) and RCP8.5

(high emission) for the 2050s and 2100s respectively. The projected minimum temperature ranges between 0.8-1.8°C, 1.7-2.5°C; 1.4-2.1°C, 1.2-2.3°C for RCP 4.5 (moderate emission) and RCP 8.5 (high emission) for the 2050s and 2100s respectively. *Figure 4-39* shows the mean monthly variations for both climate change scenarios.

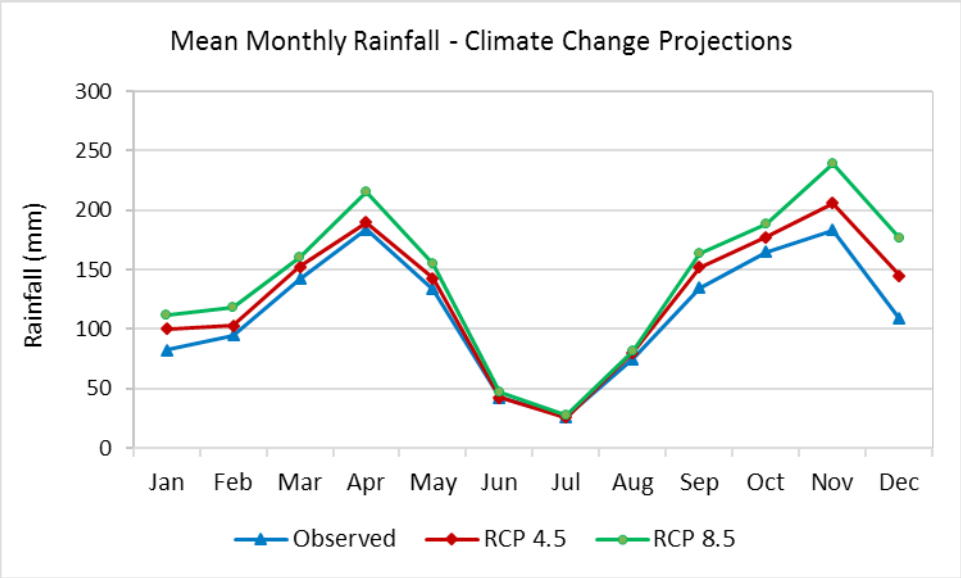


Figure 4-39: Mean Monthly Rainfall - Climate Change Scenario projections

Analysis shows an increase in flow (from the baseline) for the moderate emission scenario of about 4m³/s, Table 4-10 and an increase in flow for the high emission scenario of about 11m³/s,

Table 4-11. The increase in flow for both emission scenarios is attributed to the increased magnitude of rainfall, especially in the rainy season, a situation that may lead to increased flooding incidences within the catchment and the downstream parts.

Table 4-10: Maziba Water availability under climate change moderate emission scenario

	Water Availability under Climate Change Moderate Emission Scenario (m³/s)				
Month	**Kiruruma**	**Nyakijumba**	**Kakingu**	**Kagitumba**	**Entire Maziba**
Jan	4.747	3.097	8.994	7.957	**24.795**
Feb	3.943	2.572	7.470	6.609	**20.594**
Mar	4.068	2.654	7.707	6.818	**21.247**
Apr	5.951	3.882	11.276	9.975	**31.085**
May	6.758	4.409	12.805	11.328	**35.300**
Jun	3.897	2.542	7.383	6.532	**20.354**
Jul	2.818	1.838	5.339	4.723	**14.718**
Aug	2.580	1.683	4.888	4.324	**13.474**
Sep	3.373	2.200	6.391	5.653	**17.617**
Oct	4.399	2.870	8.336	7.374	**22.980**
Nov	6.826	4.453	12.934	11.442	**35.655**
Dec	6.854	4.472	12.987	11.489	**35.802**
Annual Average	**4.684**	**3.056**	**8.876**	**7.852**	**24.468**

Table 4-11: Maziba Water availability under climate change high emission scenario

	Water Availability under Climate Change High Emission Scenario (m^3/s)				
Month	**Kiruruma**	**Nyakijumba**	**Kakingu**	**Kagitumba**	**Entire Maziba**
Jan	6.197	4.043	11.742	10.388	**32.370**
Feb	5.259	3.431	9.965	8.815	**27.470**
Mar	5.299	3.457	10.041	8.883	**27.679**
Apr	7.675	5.007	14.543	12.865	**40.090**
May	8.566	5.588	16.230	14.358	**44.743**
Jun	4.935	3.220	9.351	8.272	**25.779**
Jul	3.610	2.355	6.841	6.052	**18.859**
Aug	3.283	2.142	6.221	5.504	**17.151**
Sep	4.177	2.725	7.914	7.001	**21.817**
Oct	5.395	3.520	10.223	9.044	**28.182**
Nov	8.907	5.811	16.877	14.930	**46.525**
Dec	9.215	6.011	17.460	15.446	**48.131**
Annual Average	**6.043**	**3.943**	**11.451**	**10.130**	**31.566**

4.4.3 Groundwater Availability

To determine the quantity of exploitable groundwater in the Maziba catchment, only the renewable groundwater resource was considered. The renewable resource is the resource that can be replenished on average each year. Groundwater exploitation beyond the renewable resource is considered to be unsustainable. To overcome the limitation of groundwater information in the catchment, relatively simple approaches, namely; recharge and base flow estimates were used to estimate the groundwater resources and estimates based on base flow were adopted. Table 4-12 shows the current groundwater availability for the sub-catchments within Maziba as well as the entire catchment.

Table 4-12: Total annual groundwater availability based on base flow under the baseline scenario

Sub-catchment	Groundwater Potential (MCM/yr)	Area (km^2)	Groundwater Potential (mm/yr)	Groundwater Potential (m^3/s)
Kiruruma	73.6	406.6	180.9	2.333
Nyakijumba	48.0	266.1	180.4	1.522
Kakingu	139.4	772.9	180.3	4.420
Kagitumba	123.3	683.8	180.3	3.910
TOTAL	**384.3**		**722.0**	

4.4.3.1 Impact of Climate Change on Groundwater Water Availability

The impact of climate change on groundwater availability was also assessed based on the rainfall estimates and stream flows generated by the model. In both cases (moderate emission and high emission scenarios), there is an increment in water availability of 74.7MCM/yr and 207.7MCM/yr respectively, Table 4-13 and Table 4-14.

Table 4-13: Total annual groundwater availability based on base low under the climate change moderate emission scenario

Sub-catchment	Groundwater Potential (MCM/yr)	Area (km²)	Groundwater Potential (mm/yr)	Groundwater Potential (m³/s)
Kiruruma	87.9	406.6	216.2	2.787
Nyakijumba	57.3	266.1	215.4	1.818
Kakingu	166.5	772.9	215.4	5.279
Kagitumba	147.3	683.8	215.4	4.670
TOTAL	**459.0**		**862.3**	

Table 4-14: Total annual groundwater availability based on base low under the climate change high emission scenario

Sub-catchment	Groundwater Potential (MCM/yr)	Area (km²)	Groundwater Potential (mm/yr)	Groundwater Potential (m³/s)
Kiruruma	113.3	406.6	278.8	3.594
Nyakijumba	74.0	266.1	277.9	2.345
Kakingu	214.7	772.9	277.8	6.809
Kagitumba	190.0	683.8	277.8	6.024
TOTAL	**592.0**		**1112.3**	

4.4.4 Water Demand Assessment

Water demand is the volume of water required by different users to satisfy their needs. The water user categories which were considered to determine the water demand for the Maziba catchment include:

- Domestic; water demanded by people in rural, built-up, and peri-urban areas.
- Agricultural (i.e. irrigation, livestock and fisheries); water required for irrigation agriculture, for watering animals, as well as fisheries (mainly fish ponds).
- Industrial; water requires to meet the industries within the catchment.
- Hydroelectric power; flow required for hydropower production (Maziba mini hydropower plant)
- Environmental water demand; flow required to maintain the proper survival of ecosystems as well as the rivers themselves.

4.4.4.1 Current Water Demand

Table 4-15 summarises the total average water demand for each consumer category per sub-catchment. Overall, most (1.06m³/s) water is demanded by irrigation (76.77%) while the least demand is from industries (0.05%).

Table 4-15: Summary of Total Current Water Demand (m³/s) per Sub-catchment

#	Category	Kiruruma	Nyakijumba	Kakingu	Kagitumba	Total	% Total
1	Domestic	0.04	0.03	0.06	0.05	**0.18**	13.04%
2	Irrigation	0.72	0.00	0.23	0.11	**1.06**	76.77%
3	Livestock	0.02	0.01	0.05	0.04	**0.11**	8.69%
4	Fisheries	0.00	0.00	0.01	0.01	**0.03**	1.45%
5	Industrial	0.00058	0	0.00012	-	**0.0007**	0.05%
6	Hydropower	1.8	-	-	-		
7	Environmental Flow	0.39	0.65	0.74	1.40		
	Total					**1.3807**	**100%**

4.4.4.2 Future Water Demand

Table 4-16 summarises the total average future water demand for each consumer category per sub-catchment. Unlike the current situation, the highest projected water requirement in 2040 is for fisheries constituting 90.7% of the total water demand.

Table 4-16: Summary of Total Future (2040) Water Demand (m^3/s) per Sub-catchment

#	Sub-catchment	Kiruruma	Nyakijumba	Kakingu	Kagitumba	Total	% Total
1	Domestic	0.05	0.04	0.09	0.08	**0.25**	1.6%
2	Irrigation	0.73	0.00	0.23	0.12	**1.07**	6.9%
3	Livestock	0.02	0.01	0.05	0.04	**0.11**	0.7%
4	Fisheries	2.35	1.31	3.50	6.83	**13.99**	90.7%
5	Industrial	0.00338	0.00001	0.00067	-	**0.004**	0.0%
6	Hydropower	1.8	-	-			
7	Environmental flow	0.39	0.65	0.74	1.40		
	Total					**15.424**	**100%**

4.4.5 Water allocation

Considering the water available within the catchment and the water demand (including environmental flow requirements), water allocation is done in which the quantity, timing, and reliability of supply is analysed. Water allocation principles applied ensure equity, environmental protection, development priorities, as well as striking a balance between supply and demand so as to manage natural variability of water availability.

Based on these basic considerations and the allocation principles from the Water Policy, (also considering both the current and projected water resources availability as well as water use and demand, the following priorities of water allocation have been followed:

- The first priority was given to domestic water needs and environmental flow,
- Second priority was given to livestock, fisheries, and irrigated agriculture,
- Third priority was given to industries.

4.4.5.1 Baseline State

The baseline state depicts a difference between the naturalized flows and the current water demand and is therefore, a clear indication the quantity of water available for allocation within the catchment. The base year taken was 2019. Table 4-17 indicates the available water in the current state, a mean annual flow of 18.18m^3/s equivalent to about 573.69MCM/Yr. There are no water deficits registered for all the water users in the current state.

Table 4-17: Current/Baseline surface water availability

	Current (2019) Surface Water Availability				
	MCM				
	m^3/s				
Month	**Sub-catchments**				**Entire Maziba**
	Kiruruma	**Nyakijumba**	**Kakingu**	**Kagitumba**	
Jan	6.60	13.09	15.51	31.28	44.37
	2.46	4.89	5.79	11.67	16.56
Feb	4.73	9.80	11.97	24.20	34.00
	1.96	4.05	4.95	10.00	14.05
Mar	5.96	11.97	14.30	28.86	40.83
	2.23	4.47	5.34	10.77	15.24
Apr	10.23	19.49	22.38	44.99	64.48
	3.95	7.52	8.64	17.36	24.88
May	12.59	23.66	26.87	53.93	77.59
	4.70	8.83	10.03	20.14	28.97
Jun	6.02	12.07	14.41	29.07	41.14
	2.32	4.65	5.56	11.21	15.87
Jul	3.81	8.17	10.22	20.72	28.89
	1.42	3.05	3.82	7.73	10.78
Aug	3.27	7.21	9.19	18.66	25.87
	1.22	2.69	3.43	6.97	9.66
Sep	4.58	9.53	11.68	23.63	33.15
	1.77	3.68	4.51	9.12	12.79
Oct	6.99	13.78	16.26	32.75	46.54
	2.61	5.15	6.07	12.23	17.38
Nov	11.27	21.32	24.36	48.92	70.24
	4.35	8.23	9.40	18.87	27.10
Dec	10.61	20.16	23.10	46.42	66.58
	3.96	7.53	8.63	17.33	24.86
Sum	**86.66**	**170.25**	**200.26**	**403.43**	**573.69**
Average	**2.75**	**5.39**	**6.35**	**12.78**	**18.18**

Projected (2029, 2034, and 2040) State

4.4.5.2 Projected (2029, 2034, and 2040) State

An assessment of surface water availability was aligned to the water demand projections for the year 2029, 2034, and 2040 assuming current statistical behavior of catchment hydrology. The impact of climate change was assessed and presented in the water balance section. While water demand projections indicate quite low increments up to 2034 for most of the categories, fisheries indicate quite high increments. Table 4-18 and Table 4-19 present the water availability for the year 2029 and 2034. Table 4-20 presents the projected water availability in 2040 which indicates deficits in the months of February, March, June, July, August, and September. These deficits are registered in the fisheries water demand, otherwise all other water demands are met.

Table 4-18: Projected (2029) surface water availability

	2029 Surface Water Availability				
	MCM				
	m^3/s				
Month	**Sub-catchments**				**Entire Maziba**
	Kiruruma	**Nyakijumba**	**Kakingu**	**Kagitumba**	
Jan	6.59	12.72	15.15	30.25	42.98
	2.46	4.75	5.66	11.29	16.04
Feb	4.72	9.42	11.61	23.18	32.61
	1.95	3.89	4.80	9.58	13.48
Mar	5.95	11.59	13.94	27.83	39.43
	2.22	4.33	5.21	10.39	14.72
Apr	10.22	19.12	22.02	43.96	63.08
	3.94	7.38	8.50	16.96	24.34
May	12.58	23.29	26.50	52.91	76.19
	4.70	8.70	9.90	19.76	28.45
Jun	6.01	11.69	14.05	28.05	39.74
	2.32	4.51	5.42	10.82	15.33
Jul	3.80	7.80	9.86	19.69	27.49
	1.42	2.91	3.68	7.35	10.26
Aug	3.25	6.84	8.83	17.64	24.48
	1.21	2.55	3.30	6.58	9.14
Sep	4.57	9.15	11.32	22.60	31.76
	1.76	3.53	4.37	8.72	12.25
Oct	6.98	13.41	15.89	31.73	45.14
	2.61	5.01	5.93	11.85	16.85
Nov	11.25	20.95	23.99	47.90	68.85
	4.34	8.08	9.26	18.48	26.56
Dec	10.60	19.79	22.74	45.40	65.19
	3.96	7.39	8.49	16.95	24.34
Sum	**86.50**	**165.78**	**195.92**	**391.15**	**556.93**
Average	**2.74**	**5.25**	**6.21**	**12.39**	**17.65**

Table 4-19: Projected (2034) surface water availability

	2034 Surface Water Availability				
	MCM				
	m^3/s				
Month	**Sub-catchments**				**Entire Maziba**
	Kiruruma	**Nyakijumba**	**Kakingu**	**Kagitumba**	
Jan	5.55	11.46	13.95	26.71	38.18
	2.07	4.28	5.20	9.97	14.25
Feb	3.68	8.17	10.40	19.64	27.81
	1.52	3.37	4.30	8.12	11.49
Mar	4.91	10.34	12.73	24.29	34.63
	1.83	3.86	4.75	9.07	12.93
Apr	9.18	17.86	20.82	40.42	58.28
	3.54	6.89	8.03	15.60	22.49
May	11.54	22.03	25.30	49.37	71.40
	4.31	8.23	9.45	18.43	26.66
Jun	4.97	10.43	12.84	24.51	34.94
	1.91	4.02	4.95	9.45	13.48
Jul	2.75	6.54	8.65	16.15	22.69
	1.03	2.44	3.23	6.03	8.47
Aug	2.21	5.58	7.62	14.10	19.68
	0.83	2.08	2.85	5.26	7.35
Sep	3.53	7.90	10.11	19.06	26.96
	1.36	3.05	3.90	7.35	10.40
Oct	5.94	12.15	14.69	28.19	40.34
	2.22	4.54	5.48	10.53	15.06
Nov	10.21	19.69	22.79	44.36	64.05
	3.94	7.60	8.79	17.11	24.71
Dec	9.56	18.53	21.53	41.86	60.39
	3.57	6.92	8.04	15.63	22.54
Sum	**74.02**	**150.67**	**181.44**	**348.67**	**499.34**
Average	**2.34**	**4.77**	**5.75**	**11.05**	**15.82**

Table 4-20: Projected (2040) surface water availability

	2040 Surface Water Availability				
	MCM				
	m^3/s				
Month	**Sub-catchments**				**Entire Maziba**
	Kiruruma	**Nyakijumba**	**Kakingu**	**Kagitumba**	
Jan	0.73	3.66	8.05	0.73	4.40
	0.27	1.37	3.00	0.27	1.64
Feb	-1.22	0.45	4.46	-4.93	-4.48
	-0.50	0.18	1.84	-2.04	-1.85
Mar	-0.27	2.77	6.71	-1.77	1.00
	-0.10	1.03	2.50	-0.66	0.37
Apr	5.36	9.32	15.69	17.44	26.76
	2.07	3.60	6.05	6.73	10.32
May	7.99	13.40	20.66	26.32	39.73
	2.98	5.01	7.72	9.83	14.84
Jun	-0.22	2.95	6.82	-1.59	1.36
	-0.08	1.14	2.63	-0.61	0.52
Jul	-2.43	-0.40	1.87	-8.71	-9.11
	-0.91	-0.15	0.70	-3.25	-3.40
Aug	-2.97	-0.69	-0.09	-9.72	-10.41
	-1.11	-0.26	-0.03	-3.63	-3.89
Sep	-1.66	0.04	3.79	-6.42	-6.39
	-0.64	0.01	1.46	-2.48	-2.46
Oct	1.51	3.99	8.87	3.38	7.37
	0.57	1.49	3.31	1.26	2.75
Nov	6.51	11.12	17.88	21.34	32.46
	2.51	4.29	6.90	8.23	12.52
Dec	5.78	9.98	16.48	18.86	28.84
	2.16	3.73	6.15	7.04	10.77
Sum	**19.11**	**56.59**	**111.19**	**54.93**	**111.52**
Average	**0.60**	**1.79**	**3.52**	**1.72**	**3.51**

4.4.5.3 Maziba Hydropower

The developed water allocation model was used to analyse the plant in consideration of the location, the head, and the installed capacity. Being upstream of most planned developments, the station is not affected by other water users. The monthly average flow available for the hydropower plant is presented in *Figure 4-40*, indicating sufficient flow to generate 1MW in both the current and projected periods. An overall system efficiency of 0.75 was applied.

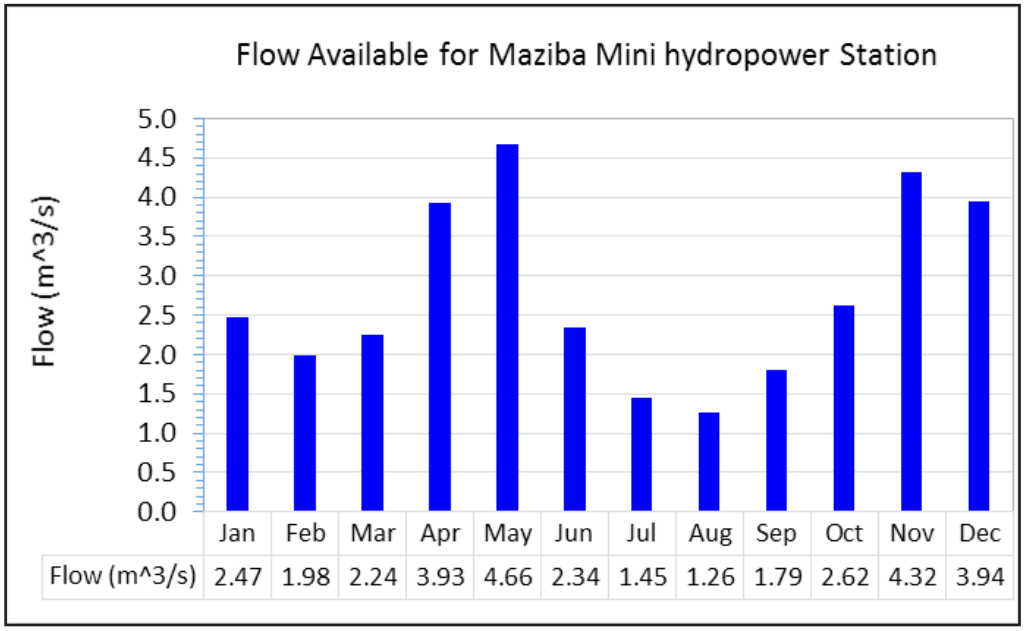


Figure 4-40: Available water to the Maziba Mini Hydropower plant

4.4.6 Water Balance

Having determined the water demand requirements as well as the available water (surface and groundwater) for both the current and projected periods, water balance is done to assess the available opportunities and/or challenges with regard water availability and demand for both the current and future states. Where a water surplus is evident from the assessment an opportunity for increased productive water use can be indicated in the management plan. More so, if water demands are currently not met or cannot be met in future, identification of the sub-catchments that require measures to improve water use efficiency and to manage water deficits is done. Currently, water availability surpasses water demand and therefore there are no water demands that are not met, Table 4-21. While there were deficits registered under the surface water assessment in 2040, conjunctive water use (surface water – ground water) eliminated this deficits, Table 4-22, thus the management plan needs to exploit groundwater to supplement surface water for sustainable use.

Table 4-21: Current/Baseline Water Balance

Sub-catchment	Baseline Water Balance				
		MCM			
		m^3/s			
	Available Water			Combined Demand	Available water for allocation
	Surface Water	From Ground Water	Total		
Kiruruma	123.580	73.600	197.180	36.915	160.265
	3.916	2.333	6.249	1.171	5.078
Nyakijumba	105.348	48.000	153.348	21.760	131.588
	3.339	1.522	4.861	0.690	4.171
Kakingu	234.640	139.400	374.040	34.378	339.662
	7.436	4.420	11.856	1.090	10.766
Kagitumba	253.946	123.300	377.246	50.773	326.473
	8.048	3.910	11.958	1.610	10.348
Entire Maziba	**717.513**	**384.300**	**1,101.813**	**143.826**	**957.987**
	22.739	**12.185**	**34.924**	**4.561**	**30.363**

Table 4-22: Projected (2040) Water Balance

Sub-catchment	Water Balance under current conditions and projected (2040) water demand				
	MCM				
	m^3/s				
	Available Water			Combined Demand	Available water for allocation
	Surface Water	From Ground Water	Total		
Kiruruma	198.409	73.600	272.009	111.744	160.265
	6.289	2.333	8.622	3.543	5.078
Nyakijumba	146.975	48.000	194.975	63.388	131.588
	4.659	1.522	6.181	2.010	4.171
Kakingu	345.664	139.400	485.064	145.402	339.662
	10.956	4.420	15.376	4.611	10.766
Kagitumba	470.283	123.300	593.583	267.110	326.473
	14.908	3.910	18.818	8.470	10.348
Entire Maziba	**1,161.331**	**384.300**	**1,545.631**	**587.644**	**957.987**
	36.812	**12.185**	**48.997**	**18.634**	**30.363**

4.4.6.1 Impact of Climate change on Water Balance

Water balance for Maziba catchment was assessed under the two climate change emission scenarios while considering the 2040 water demand. While there is a reduction in water availability for the moderate scenario , there is an increment in the high emission scenario, Table 4-24.

This indicates increased magnitude of flooding but also presents an opportunity of harvesting flood water which can be used for other purposes.

Table 4-23: Water Balance under the Climate change moderate scenario

Sub-catchment	2040 Water Balance under Climate Change Moderate Emission Scenario				
	MCM				
	m^3/s				
	Available Water			Combined Demand	Available water for allocation
	Surface Water	From Ground Water	Total		
Kiruruma	158.378	87.900	246.278	111.744	134.534
	5.018	2.787	7.805	3.543	4.262
Nyakijumba	109.003	57.300	166.303	63.388	102.915
	3.453	1.818	5.271	2.010	3.261
Kakingu	303.730	166.500	470.230	145.402	324.827
	9.624	5.279	14.903	4.611	10.292
Kagitumba	261.268	147.300	408.568	267.110	141.458
	8.277	4.670	12.947	8.470	4.477
Entire Maziba	**832.379**	**459.000**	**1,291.379**	**587.644**	**703.735**
	26.372	**14.554**	**40.926**	**18.634**	**22.292**

Table 4-24: Water Balance under the Climate Change High emission scenario

Sub-catchment	2040 Water Balance under Climate Change Moderate Emission Scenario				
	MCM				
	m^3/s				
	Available Water			Combined Demand	Available water for allocation
	Surface Water	From Ground Water	Total		
Kiruruma	202.609	113.300	315.909	111.744	204.165
	6.421	3.594	10.015	3.543	6.471
Nyakijumba	133.836	74.000	207.836	63.388	144.449
	4.241	2.345	6.586	2.010	4.576
Kakingu	384.921	214.700	599.621	145.402	454.219
	12.199	6.809	19.008	4.611	14.397
Kagitumba	339.219	190.000	529.219	267.110	262.109
	10.750	6.024	16.774	8.470	8.304
Entire Maziba	**1,060.586**	**592.000**	**1,652.586**	**587.644**	**1,064.942**
	33.611	**18.772**	**52.383**	**18.634**	**33.749**

4.4.7 Vulnerability of the Catchment to Extreme Events (Floods and Drought)

One of the issues to address in water resources assessment is to establish the status of the water resources in the catchment taking into account the risks of extreme events (floods and droughts) associated to climate variability and climate change impacts. The knowledge of stream flow extremes is also an important input to the catchment planning process. The characteristics of extremely high stream flows that cause floods and extremely low stream flows that contribute to drought conditions need to be analyzed since these adverse conditions will be among the issues to be addressed in the planning process.

To assess the potential vulnerability of the Maziba catchment and its sub-catchments to the impacts of climate change on floods and droughts, Extreme Value Analysis (EVA) was carried out on the long-term river flows from the surface water availability assessment under the historical (1957-2001) (baseline) and climate change scenarios with the target of comparing the two scenarios.

The EVA was carried out on the stream flows at the outlet of the Nyakijumba sub-catchment at the Uganda-Rwanda border with contribution from streams originating from Kiruruma sub-catchment, Kakingu sub-catchment outlet and the entire Maziba catchment outlet at the Uganda-Rwanda border.

4.4.7.1 Historical (Baseline) Scenario

Floods

For the historical (baseline) scenario, , Table 4-26, and Table 4-27 indicate the flood magnitudes at the corresponding return periods for the three Maziba locations considered for the extreme value analysis. The maximum flows at the outlets of Nyakijumba sub-catchment (36.9 m^3/s), Kakingu sub-catchment (42.3 m^3/s) and the entire Maziba catchment (116.7 m^3/s), extracted from the historical period (1957-2001), all have a return period of 25 years. This indicates more frequent risks of flooding that increase downstream.

Table 4-25: Historical flood magnitudes at the Nyakijumba sub-catchment outlet

Return period [years]	1	2	5	10	25	50	75	100	200	500	1000
Peak Flow [m^3/s]	14.6	19.5	26.0	30.8	37.3	42.1	45.0	47.0	51.9	58.3	63.2

Table 4-26: Historical flood magnitudes at the Kakingu sub-catchment outlet

Return period [years]	1	2	5	10	25	50	75	100	200	500	1000
Flow [m³/s]	16.8	22.4	29.8	35.3	42.7	48.3	51.6	53.9	59.5	66.9	72.5

Table 4-27: Historical flood magnitudes at entire Maziba catchment outlet

Return period [years]	1	2	5	10	25	50	75	100	200	500	1000
Flow [m³/s]	46.3	61.7	82.0	97.4	117.8	133.2	142.2	148.6	164.1	184.4	199.8

Droughts

For the historical (baseline) scenario, , Table 4-29, and Table 4-30 indicate the drought (low flow) magnitudes at the corresponding return periods for the three Maziba catchment locations considered for the extreme value analysis. The results indicate that the drought risk tends to decrease downstream, with higher low flow values being available at the same return periods. This can be attributed to higher base flow values associated to bigger catchments areas downstream.

Table 4-28: Historical drought magnitudes at the Nyakijumba sub-catchment outlet

Return period [years]	1	2	5	10	25	50	75	100	200	500	1000
Low Flow [m³/s]	2.3	2.6	2.9	3.3	3.8	4.2	4.4	4.6	5.1	5.9	6.6

Table 4-29: Historical drought magnitudes at the Kakingu sub-catchment outlet

Return period [years]	1	2	5	10	25	50	75	100	200	500	1000
Low Flow [m³/s]	2.7	3.0	3.4	3.8	4.3	4.7	5.0	5.2	5.8	6.6	7.3

Table 4-30: Historical drought magnitudes at entire Maziba catchment outlet

Return period [years]	1	2	5	10	25	50	75	100	200	500	1000
Low Flow [m³/s]	7.5	8.3	9.4	10.4	11.9	13.1	13.9	14.4	15.9	18.2	20.0

4.4.7.2 Climate Change Scenario

Floods

For the climate change scenario, Table 4-31, Table 4-32 and Table 4-33 indicate the flood magnitudes at the corresponding return periods for the three Maziba catchment locations for the climate change moderate and high emission scenarios in comparison to the historical (baseline) scenario. From Table 4-31, Table 4-32 and Table 4-33, it is clear that the peak flows associated to flood risks are higher for the climate change scenario compared to the historical scenario, implying that climate change will the increase the vulnerability of the catchment to flooding risks in future. The results further indicate that the climate change high emission scenario will have higher impacts than the climate change moderate emission scenario. In comparison to the historical scenario, the peak flows at the Nyakijumba sub-catchment outlet will increase at an average of 18% and 48% for the climate change moderate and high emission scenarios respectively. The peak flows at the Kakingu sub-catchment outlet will increase at an average of 17% and 42% for the climate change moderate and high emission scenarios respectively. For the entire Maziba catchment outlet, the increases will be at 17% and 51% for the climate change moderate and high emission scenarios respectively.

Table 4-31: Comparison of flood magnitudes at the Nyakijumba sub-catchment outlet under the baseline and climate change scenarios

Return period [years]	1	2	5	10	25	50	75	100	200	500	1000
Peak Flow [m^3/s] - Baseline Scenario	14.6	19.5	26.0	30.8	37.3	42.1	45.0	47.0	51.9	58.3	63.2
Peak Flow [m^3/s] - Climate Change Moderate Emission Scenario	18.4	23.8	31.0	36.4	43.5	49.0	52.1	54.4	59.8	67.0	72.4
Peak Flow [m^3/s] - Climate Change High Emission Scenario	26.4	31.8	39.0	44.4	51.6	57.0	60.2	62.5	67.9	75.1	80.5

Table 4-32: Comparison of flood magnitudes at the Kakingu sub-catchment outlet under the baseline and climate change scenarios

Return period [years]	1	2	5	10	25	50	75	100	200	500	1000
Peak Flow [m^3/s] - Baseline Scenario	16.8	22.4	29.8	35.3	42.7	48.3	51.6	53.9	59.5	66.9	72.5
Peak Flow [m^3/s] - Climate Change Moderate Emission Scenario	21.4	27.4	35.4	41.5	49.5	55.6	59.1	61.6	67.7	75.7	81.8
Peak Flow [m^3/s] - Climate Change High Emission Scenario	30.3	36.5	44.7	51.0	59.2	65.4	69.0	71.6	77.9	86.1	92.3

Table 4-33: Comparison of flood magnitudes at entire Maziba catchment outlet under the baseline and climate change scenarios

Return period [years]	1	2	5	10	25	50	75	100	200	500	1000
Peak Flow [m^3/s] - Baseline Scenario	46.3	61.7	82.0	97.4	117.8	133.2	142.2	148.6	164.1	184.4	199.8
Peak Flow [m^3/s] - Climate Change Moderate Emission Scenario	58.9	75.6	97.7	114.4	136.5	153.2	163.0	169.9	186.6	208.7	225.4
Peak Flow [m^3/s] - Climate Change High Emission Scenario	91.9	109.1	131.8	149.0	171.6	188.8	198.8	206.0	223.1	245.8	263.0

Droughts

For the climate change scenario, Table 4-34, Table 4-35 and Table 4-36 indicate the drought (low flow) magnitudes at the corresponding return periods for the three Maziba catchment locations for the climate change moderate and high emission scenarios in comparison to the historical (baseline) scenario. From Table 4-34, Table 4-35 and Table 4-36, it is evident that the low flows associated to drought risks tend to increase under the climate change scenarios, indicating reduced hydrological drought risks due to the relatively high stream flows. In comparison to the historical scenario, the low flows under the climate change moderate emission scenario, will increase at an average of 19% at the Nyakijumba sub-catchment outlet, 20% at the Kakingu sub-catchment outlet and 15% at the entire Maziba catchment outlet.

Like the climate change moderate emission scenario, the low flows at higher return periods under the climate change high emission scenario are higher than those for the historical scenario, also implying reduced drought risks if climate change high emission scenario occurs. In comparison to the historical scenario, the low flows for the climate change high emission scenario, will increase at an average of 53% at the Nyakijumba sub-catchment outlet, 55% at the Kakingu sub-catchment and entire Maziba catchment outlets.

Table 4-34: Comparison of drought magnitudes at the Nyakijumba sub-catchment outlet under the baseline and climate change scenarios

Return period [years]	1	2	5	10	25	50	75	100	200	500	1000
Low Flow [m^3/s] - Baseline Scenario	2.3	2.6	2.9	3.3	3.8	4.2	4.4	4.6	5.1	5.9	6.6
Low Flow [m^3/s] - Climate Change Moderate Emission Scenario	2.7	3.0	3.5	3.9	4.5	5.0	5.3	5.5	6.2	7.1	7.9
Low Flow [m^3/s] - Climate Change High Emission Scenario	3.5	3.9	4.5	5.0	5.7	6.4	6.8	7.1	7.9	9.0	10.0

Table 4-35: Comparison of drought magnitudes at the Kakingu sub-catchment under the baseline and climate change scenarios

Return period [years]	1	2	5	10	25	50	75	100	200	500	1000
Low Flow [m^3/s] - Baseline Scenario	2.7	3.0	3.4	3.8	4.3	4.7	5.0	5.2	5.8	6.6	7.3
Low Flow [m^3/s] - Climate Change Moderate Emission Scenario	3.1	3.5	4.0	4.4	5.1	5.7	6.1	6.4	7.1	8.2	9.1
Low Flow [m^3/s] - Climate Change High Emission Scenario	4.1	4.6	5.2	5.8	6.6	7.4	7.8	8.2	9.0	10.4	11.5

Table 4-36: Comparison of drought magnitudes at the entire Maziba catchment outlet under the baseline and climate change scenarios

Return period [years]	1	2	5	10	25	50	75	100	200	500	1000
Low Flow [m^3/s] - Baseline Scenario	7.5	8.3	9.4	10.4	11.9	13.1	13.9	14.4	15.9	18.2	20.0
Low Flow [m^3/s] - Climate Change Moderate Emission Scenario	9.2	10.0	11.2	12.2	13.7	15.0	15.8	16.4	17.9	20.0	21.9
Low Flow [m^3/s] - Climate Change High Emission Scenario	11.4	12.6	14.4	16.0	18.3	20.3	21.5	22.5	24.9	28.5	31.6

4.5 Stakeholders Engagement

The identification and subsequent engagement of stakeholders in catchment planning and management is quite vital, particularly in problem identification and resolving conflicts over resource use. Stakeholder engagement can also accelerate development of water infrastructure that is more sustainable and productive. It is therefore anticipated that the process to identify and analyze stakeholder interests and their roles and responsibilities will contribute to development of a catchment management plan that will be owned and subsequently implemented by the stakeholders themselves. Effective engagement of these stakeholders will ensure sustainability of the plan's proposed interventions.

During the consultative meetings, stakeholder analysis processes were undertaken to determine who the key stakeholders are, what their interests are, what benefits they derive from the catchment, and what roles and responsibilities they have and can play in the management of the Maziba catchment. This information was summarized and presented in Table 4-37.

It is important to note that while stakeholder analysis was done for the geographical extent described in section, *Figure 1-3*, more engagement was done during this update specifically regarding mapping of climate change issues and this was done for the entire Maziba catchment whose geographical extent is described in *Figure 1-2*.

Table 4-37: Stakeholder interests, roles and responsibilities

Key stakeholder	Interests	Roles and responsibilities in catchment management
Central Government (NFA, DWRM, WMD, MoH, NEMA, MAAIF, etc.)	Sustainable resource use and management	Putting in place the enabling environment for catchment management - relevant guidelines, policies, and institutional frameworks; Provide relevant information and technical support
Local Government (Departments of Natural Resources & Environment, Public Health, Water, Lands & physical planning, Fisheries, Agriculture, Forestry and community development)	Sustainable resource use and management, community livelihoods & development	Guiding wise use of resources to ensure livelihoods and development that do not degrade the resource base and threaten public well being
Political representatives - District, sub-county and village Councils	Access to resources & services to meet development needs of persons they represent (water, electricity, income, etc.)	Putting in place local policies and bye-laws that guide access to and use of resources
Local Community members and resource users (crop and livestock farmers, fisher folk, women, men, etc.)	Catchment resources and services (water, land, trees, fish, etc.)	Participate in identifying watershed issues, present own views and concerns, discussing options, and providing recommendations and approaches to address the issues; adopting wise use strategies to ensure sustainable productivity of the catchment

Key stakeholder	Interests	Roles and responsibilities in catchment management
Civil Society actors in the water and environment sectors	Sustainable resource use and management, community livelihoods & development	participate in identifying watershed issues, present community views and concerns, discussing options, and providing recommendations and approaches to address the issues; guiding wise use of resources for sustainable community development; provide knowledge and experiences with local conditions;
Water Supply and Sanitation operators in the area (e.g. National Water & Sewerage cooperation, water boards and other water user associations, etc.)	Availability of water; demand for water supply and sanitation services	Sustainable catchment goods and services; corporate Social Responsibility e.g. ploughing resources back towards management of water resources in the catchment from which the water originates
Representatives of **on-going water/ environment projects** within the catchment (Kagera TAMP & Kigezi diocese)	Sustainable resource use and management, community livelihoods & development	Guiding wise use of resources for sustainable livelihoods and development; provide knowledge and experiences with local conditions
Other private sector & semi-autonomous agencies (Electricity generation & distribution companies; Loggers and saw-millers, housing developers, agro-processers and dealers, etc.)	Catchment goods and services e.g. water, agricultural produce, timber, etc.	Sustainable catchment goods and services; investing in programmes that support catchment sustainability e.g. tree planting, sustainable agriculture, wetland rehabilitation, etc.

Central Government

One key category of stakeholders was grouped as central Government (NFA, DWRM, WMD, MoH, NEMA, MAAIF, etc.). These are interested in ensuring sustainable resource use and management. They have the responsibility to put in place the enabling environment for catchment management, in form of relevant resource use and management guidelines, policies, and institutional frameworks. They also bear the responsibility to provide relevant information and technical support to the rest of the stakeholders. They should therefore be involved early enough in the catchment planning process, through the implementation phase to provide technical oversight.

Political representatives

In Maziba's context, these largely include district, sub-county and village Councils. They are interested in ensuring that he persons they represent have access to resources & services, and that they meet development needs (water, electricity, income, etc.). They bear responsibility to put in place local policies and bye-laws that guide access to, and use of, resources. They should also be engaged early enough in the catchment planning stage to seek their buy-in; and later during the implementation phase for them to put in place the necessary policy, legal and institutional frameworks for plan implementation, including providing for local co-financing for plan implementation.

Local Community members

These are the day-to-day users of the resources available within the catchment (crop and livestock farmers, fisher folk, women, men, etc.). They are interested in accessing the catchment's resources and services (water, land, trees, fish, etc.) to meet their livelihood and development aspirations. They therefore have the responsibility to participate in the catchment planning process by identifying watershed issues, presenting their own views and concerns, discussing options, and providing recommendations and approaches to address the issues. During plan implementation, they should be engaged to adopt wise resource use and management strategies to ensure sustainable productivity of the catchment.

Civil Society

These are the NGO and CBO in the water, community development, natural resources, land and environment sub-sectors. They are interested in sustainable resource use and management, community livelihoods & development. They therefore have responsibility to fully participate in the catchment planning process - identifying watershed issues, presenting community views and concerns, discussing options, and providing recommendations and approaches to address the issues. During plan implementation, they should be engaged to guide wise use of catchment resources for sustainable community development; and provide knowledge and experiences on best practice gained from elsewhere.

Water Supply and Sanitation operators

Examples include National Water & Sewerage cooperation, water boards, water user associations, etc. In the catchment, they are chiefly interested in availability of water; and demand for water and sanitation services. They ought to therefore be engaged during the catchment planning process to identify key issues and agree on proposed solutions. They therefore have responsibility to support plan implementation if they are to be assured of sustainable catchment goods and services. They can be engaged through Corporate Social Responsibility approaches e.g. ploughing resources back towards management of catchment areas for sustainable water supply.

On-going water/ environment initiatives

Several water/environment initiatives are underway within the Maziba some of which are regional because of the transboundary nature of the catchment, others are national, while others are local. These include the Kigezi Diocese Water and Sanitation Programme (KDWSP), Building Resilient Communities, Wetland Ecosystems and Associated Catchments in Uganda Project, the Kagera River Basin Management Project (KRBMP), and Enhancing Resilience of Communities to Climate Change through Catchment Based Integrated Management of Water and Related Resources in Uganda" (EURECCCA) Project. This is a shared trans-boundary basin, so most of these initiatives are interested in ensuring sustainable resource use and management to meet community livelihoods & development needs in the catchment. Unsustainable activities in one part of the catchment can adversely impact on everyone else in the shared catchment. Since implementation of CMP activities requires many players to be involved, presence of these initiatives and many others is good progress towards realization of the catchment objectives.

Other private sector & semi-autonomous agencies

These include Electricity generation & distribution companies, Loggers and saw-millers, housing developers, agro-processers and dealers, etc. They are largely interested in accessing catchment goods and services e.g. water, agricultural produce, timber, etc. they should therefore be engaged to investing in programs that support catchment sustainability e.g. tree planting, sustainable agriculture, wetland rehabilitation, etc. Their investments should go beyond catchment resource development towards resource management too.

To complement the discussions above, an analysis of additional stakeholders was conducted with community members for individual institutions active in their areas and results presented in Table 4-38.

Table 4-38: Stakeholders and nature of stake

STAKEHOLDER	NATURE OF STAKE
Nature Uganda	Natural resource management and sustainable use
Africa 2000 Network	Natural resource management, promotion of zero grazing system and promote the growing of nutritious crop varieties in backyard gardens
GINA	Promote the growing of nutritious crops, child weight monitoring and agricultural production in a gender perspective
AMREF	Construction of water and sanitary facilities at selected primary schools, Sexual Reproductive health among the youth, community mobilization and empowerment
World Vision	Provision of basic education to needy children and Functional adult

STAKEHOLDER	NATURE OF STAKE
Uganda small scale industries association	Training in business Management Skills, Awareness & creation to entrepreneurship, Resource mobilization
Kabale small business association	Capacity building in business management and financial management; strengthening Small Medium Micro-Enterprises (SMMES) development strategy; influencing the social, economic, cultural and political transformation
Kick Corruption out of Kigezi	Anti-corruption campaign against misuse of public resources
NAFOD	Anti-corruption campaign against misuse of public resources, human rights and community mobilization
Kigezi Healthcare Foundation (KIHEFO)	Capacity building in sexual reproductive health services and general health education targeting the youth and women, voluntary testing and counseling
PRIDE Uganda Limited	Micro financing; financial and information services to Micro and Small scale Entrepreneurs and business growth stimulation.
Kigezi Diocese (Water & Sanitation Office)	Construction of safe water points and sanitation education
Kabale District AIDS Counseling and Information Services (KDACIS).	Counseling services; Home visiting care to people with AIDS; Training Counselors of Community Aid worker (AIDES); restoring hope and improve the quality of life of people/communities affected by HIV
Integrated Youth & Women Development Network (IYAWDEN)	Training; Income generating activities (Poultry, Apiary, farming, Metal fabrication, trade, Piggery, Horticulture; improvement of the Socio-economic status of poor communities.
NAWOU	Mobilization of women and groups formation; promote a coordinated network of member groups; improve their living standards
Kabale Diocese (Social Services and Development office.)	Promoting agricultural production; sustainable agriculture and Micro projects; Functional Adult Literacy; Domestic appropriate technology on energy saving; Reproductive health services to OVCs and youth.

4.6 Key Catchment Issues and their Underlying Causes

This section of the report presents catchment issues and their underlying causes as mapped during the development of the CMP in 2014 and updated to include climate change issues in 2020. It is therefore important to note that while mapping of catchment issues done initially was for the geographical extent described in section, *Figure 1-3*, more climate change related issues were identified and mapped covering the entire Maziba catchment whose geographical extent is described in *Figure 1-2*.

Following the catchment status assessments and subsequent stakeholder consultations, a list of key problems in Maziba catchment was compiled. They include rapid loss of vegetation cover, high to extremely high rates of soil loss in some areas, poor water quality, reducing stream flow, changing rainfall patterns and associated droughts and floods, population land pressure, limited adoption of improved farming technologies and wetland degradation. Each of these, together with the underlying causes, is discussed in details in the sections below.

4.6.1 Rapid Loss of Vegetation Cover in the Catchment

Using Landsat images, the distribution of Land-use/cover of Maziba catchment was assessed for 2005 and 2013. In 2005, subsistence farmlands (35.6%) and Bush land and thickets (35.5%) were the most dominant land use/cover. These were followed by tropical forest fully stocked (12.5%) and degraded (11.5 %). Other land-use/covers included tree plantations (woodlots) and built up areas. In 2013, subsistence farmlands remained the most dominants (49.1%) followed by bush land and thickets (35.5%) and tropical forest degraded (18.7 %). It is important to note that from their 2005 coverage that tree plantations significantly expanded (108.7%) followed by built up area (64.94%) tropical forest degraded (61.32%) and subsistence farmlands (34.55%). This was done to the expense of tropical forest fully stocked and bush land with thickets.

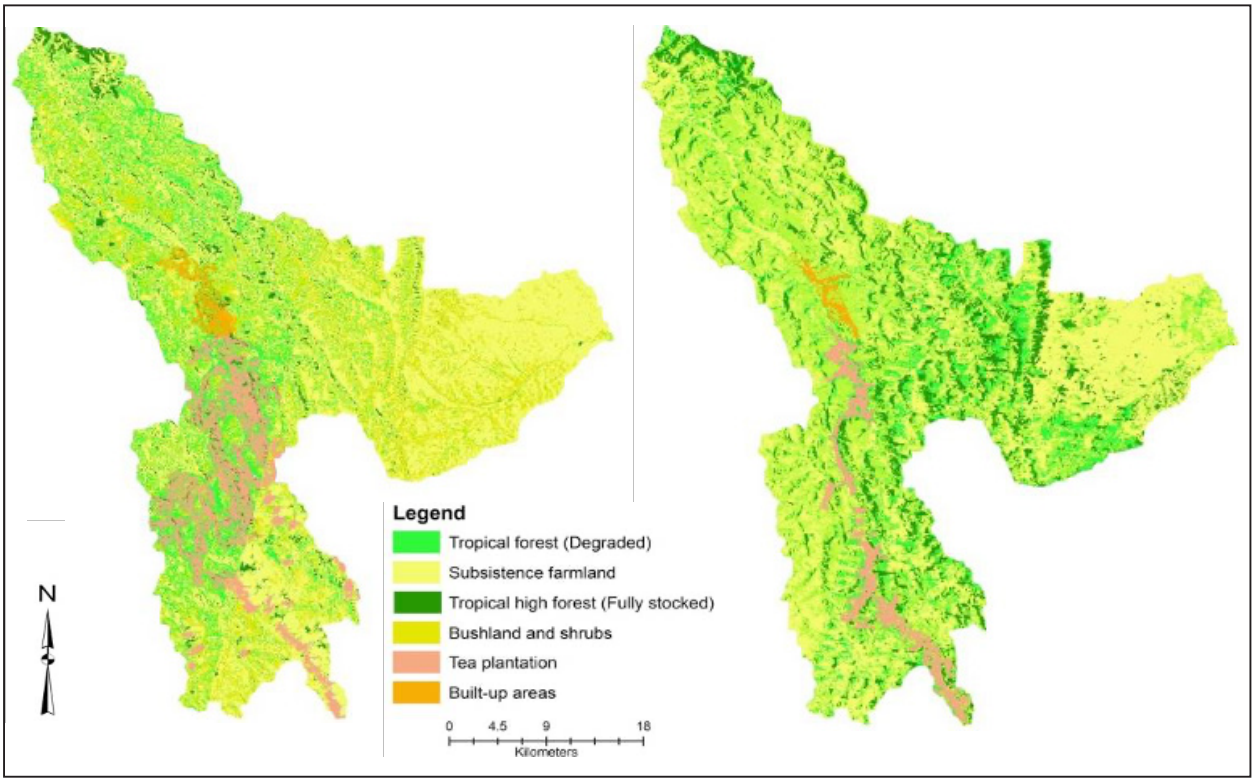


Figure 4-41: Land-use/cover change in Maziba micro-catchment

Table 4-39: Land-use/cover change in Maziba catchment (2005-2013)

Land use and cover types	2013		2005		Relative change
	Area (sq.km)	%	Area (sq.km)	%	%
Tropical forest (degraded)	218.1	18.7	135.2	11.5	61.32
Subsistence farmlands	561.2	48.1	417.1	35.6	34.55
Tropical forest (fully stocked)	53.2	4.6	150.1	12.8	-64.56
Bush land and thickets	230.7	19.8	416.2	35.5	-44.57
Tree plantations	90.4	7.7	43.3	3.6	108.78
Built up areas	12.7	1.1	7.7	0.6	64.94

To aid further analysis and comparison, vegetation degradation was also assessed by using changes in NDVI over the years since 2000 to 2012. Micro-catchment hotspot areas of vegetation degradation were then mapped as those with rapid change in vegetation particularly during the month May (just after the April rainfall peak to allow growth of vegetation) starting from 2000.

For the entire Maziba catchment, the key results indicated that some wetlands still existed in the year 2000, but these had disappeared by 2002, Table 4-40. In 2000, the catchment was dominated by low and medium vegetation density (79.14% and 20.3% respectively). The medium vegetation density increased over time up to 2008. The low vegetation density decreased over time up to 2008, but again increased and was dominant (91.43%) by 2012. This implied a loss in the medium and high vegetation density. The high vegetation density appeared in 2002, increased gradually up to 2006, before starting declining up to 2010 when it disappeared completely.

Table 4-40: Percentage (%) of vegetation cover by type (2000-2010)

Year	Water body/ Bare/ Roads	Low vegetation density (%)	Medium vegetation density (%)	High vegetation density (%)
2000	0.33	79.14	20.53	0
2002	0	57.88	30.00	12.12
2004	0	20.54	31.75	47.72
2006	0	7.78	33.02	59.20
2008	0	10.50	62.24	27.26
2010	0	91.43	8.57	0

Conclusively, Maziba catchment registers a high rate of vegetation and biodiversity loss. According to MFPED (2013), much as Uganda is on target in regards to target 7C of the MDGs to halve, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation, it is generally slow on target 7B to reduce the rate of biodiversity loss. This has adversely impacted on chances to achieve MDG no. 7 which seeks to achieve environmental sustainability.

The natural tree cover in the catchment has been removed, leading to loss of biomass and exposure of the soils along hill slopes to erosion. The issue is attributed to increasing woodfuel demands for brick making; local distillation and household use for cooking. Originally vegetated landscapes have also been converted into farmlands especially due to population pressure. According to the NDVI data analysed above, the Medium to high vegetation coverage today does not exceed 10% of the catchment.

4.6.2 Soil Erosion and Land Degradation

Although most of the micro-catchment is dominated by very low to low soil loss rates, there are particular areas that experience soil loss ranging from high to extremely high in the catchment. Particularly, Hamurwa, Kaharo, Kyanamira-Buhara and parts of Bubaare micro-catchments experience high (50-90 t/ha/yr) to extremely high (> 90 t/ha/yr) rates of soil loss, *Figure 4-42*.

In the catchment, land degradation involves both loss of topsoil and nutrient mining. Although both processes occur across the two countries within the micro-catchment, the first is highly pronounced in Uganda and the second one in Rwanda. Generally, Maziba micro-catchment is very highly degraded. The major cause of degradation is agricultural activities and particularly poor management of agricultural land.

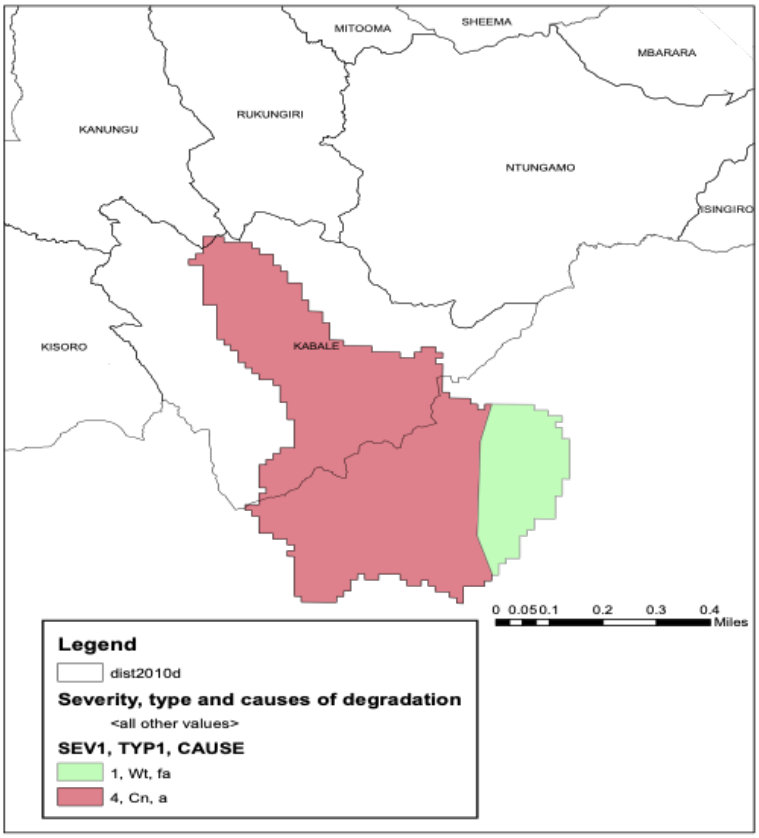


Figure 4-42: Soil loss in Maziba

The severity, type and causes of land degradation are given in *Figure 4-42* above. According to the map, the Ugandan section of Maziba catchment registers the highest severity (severity 4) of land degradation, including chemical loss of nutrients (ch), and the cause being agriculture (a). The land degradation involves both loss of topsoil and nutrient mining.

Generally, Maziba micro-catchment is very highly degraded. The major causes of degradation include a wide variety of practices, such as insufficient or excessive use of fertilizers, shortening of the fallow period, and absence of anti-erosion measures.

To further understand the land degradation status of the catchment, an NDVI (Normalized Difference Vegetation Index) analysis was conducted for Maziba catchment. Results indicate that the landscape is dominantly bare or with limited vegetation in the micro-catchment. Medium to high vegetation coverage does not exceed 10% of the catchment.

Results show that the catchment has no medium and high tree density (NDVI value above 0.4). The results of this analysis concur with those obtained in the previous analysis of vegetation degradation. The land is dominantly bare or with limited vegetation in the micro-catchment. Medium to high vegetation coverage does not exceed 10% of the micro-catchment.

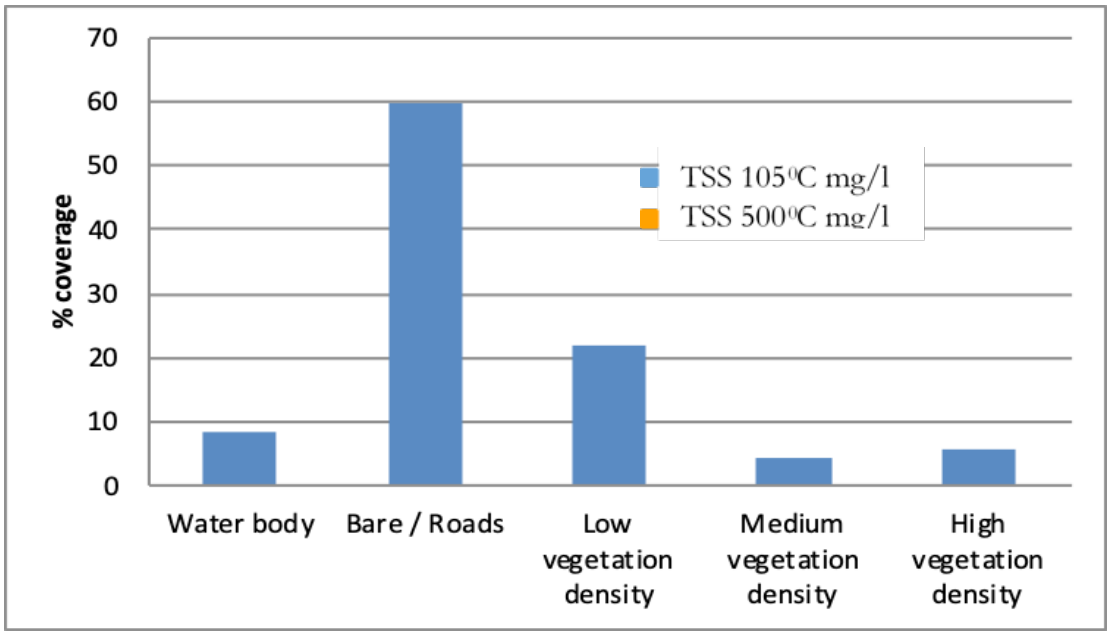


Figure 4-43: Percentage cover of different vegetation categories in Maziba catchment

With such a dominantly bare catchment, soil erosion has become one of the most serious environmental problems in Maziba catchment, characterized by huge gulleys that run downwards along the steep hill sides. Extreme cases are characterized by landslides (okutengura). The causes include inadequate conservation measures and intense human pressure on the land resource such that the land is hardly subjected to any fallow process.

In many cases, bunds are collapsed intentionally and then ploughed to accommodate crops because that is the only part of the plot any fertility is deemed to still exist. Other causes include continued encroachment on steeper and marginal areas to open up farm plots. The trees are indiscriminately cut for domestic fuel, leaving the soil susceptible to erosion.

Another cause is poor management of run-off from roadworks/culvert lines and bush burning on hill tops and hill sides. The soil erosion and associated landslides have reduced land productivity, and often destroy infrastructure like roads, settlements and farms. Kabale District Local Government (2004) suggests strongly that soil fertility loss is a key phenomenon and is on the increase, decreasing per capita food production and possibly causing malnutrition. This has resulted into abandonment of some fields on top of hill slopes in some parts of the catchment.

4.6.3 Poor Water Quality

Water quality data was also collected on key relevant parameters such as pH, Dissolved Oxygen (mg/l), Transparency (cm), Electro-conductivity (µS/cm), TDS (ppm), and Temperature to give an impression of the level of pollution. Water samples were taken for analysis at the government laboratory in Entebbe.

Electrical Conductivity measures the ability of water to pass an electric current. In Maziba catchment, EC values ranged from 117µS/cm (Tributary of River Kiruruma at Buhara) to 227µS/cm (River Kiruruma at Central ward Kabale town). Studies indicate that EC ranges between 150µS/cm to 500µS/cm support fisheries and aquatic ecology. This therefore implied that EC values meet the acceptable standard. pH values for maziba ranged from 6.6 pH units to 7.0 pH units. According to ECE standard classification for surface water quality, River Kiruruma acquired a Class I score implying that its pH is suitable to maintain aquatic life.

Adequate Dissolved Oxygen (DO) is necessary for good water health and supports all forms of aerobic aquatic life. In Maziba, DO values ranged from 6.2 mg/l to 13.6 mg/l. Sections of River Kiruruma at Hamurwa (6.4 mg/l), Kyanamira town council (6.2 mg/l) and Kamuronko-Maziba (6.6 mg/l) were categorized under Class II since their DO values were between 6.0 and 7.0 mg/l. The other sections of the river indicated DO values above 7.0 mg/l categorizing them under Class I surface water quality to maintain aquatic life.

TSS was also measured for Maziba catchment. TSS at 1050C gives an indication of both organic and inorganic matter suspended in soil. Values for River Kiruruma ranged from 42 mg/l (Southern ward) to 1072 mg/l (Hamurwa dredged channels). TSS at 500^{0}C gives an indication of only the inorganic matter (soil particles) in the suspended solids since at 500^{0}C, all the organic matter in the suspended solids will be combusted/ burnt up. Values for River Kiruruma ranged from 29 mg/l (Southern ward) to 974 mg/l (Hamurwa at dug and dredged channels). The percentage (%) of inorganic/soil in TSS ranged from 67% to 91% implying that TSS was mainly composed of soil particles not organic matter like plants and animals washed into the river. Standard for TSS is 100 mg/l. TSS values for River Kiruruma at Hamurwa (1072 mg/l), Kitumba at confluence (302 mg/l), Buhara (120 mg/l), Kyanamira town council (289 mg/l), Maziba-Kamuronko (552 mg/l) and Kaharo (748 mg/l) were above the standard, *Figure 4-44*. The water quality parameters are presented in Table 4-41.

Table 4-41: Water quality in maziba catchment

S/N	Source name	Sub-county	EC (µS/cm)	pH (pH units)	DO (mg/l)	Temp (^{O}C)	TSS (105^{0}C) mg/l	TSS (500^{0}C) mg/l	% of Soil (Inorganic)in TSS
1	River Kiruruma	Hamurwa	222	6.7	6.4	19.6	1072	974	91
2	River Kiruruma	Bubare	219	6.8	7.1	18.5	57	38	67
3	River Kiruruma	Kabale town	218	7	9	18.2	78	57	73
4	River Kiruruma	Kabale town	227	6.9	7.1	18.3	71	52	73
5	River Kiruruma	Kitumba	120	7	7.7	18.4	302	256	85
6	Tributary of River Kiruruma	Kamuganguzi	119	6.8	6.9	18	70	57	81
7	Tributary of River Kiruruma	Buhara	117	6.6	13.6	17.9	120	98	82
8	River Kiruruma	Rugyendaira	121	6.8	7.1	18.4	42	29	69
9	River Kiruruma	Kyanamira	157	6.8	6.2	18.8	289	246	85
10	River Kiruruma	Kamuronko	131	6.8	6.6	18.3	552	480	87
11	Tributary of River Kiruruma	Kaharo	196	6.9	7.1	18.2	748	649	87
	ECE standard classification of surface water quality to maintain aquatic life	Class I		6.5 - 9.0	>7		100	100	
		Class II		6.3 - 6.5	6.0 - 7.0				
		Class III		6.0 - 6.3	4.0 - 6.0				
		Class IV		5.3 - 6.0	3.0 - 4.0				
		Class V		<5.3	<3				

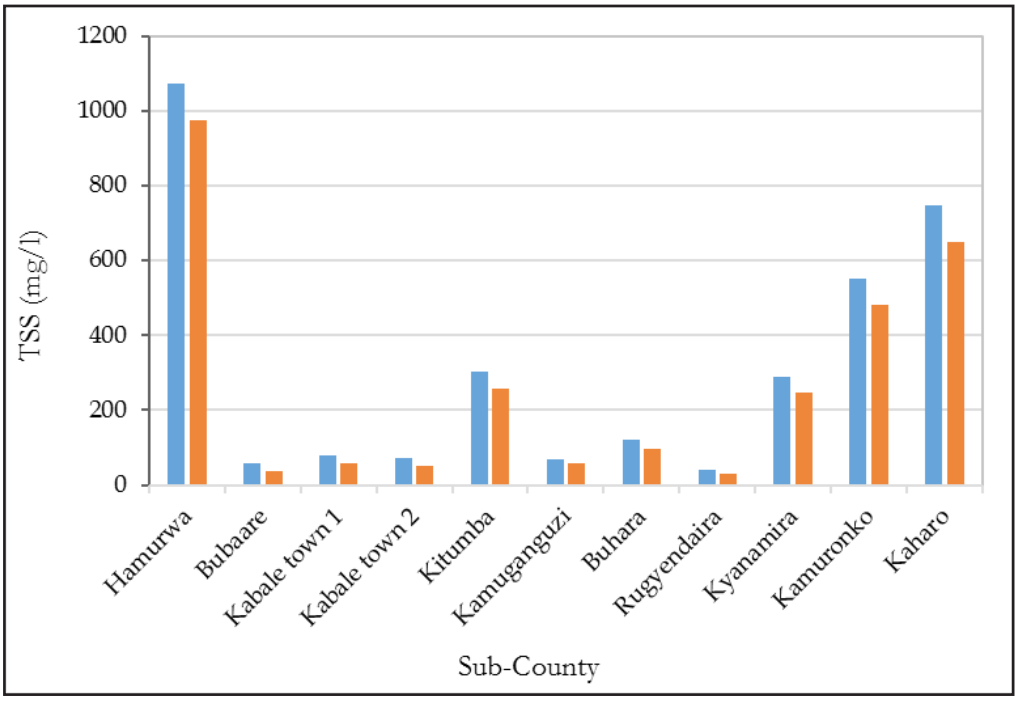


Figure 4-44: TSS loads in the river at various sub counties

"Our water is highly contaminated due to our terrible behaviours. If you want quick death, use that water from the stream. All the fish have died and the animals that take water from it are infested with worms. Livestock watering troughs no longer exist. The river is dead. Whoever has any dirty/undesirable object throws in the drain to go". Said a participant during stakeholder consultation meeting.

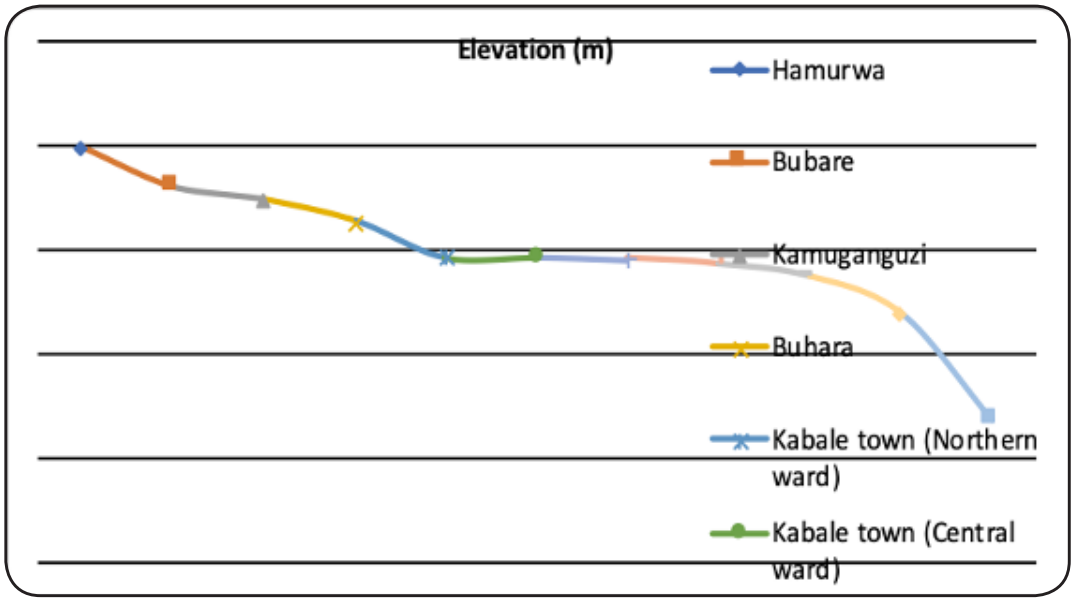


Figure 4-45: River course through the various sub-counties

Generally, all the parameters are within the limits of the Clean Water Act approved by EPA and WHO, except for TSS (5000C) at Hamurwa, Kitumba, Kyanamira, Kamuronko and Kaharo. Rivers and streams in the Maziba catchment are heavily silted especially downstream due to poor land practices upstream like cultivation on river banks and encroachment on wetlands, *Figure 4-45*. Silt load increases after a rain downpour at any section of the river. Also due to turbulence of the river at Kitumba where a tributary from Rwanda pours into River Kiruruma, TSS was observed to have increased.

Stakeholders concurred that the quality of water along Maziba River has tremendously reduced, and this is physically manifested in smelly waters that have also changed colors to brown, *Figure* 4-43.

Figure 4-46: The brown river waters near Maziba dam

The River and its tributaries are heavily silted due to poor land practices in the upstream like cultivation on river banks and encroachment on wetlands. Silt load increases after a rain downpour at any section of the river.

Much as the other parameters are still within acceptable limits, pollution from surrounding urban areas, wastes from local distilleries and other industries, poor sanitation and siting of latrines, poor farming methods & use of agrochemicals, all have potential to adversely affect water quality in the near future.

Water pollution was attributed to ignorance of users; lack of protection of water sources; lawlessness; failure to harvest water from roof- tops leading to increased run- off; cultivating very close to the water channel, bush-burning, bathing and watering of animals in the stream; destruction of terraces, indiscriminate human activities like brick making and logging; ignorance about the effects of indiscriminate dumping of wastes in water sources and bursting of sewer lines. This will obviously reduce access to quality water for domestic, industrial, hydropower and other uses. Already, the high silt loads will affect the hydropower generation potentials at the Maziba plant.

4.6.4 Declining Streamflow

The issue of declining streamflow was mentioned by stakeholders and has been attributed to increased water use within the catchment in addition to land use changes and increased temperatures.

Increasing land degradation in the catchment, surface runoff may increase coupled with less infiltration and recharge thereby exacerbating the water deficit and its impacts. Accordingly, catchment management options that consider water development alongside better catchment management (e.g. re-vegetation) will be more sustainable investments. Proposed options to improve land management, control soil erosion, harvest flood and rain water, irrigate crops during dry seasons, supply safe water, predict and mitigate against floods and droughts should instrumentally benefit from, and be guided by knowledge of Maziba's water balance. For example, periods

of the water surplus will be associated with wet soils, high river levels and run-off. Flood control and water harvesting interventions should be planned for this period, while crop irrigation interventions should be planned for months that experience a water deficit which are associated with dry soils due to ground store depletion. During this period, any previously available soil moisture has been used, with very low field capacity (the maximum amount of water soil can hold), thus justifying crop irrigation to meet livelihood needs all year round. Equally, in another example, the capacity of proposed water supply sub-projects will need to be designed based on available volumes of water across the different seasons of the year.

"The volume of the water has drastically reduced. In Hamurwa, this river was locally known as "Ruboroga", i.e. the "roaring river", but now it no longer roars. The valleys used to be full of water but this is no more. In town here, it was known as "Rwabakazi", because women would never cross it due to the large volumes. Today, they easily jump over it. Downstream in Maziba sub-county, it was known as "Rucwamahembe", because cattle would drown in it. Today, cattle comfortably water in it".

Chairperson LC111, Southern Division, Kabale Municipality

4.6.5 Drought and Flood Risks

Analysis of extreme events (floods and droughts) within the entire Maziba was done and indicates flooding risks that increase downstream. The majority of Climate Change models project an increment in Temperature and rainfall amounts in the catchment, especially towards the end of the century. At RCP 4.5, minimum temperatures are predicted to increase by 1.8^{0}C by mid-century and 2.3^{0}C by end of century; and maximum temperatures by 1.5 and 1.9^{0}C by mid and end of century respectively, Table 4-42. Rainfall is predicted to increase by 7.6% and 9.8% over the mid and end of century respectively. The predicted scenario is even worse at RCP 8.5, Table 4-43. This will obviously have a number of implications, including potentially more severe soil erosion, sedimentation, floods, droughts, landslides, and associated loss of crops, livestock, infrastructure, lives and income.

Table 4-42: Projected change in Temperature and rainfall (RCP 4.5)

Mid-Century			End-Century		
ΔTmax	ΔTmin	Rainfall (%)	ΔTmax	ΔTmin	Rainfall (%)
1.5	**1.8**	**7.6**	**1.9**	**2.3**	**9.8**

Table 4-43: Projected change in Temperature and rainfall (RCP 8.5)

Mid-Century			End-Century		
ΔTmax ^oC	ΔTmin	Rainfall (%)	ΔTmax ^oC	ΔTmin	Rainfall (%)
2.2	**2.4**	**9.8**	**3.9**	**4.3**	**23.6**

The predicted increment in *Tmax, Tmin* and rainfall amounts indicate serious drought and flood risks. The key cause is associated with the general global warming and climate change. The situation is exacerbated by the rapid loss of vegetation cover and wetland drainage, which affects micro-climatic conditions and reduces ecological resilience of the people in the catchment. Increasing temperatures could affect crop and livestock production and cause famine, particularly if no early warning and adaptation systems are not put in place.

The projected increase in rainfall amounts could also result into floods, particularly in low-lying areas. Quite often, particularly in the lowlands, farmers said they already experience seasonal floods. The obvious cause is soil erosion along the hill slopes, which causes streambed sedimentation that displaces the waters outwards into the farms and settlements. The other key cause is the fact that surface runoff comes unchecked from the bare and steep hill slopes. The floods often destroy crops, houses, roads and other infrastructure, and sometimes cause death of livestock and people.

4.6.6 Population Pressure

According to the NDP (2010-2015), there has been rapid deterioration in quality and quantity of natural resources in Uganda as a result of rapid increasing pressure from high population and economic activities. The main challenges include environmental degradation through habitat conversion, pollution, proliferation of invasive species, and handling of emerging environmental issues such as wastes. The NDP adds that habitat loss has affected most ecosystems such as forests, wetlands, rangelands and catchments. Accordingly, one key objective of the NDP is to restore degraded ecosystems (forests, wetlands, rangelands and catchments) to appropriate levels. Another is to ensure sustainable management of environmental resources and minimize degradation.

The current (2013) total population of Maziba catchment (based on the smaller geographical extent described in section, *Figure 1-3*) is 206,655 people. This grew from 149,292 in 2002. The growth rate is 3% p.a. (UBOS, 2013). The population distribution is 9% urban and 91% rural. (District Statistical Abstract, 2011). Maziba is densely populated, with about 296.8 inhabitants /km^2 and the land holding is therefore small per household. The pressure induced by the people on the catchment resources is very high and will continue to grow as population grows over time.

Particularly, there has been an increase in number of settlements in the hilly and fragile marginal lands due to increased population. The communities attributed this population increase to preference of boys to girls; poor attitudes to family planning; cultural and religious beliefs that promote big families; poverty; drunkenness and limited education especially among women.

Population pressure has contributed to land fragmentation, agricultural intensification, and encroachment into water catchment areas, with the shift from intensive cultivation of the hillside fields to conversion of wetlands to agricultural fields. As population continues to increase and the upland per capita farmlands decrease in size, people take on the arduous task of converting wetlands to crop fields and cattle farms. Land shortage is often believed to be a major factor forcing families and individuals to encroach on marginal lands. Thus the terraces and wetlands became the new agricultural frontiers.

4.6.7 Limited Adoption of Improved Farming Technologies

The smallholder farmers in the catchment area rely on the crops they grow for subsistence and income. They rely on their upland fields for the majority of their food. The livelihood and food security are highly dependent on agriculture and the availability of productive land. However, there are high incidences of poor farming methods manifested in poor farm yields, soil erosion, soil fertility loss, and declining farm/ household incomes. Farmers rarely adopt improved farming technologies, and continue to practice their traditional ones. This was attributed to poverty, demise of farmers' cooperatives, inadequate land use planning, locked mind set, land fragmentation, lack of commercialization of farming, use of poor/rudimentary farming tools; lack of modern farming mechanisms and technology, lack of farm demonstrations at community levels and inadequate knowledge and awareness about improved/modern farming.

The continued use of poor farming methods in upland fields has resulted in over use, loss of soil fertility, soil erosion and reservoir sedimentation downstream. The proposed interventions include supporting adoption of new technologies, such as soil and water conservation structures, fertility management, higher levels of input use for higher yields per hectare; shift to the cultivation of higher value crops on the small land holdings and supporting productivity improvement on marginal lands, tree planting on farmland and the cultivation of range grasses and legumes in field boundaries, agriculture diversification (fruit growing, aqua culture, etc.), formation of farming and saving groups, provision of suitable seeds, trees and grasses, fodder cropping; and increasing fertility of marginal land to befit the poor and landless.

4.6.8 Wetland Degradation

Initially, wetlands constituted about 6% of the total surface of Kabale district (current Kabale, Rukiga, and Rubanda districts), which amounts to 111 km^2, according to the 1998 wetlands status report.

Figure 4-47: A wetland drained & converted into crop fields and livestock farms in Hamurwa

According to the report, 58% of wetland surface had been converted by that time, and a lot more conversion has taken place since then, *Figure 4-47*. According to the NDVI assessment conducted, in 2002, Bubaare micro-catchment totally lost some wetlands (0.33% of the catchment's land cover) which existed in 2000 – just over 2 years.

The conversion is mainly for crop farming and dairy farming, and to a smaller extent tree planting. The few intact patches are used for the old traditional uses of harvesting wetland grasses for various uses and for hunting and fish farming at the edges.

> *"The swamps in Kabale were traditionally used as a source of reeds and fibers and the outside edges served as a land reserve for agriculture during dry years. As the population increased and land shortage became more acute in the 1940s, people started using wetlands for agriculture as a famine prevention measure. From 1940s, government assisted wetland conversion to cater for more arable land. So the degradation of wetlands has not just started. So, how are we going to address this issue?"*
> ***Chairman LC111, Southern Division.***

Examples are drawn from wetlands that particularly lie within the Maziba catchment (considering the geographical extent in section, *Figure 1-3*). In Ikona wetland, which was 1.83 km^2, 95% had been converted by 2004 and the remaining part threated by conversion. In North Kiruruma which was 9.04 km^2 and South Kiruruma which was 16.46 km^2, 100% had been converted by that year. Observations made by the Environment Department and farmers indicated that water had either disappeared or drastically reduced in volume after drainage of water in farms in North Kiruruma in 2004 (e.g. a water source named Rushoroza, Kabugu village in Bubare SC adjacent to N.Kiruruma wetlands.

Seasonal wetlands are most affected by conversion compared to the permanent wetlands. *"Conversion of seasonal wetlands is more frequently undertaken because they are small in size, contain less water and therefore they are less laborious to convert", said the Parish chief of Nyanja.*

Physical observation alongside reports from stakeholders indicated that most of the wetlands in the catchment have been encroached upon, especially by the rich, to put up cattle farms. Encroachment of wetlands was blamed on loss of soil fertility in the upland; population pressure; unsuitable farming methods; lack of knowledge about the dangers of wetland degradation and the importance/ benefits of wetlands; inadequate extension/advisory services; lack of appreciation of the ecological services of the wetlands, lack of enforcement and poor leadership.

However, during public consultations, communities appreciated that wetlands provide a variety of economic and socio-cultural values to the local people like papyrus and other sedges that are used for roof thatching.

Wetland degradation has numerous ecological implications. It could potentially lower the water table as it reduces the natural groundwater recharge potential of the landscape. It can adversely affect the hydrology of the area, reduce water availability and cause micro-climate changes. The large sediment load along the Maziba River is associated with it. Household access to wetland goods like papyrus and grass for thatch and mulch has reduced.

4.6.9 Poor Environmental Sanitation and Hygien

Although some of the district's environmental health indicators are improving, there is still a high prevalence of water related diseases associated with low sanitation standards. According to MWE sector performance indicators (2013), household sanitation coverage stands at 92%; but there is no Open Defecation Free (ODF) village recorded in Kabale. This means that 8% of the population possibly still has no latrines; and that all villages in the district still register cases of open defecation. The report indicates that average increase in household sanitation coverage only increased by 0.8% from 2008 to 2013, against the national target of 2.5%. The majority of households both in urban and rural areas lack toilets and those living near the drains abuse the drains by locating latrines near water sources and opening filled ones and waste waters to the drains, causing water pollution.

The poor environmental sanitation and hygiene situation is attributed to ignorance; stubbornness/mindlessness; lack of land; poor/lack of enforcement of laws, and poor urban planning. There are no local ordinances or bye-laws to promote environmental sanitation and hygiene, and the enforcement mechanism of the existing national laws is weak. There is a low level of awareness about best practices on hygiene and waste disposal.

Waste management practices are quite poor in the area. The streams have been highly abused and have been turned into dumping sites for domestic waste. This, according to the community, is attributed to lack of structures and systems to govern and control the streams (streams belong to no one and nobody cares, including local leaders); lack of gazetted dumping sites; poverty as community cannot afford cesspool emptier services, poor leadership, and lack of latrine and bathing facilities at house hold level.

Figure 4-48: Car washing and waste dumping along stream banks in Northern Ward, Kabale Town

4.6.10 Governance Issues

Until recently, the country as a whole did not have specific local and representative governance arrangements specifically charged with responsibility to manage water catchment areas. The existing local councils have been weakly responsive to, barely transparent and accountable over water catchment degradation issues and the associated adverse impacts like flash floods, reduced water retention in the catchment, etc. The key underlying causes are that the existing structures are under-staffed, lack funding, equipment and necessary skill to address catchment management problems. Another major underlying cause is lack of political will and support owing to a silent attempt by local political leaders to maintain popularity among the voting population. In one stakeholders' workshop, an example was presented where an effort to develop a wetland use and management ordinance for Kabale District did not receive sufficient political support from the LC V council itself. With weak natural resources governances, wetlands get degraded, natural vegetation cover lost, soils eroded and deposited along streams, especially when farmers barely adopt good farming technologies. Agricultural production and productivity consequently declines and poverty multiplies among the population. In the wake of climate change, the population gets further vulnerable to hazards like floods and droughts.

4.6.11 The Upstream-Downstream Impacts and Potential Conflicts

Since the Maziba catchment is trans-boundary, there are latent upstream-downstream relations with potential adverse impacts on the lower parts of the catchment located in Rwanda. For example, the poor farming methods, rapid loss of vegetation cover in the upstream in Uganda is responsible for soil erosion, transportation and subsequently the heavy sediment loads on the streams and rivers which flow downstream to Rwanda.

As the river flows towards Rwanda, TSS values at Maziba (552 mg/l) and Kaharo (748 mg/l) were found to be above standard. In the last ten years the general trend of annual water flow has been on decline. The predicted increment in *Tmax, Tmin* and rainfall amounts indicate serious drought and flood risks on the Ugandan side, and this too has implications for the downstream Rwandan side in terms of water availability/floods. These situations could adversely impact on any water resources development potentials downstream on the Rwandan side, including hydropower generation, crop and livestock production and potable water supply; e.g. the large tea estates in the Mulindi area, and the cattle farms and rice fields in valley bottoms of the Muvumba area.

4.7 Ongoing/Completed Catchment Management Initiatives at Regional, National and Local Levels

The assessment of ongoing/completed catchment management initiatives was done at the time of development of the CMP in 2014 and is therefore based on the geographical extent described in section, *Figure 1-3*. At that time, some of the initiatives that were ongoing have now been completed and this has been updated in the current/updated CMP.

4.7.1 Regional Initiatives

4.7.1.1 The Kagera River Basin Management Project (KRBMP)

The Kagera River is the largest of the 23 rivers that drain into Lake Victoria. The river basin covers about 60,500 km^2 including portions of the four countries of Burundi, Rwanda, Tanzania and Uganda. The basin continues to face water and natural resources related threats, yet their sound management and development provides opportunities to enable the peoples of the Kagera River basin to move from poverty to improved standards of health and economic well-being. The KRBMP, which is hinged within the Nile Equatorial Lakes Subsidiary Action Program (NELSAP) of the Nile Basin Initiative (NBI), aims at establishing a sustainable cooperative framework for the joint management of the water and related resources of the Kagera River Basin; in order to prepare for sustainable development oriented investments that will improve the living conditions of the people while protecting the environment. Thus, the project contributes to the improvement of living conditions of the basin communities through social economic development, poverty reduction and reversal of environmental degradation. Among other things, the KRBMP developed the first CMP for Maziba catchment in 2014 which, on the Ugandan side, covered about 40% of the catchment in Uganda. Some activities identified were also implemented under the same project. However, since climate change aspects were not explicitly handled in the first CMP, this necessitated an update to take care of climate change but building onto the previous work.

4.7.1.2 Lake Victoria Environment Management Project (LVEMP II)

At regional level, the Lake Victoria Environment Management Project (LVEMP II) was a similar on-going project that contributed to management of the wider Lake Victoria basin within which Maziba catchment drains. LVEMP II is an East African Community project that was implemented in the five countries that share the Lake Victoria Basin. The project was implemented by:

(i) Lake Victoria Basin Commission and the Lake Victoria Fisheries Organization at the regional level

(ii) The national authorities, fisheries, and environmental management institutions at the individual country level

(iii) Community-level organizations

The project objectives that contributed to catchment management and control of land degradation were:

- Strengthening institutional capacity for managing shared water and fisheries resources

  Under this objective, the following activities were undertaken

  (i) Research,

  (ii) Management of resources

  (iii) Enforcement of environmental standards

- Watershed management

  The activities under this objective were;

  (iv) Rehabilitation and improvement of wastewater treatment facilities

  (v) Promotion of cleaner production technologies

  (vi) Pollution risk management and safety of navigation.

- Point Source pollution control and prevention

  The activities under this objective were;

  (vii) Natural resources conservation and livelihoods improvement;

  (viii) Community capacity building and participation.

LVEMP II therefore sought to improve collaborative management of trans-boundary natural resources of Lake Victoria Basin and, reduce environmental stress in the targeted pollution hotspots and selected degraded catchments/sub-catchments as a means of improving the livelihoods of communities who depend on the natural resources of the Basin.

4.7.1.3 Mount Elgon Regional Ecosystem Conservation Project (MERECP)

Another regional-level related initiative is the Mount Elgon Regional Ecosystem Conservation Project (MERECP). This is a project of the East African Community (EAC) that is mandated to address the conservation and development needs of the Mount Elgon ecosystem, among others. It is a related initiative because it targets Mt. Elgon as a water tower of the Lake Victoria basin. The Visions of the project are to:

- Strengthen the management of protected area components of the Mt. Elgon ecosystem and initiate sustainable development activities
- Have a secure and productive Mt. Elgon ecosystem

The objectives/outputs are:

1. Benefit sharing and co-management models of ecosystem and biodiversity conservation and management. The activities to achieve this output are: Zoning of areas within National parks and forest reserves and

adjacent district lands; identification of degraded areas within National parks and forest reserves, and districts; provision of technical assistance to CBOs; operationalization of ecological monitoring tools and database; and identifying a catalogue of cross-border activities that can be regularized under an administrative agreement.

2. Equity and benefit sharing models/revolving funds that create opportunities for payment of ecosystem goods and services. The activities that target to achieve this output are: Identification and registration/ communication of CBOs; provision of technical assistance to CBOs to build capacity; transfer of seed capital for establishing Central Forest Reserves (CFRs); and monitoring of CBO performance in CRF management.

3. Linking of livelihoods improvement to climate change mitigation/adaptation. Activities to achieve this output are: Planning and study of the entire Mt Elgon Ecosystem; Climate Change/REDD-based strategy covering all settlements adjacent to the Protected Areas; undertaking of a Climate Change adaptation study covering vulnerable and high risk area; carrying out baseline surveys; and monitoring of plantations and ecosystem health.

4. Appropriate institutions strengthened in support of the trans-boundary ecosystem approach. The activities to achieve this output are: Capacity building in management of protected areas and trans-boundary ecosystem management; documentation of trans-boundary NRM processes and information dissemination to stakeholders; multi-stakeholder and Technical Working Groups set up for activity implementation Capacity of local NGOs/CBOs supported to improve implementation of trans-boundary NRM processes and partnerships developed with various institutions; and support to design and write up a trans-boundary tourism/ecotourism development, monitoring and protection plan

4.7.1.4 Lake Victoria Basin Commission (LVBC)

The Lake Victoria Basin Commission (LVBC) is the regional institution that coordinates such related initiatives. It is an institution of the East African Community (EAC) that is mandated to coordinate the sustainable development of the Lake Victoria Basin. The commission aims at promoting, facilitating, and coordinating activities of different actors towards sustainable development and poverty eradication of the Lake Victoria Basin. As such, since the Maziba catchment is part of the Lake Victoria Basin, coordination of catchment management related activities within the catchment is an important aspect of the LVBC.

4.7.2 National and Local Initiatives

4.7.2.1 Enhancing Resilience of Communities to Climate Change through Catchment Based Integrated Management of Water and Related Resources in Uganda" (EURECCCA) Project

With funding from the Adaptation Fund through Sahara and Sahel Observatory (OSS), MWE is implementing the "Enhancing Resilience of Communities to Climate Change through Catchment Based Integrated Management of Water and Related Resources in Uganda" (EURECCCA) Project. The EURECCCA project has, among other things, undertaken updating of the Maziba CMP (2020) to include aspects of climate change which were not addressed in the previous CMP of 2014. The project is, among others, supporting government's efforts to implement Integrated Water Resources Management (IWRM) through Catchment Management Planning and increase the resilience of communities to the risk of floods and landslides in Maziba, Aswa and Awoja Catchments. The overall goal of the EURECCA project is to increase the resilience of communities to the risk of floods and landslides of Awoja, Maziba and Aswa Catchments through promoting catchment based integrated, equitable and sustainable management of water and related resources.

The 5-year project which started in 2017 has registered many successes with regard to catchment management interventions in addition to reviewing, updating, and publishing several guiding documents including the CMP guidelines and CMPs for Awoja, Aswa, and Awoja. Among other things, the project has established sub-catchment management structures to enable implementation of various activities identified in the catchment management plan, and supported activities to;

- Rehabilitate degraded wetlands,
- Harvest water and control floods,
- Reduce levels of forest degradation (e.g. promotion of improved cooking stoves),

- Restore degraded river banks and protect buffer zones,
- Undertake climate change adaptation activities,
- Train and support establishment and management of tree nursery beds,
- Knowledge and experience sharing regarding ecosystems conservation,
- Climate smart agriculture, alternative income generating activities, e.t.c.

4.7.2.2 Building Resilient Communities, Wetland Ecosystems and Associated Catchments in Uganda Project

The Ministry of Water and Environment is implementing the eight-year- Building Resilient Communities, Wetland Ecosystems and Associated Catchments in Uganda project. The initiative aims at restoring wetlands and increase resilience of ecosystems and communities living around the wetlands, and is being funded by the Green Climate Fund (GCF) and United Nations Development Program (UNDP). The Multi-sectorial project which started in November 2017 is estimated to end in December 2025 is expected to directly benefit up to 800,000 people in 20 districts of East and South Western Uganda (including Ntungamo District in the Maziba catchment). It will also target to restore 64, 370 hectares of Wetlands and 11,630 hectares of catchments.

The project focuses on restoring wetlands, agricultural land, forest and rangelands through various interventions including; climate smart agriculture and bio diversity conservation among others. It also will provide support to communities in the targeted areas to sustainable use their wetlands and the areas surrounding them. It emphasises four key elements;

- Restore critical wetlands to improve ecosystem services such as ground water recharge, flood control, fishing and agriculture for enhanced livelihoods to the most vulnerable subsistence farming communities.
- Diversify livelihood options and make agriculture more resilient to climate shocks, by enhancing the skill set of beneficiaries especially women and youth for employability and adaptation.
- Empower communities in sensitive wetland areas in risk reduction and preparedness to climate-related disasters through participatory and decentralised early warning systems and capacity development for implementing disaster risk reduction measures.
- Protect important wetlands that provide water for domestic and productive activities; waste treatment and flood control.

4.7.2.3 Kigezi Diocese Water and Sanitation Programme (KDWSP)

The Kigezi Diocese Water and Sanitation Programme is implementing strategies to mitigate against floods and control soil erosion. Key interventions include supporting gully rehabilitation, construction of check dams and trenches; and using gunny bags filled with soil to check run-off. Elephant grass, sugarcane and Calliandra are used to stabilize slopes and banks of the soil and water conservation trenches. These technologies are multi-purpose in nature. They supported soil and water conservation, and provide food and fodder. Other activities include riverbank protection to reduce siltation and flooding. However, the project could not achieve the statutory 30-metre buffer zone requirement; and only managed to secure 5 m due to population land pressure in the area. A stretch of 0.5 km along this buffer was planted with Alnus tree species.

To control water pollution along the streams, the project has also introduced soak pits for discharge of distillation wastes, and has introduced institutional energy saving stoves for the local distillation units to reduce tree biomass loss in the catchment. In order to re-vegetate the bare hill slopes and meet the increasing woodfuel needs, the project established 6 community-managed tree nurseries in the 6 intervention villages. This was done after learning a lesson that procurement and supply of tree seedlings from elsewhere was not sustainable. The nurseries produce a number of agroforestry tree seedlings, but grafted fruit trees (e.g. Ovacado) are particularly popular, for they are fast maturing, diversify household income, improve nutrition and support environmental rehabilitation concurrently.

A key success factor was the application of farmer-friendly approaches, technologies that provide multiple benefits; and using these benefits to catalyse participation, adoption and replication (as opposed to using money/

allowances to attract participation). The project also established new/parallel governance structures (Local Environment Committees) to implement project activities, composed of beneficiary farmers. These were key success factors, but with a challenge. The pre-existing governance structures (e.g. local councils) feel sidelined and are not that supportive to the project. Another key failure concerned the initially planned wetland rehabilitation activities. These were not achieved due to population land pressure, and the potential conflicts that could be triggered by the activity. For the future, the project recommends promotion of wetland wise use activities based on detailed studies that will guide choice of wise use activities that can be implemented without degrading wetland hydrology and integrity.

4.7.2.4 The Kagera Trans-boundary Agro-Ecosystems Management Project (TAMP)

The Kagera Trans-boundary Agro-Ecosystems Management Project (TAMP) is, on the other hand, promoting Sustainable Land Management (SLM) in the Kagera catchment, within which the Maziba catchment lies. The project is promoting agro-forestry and tree growing, trenching and mulching in banana plantations that lie along steep slopes; grass strips and stone lines. The key success factor has been promotion of technologies that are already familiar to farmers; and are therefore acceptable and easy to adopt and replicate. The project only trains them on how to modify and use these technologies more effectively. The key challenge is that the interventions are spread too wide over the Kagera catchment, and the cumulative impact of the interventions is not easy to appreciate. Some farmers have also not fully embraced the Farmer Field School (FFS) approach adopted by the project, even though they all lie within the same catchment. This means that if such farmers are located upstream, then their poor farming activities are bound to adversely impact on downstream farmers who could have adopted the SLM technologies.

4.7.3 Effectiveness and Efficacy of the Existing Interventions; and Lessons for Maziba

The completed/on-going interventions discussed above present a number of key success factors, failures, and lessons to learn; and an opportunity to evaluate what works (and why) and what does not work (and why not). This provides basis for evaluation of best practice to be scaled up, and mistakes to be avoided. Specifically, the following aspects of efficiency and effectiveness have been analyzed and are highlighted for consideration during implementation of future interventions in Maziba catchment:

1. Technologies that are multi-purpose in nature (e.g. use of elephant grass, sugarcane and Calliandra to stabilize slopes and banks of the soil and water conservation trenches) are quite effective and efficient. They support soil and water conservation, provide food and fodder; and are quickly adoptable as compared to those that provide a single benefit.

2. Forceful interventions that seek to achieve statutory requirements (e.g. riverbank protection to reduce siltation and flooding) can barely bear fruit, and are costly. The reason is that they never consider unique socio-economic contexts of the project areas in question. Even when it applied a negotiation approach, the Kigezi diocese project could not achieve the statutory 30-metre buffer zone protection requirement; and only managed to secure 5 m. Due to the unique population land pressure and associated poverty in Maziba catchment, the river buffer zones should be negotiated and accepted; and thereafter put to regulated economic and sustainable uses (e.g. planted with tree species that do not drain water like Alnus; or utilized for fish farming; bee keeping; controlled grazing, etc.). Such uses should not adversely affect the ecology and hydrology of the Maziba system.

3. Interventions that seek to reduce fuel wood consumption and the associated biomass loss through introduction of energy saving technologies are often ineffective and inefficient if they are not affordable to the average household, or if they are not socially acceptable. In such cases, the wasteful traditional 3-stone fire places continue to be used even where the demonstration wood fuel saving demonstration technologies exist in the villages. Accordingly, cheap and affordable technologies that also meet the social requirements of the people of Maziba ought to be designed and introduced in order to sustainably meet the increasing woodfuel demands; and reduce biomass loss in the catchment.

4. To successfully re-vegetate the degraded catchment, procurement and supply of tree seedlings from elsewhere is not effective, efficient and sustainable. Considering lessons from the Kigezi diocese, it is advisable to establish community-managed tree nurseries in the intervention villages. The nurseries should

produce a variety of agroforestry tree seedlings that can co-exist with crops, owing to the fact that most farmers have no land to establish separate woodlots. Trees with multiple benefits are particularly encouraged. For example, grafted fruit trees (e.g. Ovacado) are particularly popular, for they are fast maturing, diversify household income, improve nutrition and support environmental rehabilitation concurrently.

5. Establishing totally new/parallel IWRM governance structures to implement project interventions is ineffective and inefficient. The pre-existing governance structures (e.g. local councils) feel sidelined and cease to be supportive to the project. Any new governance arrangements ought to integrate the existing local governance structures so as to ensure their participation and support. It is advisable to build the capacity of, and work through, existing statutory institutional arrangements and integrate beneficiary farmers to work in collaboration with them.

6. Technologies that are already familiar to farmers are effective, efficient, and will quickly be adopted. Kagera TAMP has registered success through promotion of such technologies for they are acceptable and easy to adopt and replicate. The project only trains them on how to modify and use these technologies more effectively and efficiently. However, the efficiency and effectiveness is watered down by the fact that the interventions are spread too wide over the Kagera catchment, and the cumulative impact of the interventions is not easy to appreciate. It is therefore advisable to avoid spreading the interventions too wide and instead concentrating them within carefully selected hotspot micro-catchments.

7. Interventions that seek to improve collaborative management of trans-boundary natural resources (e.g. LVEMP & MERCEP) have been effective in reducing environmental stress in targeted hotspot catchments as a means of improving the livelihoods of communities who depend on the trans-boundary natural resources. Benefit sharing and co-management models of ecosystems (e.g. National parks and forest reserves) can be effective. Lessons from the MERCEP project which considers Mt. Elgon as a water tower for Lake Victoria have proved this. These models can therefore be considered for wetland management interventions in the Maziba catchment, in collaboration with the local governments, large dairy farm owners and cooperative societies that own sections of these wetlands. A similar model was in the mid-2000s adopted by Nature Uganda to bear some fruits in the Nyamuliro wetland in Kabale, Albert WMZ.

8. Equity and benefit sharing/revolving fund models that create opportunities for payment of ecosystem goods and services are also effective. They present an opportunity for using the revolving funds/benefit sharing scheme as an incentive for adoption of best practice (e.g. soil and water conservation technologies), as opposed to the punitive measures which are quite often ineffective and inefficient. Introducing multiple economic benefit interventions is a more effective and efficient approach to catalyse participation, adoption and replication as opposed to using money/allowances or force to attract participation.

9. Institutional strengthening and capacity building by both the national/local and regional initiatives e.g. EURECCCA, LVEMP, MERCEP, have been effective in realising implementation of catchment management interventions. Specifically, capacity building activities in support of the trans-boundary ecosystem approach under LVEMP and MERCEP have also partly been effective and could provide some lessons for Maziba. Capacity building in trans-boundary ecosystem management; documentation of trans-boundary NRM issues and information dissemination to stakeholders; multi-stakeholder processes and establishment of trans-boundary Technical Working Groups for activity implementation; partnerships and capacity building of local NGOs/CBOs to improve implementation of trans-boundary WRM have been fairly effective. Such examples could provide good lessons for replication, considering its trans-boundary nature across Uganda and Rwanda.

5. CATCHMENT VISION, OBJECTIVES AND OPTIONS ANALYSIS

5.1 Vision and Strategic Objectives

The knowledge base on the status of Maziba catchment, the key catchment issues and the existing agro-ecological potentials of the area were presented to stakeholders in all the sub-counties for review and discussion. Based on this, the stakeholders provided their perspectives on how the key IWRM problems ought to be addressed, taking into account the agro-ecological potentials of the catchments in order to improve livelihoods of the people in the area. From these stakeholder consultations, a vision and objectives were developed for Maziba catchment.

CATCHMENT VISION

> ***"Sustainable and equitable access to natural resources and resilient livelihoods in Maziba catchment"***

STRATEGIC OBJECTIVES

The vision will be achieved through the following objectives:

1) To promote sustainable land management for better agricultural production and productivity in Maziba catchment

2) To improve the quality and quantity of natural resources in the catchment

3) To build social, economic and ecological resilience of the livelihoods of the population in the catchment

4) To build capacity for better natural resources governance and conflict management in the catchment

5.2 Options and Sub-Options

The objectives will be achieved by addressing the catchment issues in the catchment through a number of options and sub-options. For clarity and ease of reference, these are tabulate, presented and discussed for each objective in this section.

5.2.1 **Objective 1:** *To promote Sustainable Land Management (SLM) for better agricultural production and productivity in the catchment*

It is estimated that about 26,400 ha of land in the catchment will be brought under Sustainable Land Management, including Agroforestry and various soil and water conservation measures. As highlighted in the table below, 7,042.2 ha of this will be in Hamurwa, 10,387 ha in Bubaare, 4,384.10 ha in Kyanamira-Buhara, 2,245.70 ha in Maziba west and 2,340.2 ha in Rubaya-Kamuganguzi.

Table 5-1: Proposed restoration area (ha) under agroforestry, soil and water conservation

Micro-catchment	Proposed restoration area (ha) under agro-forestry, soil and water conservation
Hamurwa	7,042.20
Bubaare,	10,387.50
Kyanamira-Buhara,	4,384.10
Maziba west,	2,245.70
Rubaya-Kamuganguzi	2,340.20
TOTAL	**26,399.70**

The proposed area was estimated basing on the values of vegetation health, where areas with lowest vegetation densities and are thus associated with faster rates of soil loss. The values were extracted using the Normalized Differential Vegetation Index (NDVI) map for the catchment. Micro-catchments like Bubaare which have large areas with low vegetation density and experience soil erosion will have more areas under agro-forestry and soil and water conservation interventions. The validation of areas of intervention was then done based on field observation, findings and secondary data.

Table 5-2: Options and sub-options for strategic objective 1

Option	Sub-options
Promoting adoption of improved farming technologies	• Farmer awareness initiatives to promote attitude change, learning and appreciation of the benefits of improved farming technologies • Prepare a tailor-made Sustainable Land Management (SLM) manual that provides the technological approaches for Maziba • Farm-level land-use planning according to sustainable land management principles. E.g. design and lay-out to include contouring, footpath design, locating woodlots, trenches for runoff management, etc. • Re-package appropriate technologies to become complete, affordable, gender and terrain-friendly, less labour intensive and socially acceptable • Training programmes that involve men in improved farming technologies • Set up demonstrations e.g. soil and water conservation structures, fertility management, intensive farming & improving productivity per hectare; etc. • Support adoption and replication of the new technologies through farmer groups (e.g. FAO's Farmer Field School model - e.g. use of bio-fertilizers, farm-yard manure and other better farming technologies/practices, etc.) • Consolidation of land where acceptable – e.g. group farms/fields • Integrated pest, disease and fertility management • Introduce livestock improvement programme e.g. cross-breeding • Monitoring the impacts of sustainable land and environmental management in terms of improved farming output (individual benefit), and downstream water management

Option	Sub-options
Controlling soil erosion and land degradation	• Conduct farm-level soil erosion risk mapping • Training and learning exchange visits for technology transfer and farmers to appreciate what works/does not work. • Construction of soil and water conservation and slope stabilization structures (e.g. check dams, trenches, *fanya chini-fanya juu*, terraces, grass and tree strips, stone packs, etc.); • Rehabilitation of degraded landscapes and gullies (e.g. in-filling with stones, agricultural residue, stone packs, re-vegetation, etc.). • Bye-laws to support soil erosion control e.g. to strengthen terraces management • Riverbank protection and stabilisation - gabions, management of cattle access points, protection of riparian vegetation • On-farm rainwater harvesting, channelling and storage of runoff • Introduce agro-forestry and the cultivation of livestock fodder & legumes along field boundaries • Determine current stocking rates and assess carrying capacity. Develop a plan to keep the numbers of animals within the limits of carrying capacity

Promoting adoption of improved farming technologies

The seven (7) delineated micro-catchments lie in ago-ecological zones with great potential for crop and livestock production. However, the persistent use of poor farming methods and limited adoption of improved farming technologies in upland fields has resulted in over use, loss of soil fertility, soil erosion and stream sedimentation in the valleys. This state of affairs needs to be addressed and justifies promotion of interventions that will quickly promote adoption of better farming methods. Quite often, modern farming technologies are not adopted by the farmers owing to a number of factors – social, economic and other. The key challenge has been that many times, the new technologies are not adopted due to negative attitude, while at times it is due to high costs and labour intensiveness. Sometimes, the new technology is also not socially acceptable.

In response, it is therefore proposed that new and improved farming technologies should be selected and introduced very carefully, in a participatory manner. Many new technologies have often been introduced forcefully, without farmers making decision on whether they want them or not. The farmers were often not given opportunity to learn and appreciate the benefits of the technologies through demonstrations. Therefore, there will be need to set up demonstrations of improved farming technologies such as soil and water conservation structures, fertility management, higher levels of input use for higher yields per hectare; shift to the cultivation of higher value crops on the small land holdings and supporting productivity improvement on marginal lands, agro-forestry and the cultivation of range grasses and legumes in field boundaries, agriculture diversification (fruit growing, aqua culture, etc.). It is anticipated that farmers will learn from these demonstration sites, appreciate the value of the new technologies, and replicate them elsewhere on their farms in the catchment.

Under this intervention, the key crops and livestock enterprises to be promoted are tabulated below.

Table 5-3: Crop and livestock enterprises to be promoted

Crop/livestock	Reason
Tea	Improves income; supports soil and water conservation
Coffee	Improves income; supports soil and water conservation
Apples	Improves nutrition and income; have ready market
Bananas	Food security, ready market. Can do well in Maziba, Kaharo and Kyanamira
Irish Potatoes	Improves income and food security. Ready market
Horticultural crops (carrots, beetroot, cabbages, etc.)	Better nutrition; ready market
Livestock enterprise	
Dairy cattle keeping	Improve nutrition especially among children; ready market; source of manure for soil fertility improvement; needs little land area if zero grazing is adopted
Piggery	Ready market, source of manure for soil fertility improvement; needs little land area
Poultry	Needs little land, ready market, improves household income, needs little capital and thus affordable. Croilers are recommended as they grow big very fast (4 months) and fetch high prices (up to UGX 40,000 each)
Apiculture	Needs little land. Can be done as part of sustainable use of wetland reserves
Aquaculture	Can be done as part of sustainable use of wetland reserves; sustains water in the ecosystem; improves nutrition

Note: It is proposed that the promotion of these enterprises should include a component of agro-processing for value addition in order to effectively benefit the farmers and therefore promote their adoption and replication to improve livelihoods.

The technologies should be affordable, less labour intensive and socially acceptable. The innovations should include opportunities for farmers to procure and implement the technologies in groups (e.g. FAO's Farmer Field School model), for the required capital cost and labour is spread across group members. Preferably, the new farming technologies should as much as possible build upon the traditional way in which the farmers have often attempted to address the issue. For example, if the farmers have always constructed traditional structures for slope stabilization, then it will be advisable to only improve on the effectiveness of what they have been doing. This increases adoption rates as compared to introducing totally new technologies.

Controlling soil erosion

As mentioned earlier, all the seven (7) delineated micro-catchments fall within agro-ecological zones with great potential to produce various crops for both domestic consumption and sale. However, it was established that some parts of Hamurwa, Kaharo, Kyanamira-Buhara and Bubaare micro-catchments experience high (50-90 t/ha/yr) to extremely high (> 90 t/ha/yr) rates of soil loss. The soil loss is two-pronged: loss of the physical soil particles, and the nutrients therein. Even the lowest rate of soil loss registered (2 t/ha/yr) is still unacceptable due to its cumulative adverse impact. This is particularly a threat livelihoods of the people who depend on land productivity for their livelihood; and is the underlying reason why interventions to abate soil erosion are proposed.

The proposed soil and water conservation interventions include the following:

1. **Construction of check dams** using sand bags, stones, poles and any other locally available materials as barrages. These reduce rates of run-off and trap silt. Subsequently, existing gullies get filled, healed and rehabilitated. If locally available materials are used e.g. poles, they can be affordable to many farmers.

2. **Construction of trenches** e.g. fanya chini-fanya juu. If constructed along steep slopes, these have capacity to trap run-off and silt. The water is retained in the trenches and allowed to seep into the land, thereby improving soil moisture and crop survival even during drier spells. The trapped silt is periodically scooped back to the fields. If it is composed of fine fertile top soil eroded from elsewhere, it can increase fertility of the patch of land where it is deposited.

3. **Excavation of rain and storm water harvesting ditches and ponds** (locally known as ebitaba). They trap and retain rain and storm water, and allow it to seep slowly into the soil. They therefore improve soil moisture, and reduce the otherwise erosive impact of storm water. Often, crops planted around such ditches and ponds perform quite well e.g. Bananas. The harvested water can also be used for other on-farm purposes, e.g. watering livestock and making bricks. They are socially acceptable and economically affordable, and have been adopted by banana farmers in neighbouring parts of Ankole.

4. **Construction of terraces** and better management of existing ones. A terraced landscape reduces the speed of run-off, and thus its erosive capacity. The advantage is that they are not a new technology to farmers in Maziba, having been introduced by colonialists in the past.

5. **Establishment of grass strips**. These may be strips of natural grass spared along plot boundaries, or planted grass. The advantages are that the grass traps run-off and sediment along hill slopes. That strip of land also undergoes fallow and is found to be fertile once opened up for cultivation after some 3-5 years. It is recommended that palatable grass varieties are used so as to also serve as fodder

6. **Agro-forestry.** Trees or shrubs are grown around or among crops or pastureland. It combines agriculture and forestry to create more diverse, productive, profitable, healthy, and sustainable land use. It offers increased productivity, economic benefits, and more diversity in the ecological goods and services provided. It can increase farm income, contribute to food security, reduce run-off and soil erosion, reduce deforestation, and provide medicinal herbs and fodder. The trees can stabilise the slopes, act as wind breaks and boundaries, and provide shade.

7. **Contour ploughing.** This involves ploughing and/or planting across a slope following its elevation contour lines. The contour lines check run-off, reduce the formation of rills and gullies and thus the rate of soil erosion. This allows water to infiltrate into the soil, thus increasing soil moisture. The ploughing is done perpendicular rather than parallel to slopes, usually resulting in furrows that curve around the hill slope, thereby reducing the formation of rills and gullies owing to tillage of the land.

8. **Contour bunding.** This is almost similar to contour ploughing. Stones are placed around the contours of slopes to check run-off and trap silt. The practice is not new as it is common in the neighbouring district of Kisoro, and could quickly be adopted by farmers with stony pieces of land, as it helps rid the garden of stones.

9. **Establishing hedgerows.** This is a line of closely spaced agro-forestry trees or shrubs, planted and trimmed to form a barrier. The hedgerow traps run-off and sediment, marks plot boundaries and can provide fodder once trimmed.

The challenge has always been the low adoption rates for these technologies. The reason is that some of these new technologies have always been labour intensive, costly, and sometimes, socially unacceptable. The way forward is therefore to learn from experience elsewhere in the area, and be able to identify what has worked and what does not. Particularly, attempts ought to be made to introduce technologies that build upon local knowledge (e.g. how they have traditional always tried to control soil erosion); less costly and can be constructed in groups so as to support the less able bodied e.g. women and the elderly.

5.2.2 **Objective 2:** *To improve the quality and quantity of Natural Resources in the catchment*

Table 5-4: Options and sub-options for strategic objective 2

Options	Sub-options
Reducing loss of vegetation cover	• Public awareness campaigns about the dangers of rapid loss of vegetation cover and the benefits of tree growing • Develop a forestry handbook and provide training to forest, land care and agricultural managers and community members • Establishing tree nurseries at community level for sustainable supplies of seedlings • Massive planting of agro-forestry and other multi-purpose tree species interspersed with crops, or on plot boundaries, for hedgerow establishment along the terrace bunds. • Encouraging sustainable exploitation of existing tree resources e.g. controlled harvesting for fuelwood • Promoting energy-saving technologies to reduce wood consumption and related biomass loss by making the technology readily available • Introduce affordable and socially acceptable alternative renewable sources of energy e.g. low-cost solar panels for lighting, radios, cell phones, biogas for cooking and lighting, etc. • Promoting tree species with high value products to protect the environment but also provide income to the communities • Providing incentives for on-farm tree conservation e.g. value addition and market linkages to tree products, simple reward systems, etc. • Supporting the communities to tap into regional and global opportunities like carbon trade and CDM • Enacting and enforcing bye-laws to regulate indiscriminate tree cutting
Improving water quality and quantity	• Public awareness campaigns • Strict regulation of water abstraction, use and wastewater discharge • Developing new water sources (both surface and ground) to increase access to safe water • Protection and re-vegetation of river and stream banks • Enforcement of existing laws and guidelines for water source protection • Water efficiency evaluation and recommendations • Improvement of sanitation in the micro-catchments • Refurbish the existing water resources monitoring infrastructure and equipment • Frequent monitoring of point and non-point pollution sources

Options	Sub-options
Reducing wetland and riverbank degradation and rehabilitating critical wetland sections	• Regular updating of district wetland inventories • Public awareness activities (including exchange learning visits) about the dangers of riverbank and wetland degradation and benefits of wetland conservation, and on the existing policy and legal frameworks • Develop and implement community-based wetland use and management plans • Mapping, demarcating and regulating the use and management of wetlands and riverbanks, including establishment of protection buffer zones along streams and rivers. • Gazette and rehabilitate critical riverbank and wetland sections (e.g. critical wetlands that serve for hydropower dam protection, water and sewerage services, flood control, etc.). • Supporting the sustainable, wise utilization and management of already converted wetlands e.g. for aquaculture, regulated sugarcane growing, etc. • Develop a tailor-made manual on aquaculture and wetland edge gardening • Assist farmers to rehabilitate viable fish farms and in the construction of new demonstration fish ponds • Formulation and enforcement of local policies and laws for better riverbank and wetland conservation, use and management

Reducing loss of vegetation cover and promoting agro-forestry

For some of the delineated micro-catchments to lose over 1,500 m^2 of vegetation cover per year is extremely risky to the ecosystem and livelihoods in the area; and is therefore unacceptable. Quickly, interventions that will reverse this rate of vegetation loss ought to be implemented. The key challenge has been that medium and high vegetation density areas have to be opened up for cultivation as the population pressure on land increases. Farmers find it challenging to spare land under tree cover, yet they barely have where to cultivate crops. The opportunity is that the 3 agro-ecological zones in this area have potential to grow both trees and crops.

To address the issue, therefore, the proposed interventions should include promoting agro-forestry, considering that all the 5 hotspot micro-catchments have great agro-ecological potential to produce various economically viable crops. As proposed under objective 1 above, it is estimated that about 26,400 ha of land in the catchment will be brought under SLM that includes Agroforestry. Tree species that positively co-exist with crops and provide multiple benefits to farmers (e.g. fruits, fodder, firewood, poles, soil fertility improvement, etc.) have particularly proved to be more popular, according to lessons learnt from on-going projects implemented by Kagera TAMP and Kigezi Diocese. Observations indicate that a few other agroforestry tree species have also been adopted, including Calliandra, Leucaena, Sesbania, Alnus, and Grevillea (largely introduced by ICRAF in early 2000s). These are interspersed with crops, or on plot boundaries, while Leucaena and Calliandra are used for hedgerow establishment along the terrace bunds. It will require establishing tree nurseries at community level to ensure sustainable supplies of seedlings.

Other interventions should include promoting energy saving stoves to reduce wood consumption. Eucalyptus is a preferred tree species because it is quick growing, grows straight, is marketable and has multiple uses. However, it should be grown in marginal and poorly productive patches of land due to its high soil moisture intake rates and ability to perform well on such patches of land.

Improving water quality and quantity

There is strong motivation for interventions that increase water retention, ground recharge and stream flow, particularly in the dry seasons; and improve water quality. River flow was found to have systematically dropped

over the last 10 years. Water balance calculations indicated that the catchment experiences a water deficit for 8 months each year. In terms of water quality, TSS (500^0C) at Hamurwa, Kitumba, Kyanamira, Kamuronko and Kaharo was a key parameter that was not within the limits of the Clean Water Act approved by EPA and WHO. Availability of good quality water in sufficient amounts is paramount to the livelihoods and development of people in the catchment. If not addressed, the issue will adversely impact on water availability for domestic, industrial, hydro-electric power, irrigation and other uses.

The agro-ecological potentials (especially farming and potentially agro-based industries) of the catchment cannot be fully exploited without sufficient quality water. The challenge is that the rivers and streams become heavily silted especially downstream due to poor land use and management practices upstream. Farmers have barely adopted any modern farming methods to conserve soil and water in the uplands. Whenever it rains, the soils along steep hillsides are eroded and deposited in the valleys, such that the silt load increases along the rivers and streams. The wetland vegetation that would have naturally filtered the water of this sediment was lost and the wetlands converted into farms.

To address the water quality and quantity issue, proposed interventions include strengthening activities that promote and enhance water quality (e.g. public awareness campaigns, wetland rehabilitation, erosion control measures in the upstream, wastewater treatment, etc.). Others will include re-vegetation of the catchment, with specific attention to protection of stream buffer zones, wetland restoration along the streams, and soil and water conservation measures along hill slopes. Many past interventions that took a forceful approach did not work. A more participatory approach that raises popular appreciation of the issues, including upstream-downstream concerns, is recommended. Once water availability is sustained, then attempts could in future be made to further exploit the potentials of the 3 agro-ecological zones by introducing dry season irrigation farming in the 7 delineated micro-catchments. This would introduce a 3rd or 4th crop in the year, thereby improving farm income and livelihoods in the catchment.

Reducing wetland degradation and rehabilitating critical wetland sections

Across the 3 agro-ecological zones that cover Maziba, the valleys and associated wetlands have potential for production of Irish potatoes and vegetables. However, the key concern is that the sulfurs contained in the wetland soils, once drained, get acidified. Besides, wetland drainage affects the hydrology of the landscape, and is partly responsible for the drop in river flow in the past 10 years. According to the NDVI assessment conducted, the last pristine wetland (0.33% of the catchment's land cover) was lost in 2002. The conversion was mainly for crop and dairy farming, and to a smaller extent tree planting. This presents a serious challenge because the catchment has lost both the ecosystem functions and socio-economic benefits of these wetlands. By draining away and converting the wetlands, the catchment loses ecosystem benefits like water retention, flood control, sediment retention, micro-catchment modification, etc.; and direct benefits like fish, craft and building materials, firewood, etc. The adverse impacts also manifest in form of high sediment load in the river as discussed in earlier sections. These present strong reason for interventions that will abate further loss of wetlands in the catchment.

The challenge is that even when these adverse impacts had been experienced, communities continued to convert the wetlands owing to population land pressure. The wetlands provided the only available extra land where new farms could be opened up to increase production and meet the needs of the increasing population. However, this is not a sustainable solution as the wetland area is fixed.

To address this issue, the proposed interventions include: Supporting the sustainable, wise utilisation and management of already converted wetlands, identifying and supporting alternatives for community wetland uses; promoting programs aimed at reducing population increase, promoting programs for wetland conservation and management, strengthen programs for public awareness creation about conservation and sustainable use of wetlands, support formulation of local policies and laws for wetland conservation and management, and implementing wetland rehabilitation/restoration activities where critical need arises (e.g. for hydropower dam protection, water and sewerage services, stream banks, etc.). The rehabilitation and protection of critical wetlands is provided for in the National Wetlands Policy (1995), and national guidelines exist to technically support wetland edge gardening, with the aim to protect the immediate river banks. These should be operationalized to guide wetland farmers.

Accordingly, depending on negotiation and agreement with adjacent land owners, it is estimated that a minimum of about 6 km^2 of critical wetland sections will be rehabilitated/restored along the major river banks. Of this, 1.6 km^2 will be restored in Hamurwa, 2.1 km^2 in Bubaare, 1.3 km^2 in Kyanamira-Buhara; 0.5 km^2 in the immediate micro-catchment around the hydro-power dam in Maziba west; and 0.4km^2 in a critical wetland section in Rubaya-Kamuganguzi.

Table 5-5: Estimates of area to be brought under wetland rehabilitation and riverbank protection

Micro-catchment	Area of wetland and riverbank (sq.km)
Hamurwa	1.6
Bubaare	2.1
Kyanamira-Buhara	1.3
Maziba west,	0.5
Rubaya-Kamuganguzi	0.4
Total	**5.9**

To arrive at this, a proximity analysis procedure was adopted to estimate the actual areas of river bank protection. A buffer of a minimum of 10m from the streams was created round the river Maziba to estimate the areas of riverbank protection. The validation of areas of intervention was then done based on field observation, findings and secondary data. Take note that these are bare minimums that could go higher if the implementation teams can negotiate and agree with communities for larger wetland areas to be restored, e.g. based on say 10-30 m of riverbank, considering the socio-economic and land pressure conditions in the area.

Previous attempts had been made by local and central government to restore some of the degraded wetland sections but with limited success. The reason was that forceful approaches had been used. It is proposed that buy-in should first be sought from communities and their local leaders, allowing them opportunity to appreciate the adverse impacts of wetland degradation. Once but-in and appreciation have been achieved, local rules and regulations can then be successfully instituted and enforced to rehabilitate and protect the identified critical wetland sections.

5.2.3 Objective 3: *To build social, economic and ecological resilience of the livelihoods of the population in the catchment*

Table 5-6: Options and sub-options for strategic objective 3

Options	Sub-options
Reducing population pressure	• Integrated public education and awareness campaigns to change attitudes towards large families • Supporting local legislation to give effect to the population policy • Materials support to adoption of family planning among the communities • Integrate family planning into all development processes using a multi-sector approach
Supporting livelihood improvement to catalyze better catchment management	• Support increase in agricultural production and productivity per hectare (e.g. introducing high-yielding seed varieties, promoting use of farmyard manure and fertilizers, etc.) • Creation of alternative and nature-friendly income streams to reduce the stress on tree and other natural resources (e.g. fruit tree growing, bee-keeping, aquaculture, goat rearing, sustainable milk production, poultry rearing, etc.)

Options	Sub-options
Supporting livelihood improvement to catalyze better catchment management	• Investment support to Maziba hydropower rehabilitation and grid distribution especially to upstream communities as a Payment for Ecosystems Services (PES) scheme tagged to improved catchment management • Re-engineering and building the capacity of economic groupings and cooperatives; e.g. women economic groups; farmer cooperative societies, etc. • Supporting savings and small-scale local lending schemes to increase access to micro-credits and address poverty as one key driver to catchment degradation • Conducting a Participatory Livelihood Improvement Monitoring and Evaluation programme
Improving environmental sanitation and hygiene	• Prepare a tailor-made hygiene and sanitation promotion manual for Maziba • Train communities to change behaviour and attitudes, and promote the adoption of recommended hygiene and sanitation practices, including the 3RRR- Recycle, Reuse, Reduce • Promote Community-Led Total Sanitation (CLTS) interventions that identify ODF villages. Promote the adoption of recommended hygiene and sanitation practices at institutional and household level Materials support and construction of innovative sanitation technologies in public places and at household level • Refurbishing non-functional springs, boreholes, pumps, hand pumps • Feasibility studies of availability and supply for prioritised small towns and settlements • Design and construction of further piped water schemes for growing small towns and villages at growth centres, including supply to growing industries • Design and construction of groundwater schemes for towns/settlements • Provision of subsidised rainwater tanks to willing buyers. Implementation should be based on a cost-sharing mechanism • Enact and enforce strict laws on sanitation and hygiene and against indiscriminate waste dumping in streams, rivers and other non-gazetted areas • Provide waste dumping sites and skips at gazetted sites in urban areas
Addressing climate risks - droughts and floods	• Participatory climate risk vulnerability mapping using tools like CVCA (Climate Vulnerability and Capacity Assessment and CRiSTAL (Climate Risk Assessment Tool – Adaptation and Livelihoods) tools • Public awareness campaigns about climate change and associated risks • Establish real-time early warning systems (e.g. automated weather & river flow monitoring stations) • Needs identification for location and type of dams and associated water storage facilities • Feasibility & design of prioritised small valley dams and tanks dams for stock watering and human needs. Construction, with cooperation and input from local communities • Assess structures within flood prone areas (roads, bridges, culverts) and their resistance to flooding. Then strengthen roads, bridges and culverts for better flood resistance and ensure that escape routes are not cut off; and raised embankments against floods and storms, better drainage around major installations

Options	Sub-options
Addressing climate risks - droughts and floods	• Plan and implement temporary flood water harvesting and retention structures, including construction, with cooperation and input from local communities • Provide farmers with appropriate technologies for the abstraction of water from rivers and shallow boreholes. E.g. facilitating farmer access to treadle pumps and small motorised pumps and the construction of small diversion barrages for floodwater harvesting, storage and use during dry season • Construction of dry season irrigation schemes e.g. simple gravity-fed schemes, a low-power pumped schemes that utilize water from nearby rivers, swamps and lakes; • Assist farmers to adopt dry-season farm-level irrigation activities e.g. drip and canal irrigation that draws water from existing streams, ponds and harvested flood waters • Support research in drought/flood resistant crop varieties • Promote dissemination and adoption of drought/flood resistant crop and livestock varieties • Nature-based and engineering adaptation and resilience building solutions e.g. tree and vegetation buffers, and promoting river bank protection to reduce silting & flooding • Climate risk management (assessment, analysis, monitoring & evaluation) • Governance & framework management plans • Law enforcement and enforcement • Establishment of Greenhouse Gas monitoring systems • Construction of climate and early warning systems • Dissemination of information in journals and newsletters

Reducing population pressure

Strong justification exists why interventions are urgently needed to regulate population growth in Maziba. At a population growth rate of 3% p.a. and an average of about 296.8 inhabitants/km^2 (UBOS, 2013), Maziba catchment has experienced rapid deterioration in quality and quantity of its agro-ecological potential as a result of the rapidly increasing pressure from its population. The main problem arises from environmental degradation through ecosystem conversion. This occurs because, as population increases, individual households seek to increase production and productivity by clearing and opening up new patches of land in medium and high vegetation density, wetlands and other fragile marginal lands. The pressure induced by the people on the catchment resources is very high and will continue to grow as population grows over time.

During stakeholder consultations, the communities attributed this population increase to preference of boys to girls; poor attitudes to family planning; cultural and religious beliefs that promote big families; poverty; drunkenness and limited education especially among women. To address this therefore requires integrated population programs that, as a first step, appreciates and responds to these root causes. The new catchment management programs should integrate components on public education and awareness campaigns to change attitudes towards large families and engage the population in poverty reduction initiatives. These should be initiated and implemented in the catchment, with anticipation that they will support reduction in population growth rates and the current pressure on land, water, wetlands and other resources in the catchment.

Supporting livelihood improvement to catalyze better catchment management

Quite often, poverty is a key driver to catchment degradation. Therefore, interventions that reduce poverty and improve livelihoods will be a logical solution to further degradation. The reason is that poor people can barely consider sustainable exploitation of the catchment's natural resources if their immediate survival and livelihood needs are not met. For example, they will quickly clear vegetation cover to open up land so as to meet their immediate food and income needs, irrespective of the adverse ecological impacts that this comes with (e.g. soil erosion, micro-climatic changes, declining land production and productivity, etc.).

Therefore, to address the livelihood concerns while ensuring that the integrity of the catchment is maintained, an integrated catchment management and development approach will need to be taken. It should integrate programs for improvement of household incomes (fruit growing, bee-keeping, aqua culture, goat rearing); re-engineering economic groupings and cooperatives; promote livelihood activities that do not cause natural resource abuse (e.g. sustainable milk production, poultry rearing, bee-keeping, and other sustainable agriculture initiatives); promoting women economic groups; developing women skills in leadership, and problems identification and better land management and use; and supporting savings and small-scale local lending schemes to address poverty (one key driver to catchment degradation).

During stakeholder consultations, a key gender issue was observed. Increase in agricultural productivity might lead to men appropriating on-farm gains more than women. With an increase in land productivity women participants felt, men would choose to increase the production of cash crops. It is important therefore that women are empowered in decisions making over land use and crop planning, to ensure that household food requirements are provided for adequately.

During catchment status assessment, poverty was identified as a key driver of degradation of the catchment's resources, and therefore needs deliberate interventions to address it. Accordingly, interventions that improve incomes and livelihoods were therefore integrated across the 3 of the 4 objectives of the catchment management plan as highlighted below:

Under objective 1 that seeks to promote SLM, the proposed soil and water conservation, livestock improvement, intensive farming, pest, disease and fertility management initiatives, etc., will improve productivity per hectare; and thus result into better farm incomes and livelihoods. Rehabilitation of degraded landscapes and gullies, on-farm rainwater harvesting, channeling and storage of runoff, agro-forestry and the cultivation of livestock fodder & legumes along field boundaries will also improve farm productivity, incomes and livelihoods.

As part of objective 2 that seeks to improve the quality and quantity of natural resources; tree nurseries will be established as community enterprises to generate income from the sale of seedlings. The planting of agro-forestry and other multi-purpose tree species will also be done as an enterprise – targeting the sale of tree products. Particularly, promoting tree species with high value products will provide income to the communities. Providing incentives for on-farm tree conservation e.g. value addition and market linkages to tree products, will further make tree growing enterprises more profitable. Supporting the communities to tap into regional and global opportunities like carbon trade will act as an incentive that generates income.

In relation to wetland use and management, assisting farmers to rehabilitate viable fish farms and in the construction of new demonstration fish ponds will be another source of income and improved livelihoods. Regulated wetland edge gardening through growing of vegetables and sugarcane will be another source of income to the farmers.

Objective 3 of the plan principally addresses incomes and livelihoods as a way to build economic resilience of the population as explained above. Under this objective, promoting adoption of family planning and reduced family size will ultimately reduce household expenditure, promote savings, and improve household productivity and livelihoods. Specific enterprises are proposed (both in objective 1 and 3) that will diversify income streams. Crop and livestock enterprises to be promoted include Tea, Coffee, Apples, Bananas, Irish Potatoes, Horticultural crops (carrots, beetroot, cabbages, etc.), Dairy cattle keeping, Piggery, Poultry, Apiculture and Aquaculture. It is proposed that the promotion of these enterprises will include a component of agro-processing for value addition in order to effectively improve livelihoods.

Investment support to Maziba hydropower rehabilitation and grid distribution has potential to spur agro-based industries which will in turn generate employment opportunities, improve incomes and livelihoods. Re-engineering and building the capacity of economic groupings and cooperatives; e.g. women economic groups; farmer cooperative societies, etc. will improve production, marketing and savings among farmers, and thus improve their incomes and livelihoods. Supporting savings and small-scale local lending schemes will increase access to micro-credits and address poverty. Indirectly, promoting Community-Led Total Sanitation (CLTS) interventions will also reduce disease incidences and associated household expenditure; improve savings, productivity, incomes and livelihoods. Addressing flood and drought risks through establishing real-time early warning systems will reduce potential farm and off-farm losses; and thus increase productivity and improve livelihoods in the long run. Construction of small valley dams and tanks to harvest flood waters will store and avail water for production. Dry season irrigation schemes and promotion of drought/flood resistant crop and livestock varieties will support agricultural production all-year round, thus improving farm income.

To aid Participatory Learning, Monitoring and Evaluation during implementation of the catchment plan, a Livelihood Improvement Beneficiary Form has been developed (Annex 7). It has been developed for each village, against which changes in livelihood parameters will be measured.

Improving environmental sanitation and hygiene

The overall safe water coverage in Kabale District stands at 67.3%. Latrine coverage in the District is also high with 99% of the households with safe latrines, but 1,168 use the bush (Kabale DDP, 2008/09 – 2010/11). Although these environmental health indicators have improved, there is still a high prevalence of water related diseases associated with low sanitation standards; and this calls for sub-options that will reverse this state of affairs. The streams have been highly abused and have been turned into dumping sites for domestic waste. This is attributed to ignorance; stubbornness/mindlessness; lack of land; and poor urban planning. There are no local ordinances or bye-laws to promote environmental sanitation and hygiene, and the enforcement mechanism of the existing national laws is weak. There is a low level of awareness about best practices on hygiene and waste disposal, lack of gazetted dumping sites; and lack of latrine and bathing facilities at some of the households.

To address this, the proposed interventions include promoting the adoption of recommended hygiene and sanitation practices at institutional and household level, supporting provision of public toilets, bathrooms and other sanitation facilities, promoting positive behaviour change and attitude of the community towards environmental sanitation, enacting local environmental sanitation laws, strengthening the capacity for enforcement of environmental health laws, improving access to safe water, and regulating the use and management of stream banks in the catchment, including establishment of protection buffer zones along streams and rivers.

Previous efforts to promote sanitation and hygiene seem to have registered success, explaining the 99% latrine coverage. Particularly, the public awareness campaigns need to be maintained, though a strong collaboration between civil society organizations and local governments. The same model that contributed to improved household sanitation could be adopted to regulate waste dumping in streams and rivers. For the urban areas, waste dumping sites and skips ought to be provided by the urban authorities at various sites, and bye-laws strictly enforced against indiscriminate waste disposal. This should be done concurrently with public awareness campaigns for the residents to appreciate why waste disposal has to be regulated.

Addressing the climate risks – floods and drought

The 3 agro-ecological zones that cover the seven (7) delineated micro-catchments initially had favorable climate to support crop growth, establishment of livestock farms and development of woodlots. However, the Majority of Climate Change models project an increment in temperature and rainfall amounts in the catchment. This will obviously have a number of implications, including potentially more severe soil erosion, sedimentation, floods, droughts, landslides, and associated loss of crops, livestock, infrastructure, lives and income. This presents strong rationale for interventions that will climate-proof the area's economic activities and build resilience of the people, particularly to droughts and floods. The key challenge is that the potentials of the 3 agro-ecological zones of the area are currently exploited through rain-fed agriculture.

Accordingly, climate-smart practices need to be promoted in the catchment. A number of early warning, adaptation and resilience building measures ought to be put in place to prepare for and manage the predicted climate change and its impacts. These, among others, should include establishment of real-time early warning systems (e.g. automated weather and river flow monitoring stations), and nature-based and artificial adaptation and resilience building structures e.g. tree and vegetation buffers and raised embankments against floods and storms, soil and water conservation structures, better drainage around major installations, and promoting river bank protection to reduce silting & flooding. These should be complemented with programs that build social and economic resilience (e.g. community livelihood improvement programs, innovative village saving and credit schemes whose conditions of access relate to better catchment management, etc.) to support adaptation even when climate-related disasters strike.

5.2.4 **Objective 4:** *To build capacity for better natural resource governance and conflict management in the catchment*

Table 5-7: Options and sub-options for strategic objective 4

Option	Sub-option
Strengthening NR governance and mainstreaming gender issues	• Establish highly representative (of men, women, elderly, youth, PWD), transparent and accountable local governance arrangements charged with responsibility to manage water catchment areas • Representation and participation of both women and men in decision making • Building capacity of women and men to effectively perform their roles and responsibilities in the development, use and management of the catchment's resources • Women empowerment by access to micro-credits and other catchment resources • Support gender-sensitive programming and governance across sectors in the catchment • Develop women's capacity and skills in leadership, decision making, negotiation, problems identification and planning in land use and enterprise development and management
Addressing potential upstream-downstream conflicts	• Establish and operationalise catchment institutional arrangements that bring upstream and downstream communities to plan together • Create awareness amongst communities on the impacts of upstream activities on the downstream • Develop and implement a simple Payment for Ecosystem Services scheme for upstream users • Provision of incentives to encourage adoption of best practices upstream • Frequent convene a stakeholders' forum to resolve upstream-downstream issues that arise
Building capacity for better catchment management	• Support procurement and installation of various water monitoring equipment at existing and new strategic monitoring stations in the catchment • Training of technical staff for better monitoring and reliability of water resources data • Support regular maintenance of equipment at the monitoring stations. • Train a devoted team of extension service workers to provide services for sustainable agricultural, land and catchment management • Develop support materials for use by extension officers

Option	Sub-option
Building capacity for better catchment management	• Support procurement of equipment to support extension work e.g. motorcycles, GPS handsets, bicycles, computers, etc. • Tailor-made training and awareness programmes, manuals and materials for schools and model farms, including integration of catchment management activities in school programmes and clubs • Support local councils to review existing ordinances and bye-laws to integrate catchment management issues • Strengthen enforcement units with capacity to enforce the revised bye-laws and ordinances

Addressing governance, gender, conflict and capacity concerns

The catchment-based model to water resources management is a new approach in Uganda. Governance arrangements have therefore not been in place to promote better management of catchment areas in Uganda, including Maziba. Those that have been in place (e.g. Local Environment Committees) have not been specifically representative and responsive to catchment management issues like latent upstream-downstream conflicts and barely have capacity to address them. Gender concerns like women's access to and use of natural resources have not been adequately addressed. It is therefore logical that Maziba's governance, gender, conflict and capacity concerns are addressed as part of the sub-options proposed for implementation as discussed below.

(a). Governance

Highly representative local governance arrangements charged with responsibility to manage water catchment areas (e.g. catchment and micro-catchment management and technical committees and secretariats) will need to be established and their capacity built to do their work. Their structures should ensure representation of a diversity of stakeholders from the different micro-catchments, including representation of men, women, youth, the elderly and persons with disability. They should be responsive, transparent and accountable to the wider population. One way to operationalize them is to empower them to manage catchment management funds, on condition that they are accountable to a wider catchment stakeholders' forum. Governance structures that manage funds are often bound to be strong, operational and recognized. They should be well staffed, funded, equipped and skilled to address catchment management problems. They should be non-partisan, supportive and responsive to the needs of all stakeholders in the catchment. Strong checks and balances ought to be put in place to ensure that personal political desires of individual representatives on these governance structures do not interfere with interventions designed to address technically proposed catchment development and management interventions.

(b). Addressing gender concerns

This section highlights how the identified gender issues will be addressed (namely ease of access to and utilization of resources like water, tree products; access to micro-credits and productive resources and technologies; participation in planning and decision making, lack of capacity, etc.). Key gender concerns will be addressed through the following actions:

- Representation and participation of both women and men in decision making
- Building capacity of women and men to effectively perform their roles and responsibilities in the development, use and management of the catchment's resources

Women empowerment by increasing their access to micro-credits and other catchment resources

- Participation of both women and men in problem identification and planning for land use and enterprise development and management
- Affirmative action to ensure equitable and fair access to and benefit from proposed catchment management and development interventions

The catchment governance arrangements will be established to ensure representation and participation of both women and men in decision making over the development, use and management of the catchment. Affirmative action will be ensured to establish highly representative governance structures composed of men, women, elderly, youth, PWD; with at least 30% being women. Tailor-made training programmes will be conducted to build the capacity of the women to become operational and effectively do their work. Such trainings will develop women's capacity and skills in leadership, decision making, negotiation, problems identification and planning in land use and enterprise development and management.

To support their further empowerment, access to, and use of the catchment's resources, affirmative action will be ensured for women to administer and access micro-credit through the proposed revolving Catchment Management Fund (CMF). Gender-sensitive programming across sectors in the catchment will be ensured through both affirmative action and the gender-representative governance arrangements proposed above, such that any activity, project or programme development processes involve the perspectives of both women and men. Affirmative action will then be ensured to guarantee equitable and fair access to and benefit from proposed catchment management and development interventions, e.g. both women and men, the poor and other disadvantaged groups also benefit from modern farming technologies introduced, access micro-credits for livelihood improvement, etc.

Additionally, considering that gender issues are cross-cutting in nature, they have also been addressed and budgeted for across all the other three (3) objectives of the catchment management plan as highlighted below:

Under objective 1 that seeks to promote SLM, it is proposed that appropriate, gender-friendly technologies will be promoted that do not discriminate against women or men. SLM trainings and learning exchange visits will also be organised for both men and women to participate.

Under objective 2 that seeks to improve the quality and quantity of natural resources; it is expected that promoting energy-saving technologies will reduce the burden on women who will now require less firewood from otherwise distant sources. Introduction of affordable alternative renewable sources of energy e.g. low-cost solar panels and biogas will equally reduce the household energy demands on women. Gazetting and rehabilitating critical riverbank and wetland sections will allow natural regeneration of wetland vegetation which often provides women with nearby sources of craft material and woody biomass for firewood e.g. papyrus and reeds. Planting of agro-forestry trees and woodlots will also increase wood fuel availability and further reduce the burden on women and avail them more time to engage in other productive work.

As part of objective 3 that seeks to build social, economic and ecological resilience of the livelihoods of the population in the catchment; promoting family planning and change in attitudes towards large families will ultimately reduce the burden of caring for large families among both women and men in the households. Building the capacity of women's economic groupings and cooperatives; e.g. women economic groups; will improve production, marketing and savings among women, and thus improve their incomes and livelihoods. Supporting savings and small-scale local lending schemes among such women groups will increase access to micro-credits; and will increase their access to productive assets like land; and will thus address poverty among them. Refurbishing non-functional water sources and construction of new ones (including rainwater harvesting) will increase access to safe water and thus reduce the burden among women. They will walk shorter distances and save time to again engage in other productive on- and off-farm activities.

In terms of the overall budget, interventions that address gender issues total up to US$ 8,432,500, equivalent to 37.7% of the total budget. It is therefore hoped that if this budget is indeed committed to implementation of gender-responsive options and sub-options, the catchment management plan will go a long way in addressing the key gender issues identified.

(c). Conflict management

The governance arrangements should be facilitated to convene dialogue meetings to resolve potential conflicts between upstream and downstream users. Other mechanisms like Payment for Ecosystem Services (PES) should be encouraged to resolve such potential upstream-downstream conflicts, and promote good water resources stewardship among upstream communities. Additionally, the capacity of these institutional arrangements,

including the local government extension staff and Victoria WMZ need to be built through equipping them and providing tailor-made training opportunities.

(d). Capacity building

Stakeholders involved in implementation of the plan will have their capacity built to do their work. The training aspects of capacity building have been fully addressed under section below. A devoted team of extension service workers will be to provide services for sustainable agricultural, land and catchment management. They will be supported with materials they need to effectively provide extension services e.g. training and demonstration materials, vehicles, motorcycles, GPS handsets, bicycles, computers, etc. Procurement and installation of water monitoring equipment at existing and new strategic monitoring stations in the catchment will be done, and technical staff trained and supported to conduct the monitoring and routine operation and maintenance of the equipment. Tailor-made training and awareness programs, manuals and materials for schools and model farms will be provided to support extension work. The local councils will be supported to review existing ordinances and bye-laws so as to provide the necessary enabling environment for better catchment management, and enforcement units will be strengthened with capacity to enforce these revised bye-laws and ordinances.

5.3 Multi-Criteria Evaluation and Prioritization of the Proposed Options

The proposed options were subjected to a multi-criteria evaluation exercise in order to consider various assumptions & constraints, and subsequently guide decision on best options amidst the existing constraints and assumptions. Particularly for the major options, this was done in consultation with stakeholders during the stakeholder consultation meetings, and scores assigned using an off-line screening tool.

The key evaluation criteria included: Overall impact of option, importance of issue(s) addressed, social benefit, economic benefit, environmental cost (-ve), environmental benefit (+ve), opportunity costs (if any), ease of implementation (physical feasibility), cost, likelihood of funding, capacity to implement, consequences of failure to implement, and sustainability.

The scoring system worked in such a way that for the positive aspects of given criteria, scores ranged between 1 and 5, with 1 representing low, 3 representing medium and 5 representing a high score. For the negative aspects e.g. opportunity cost, negative scores were instead assigned to the criteria. Score 0 was assigned where there was no implication, whether positive or negative.

Based on the assigned scores per criterion, total scores were computed for each option and sub-option. A relative score was then calculated for each option and sub-option by subtracting the average scores from the total scores.

For a few selected criteria, an example of the scoring system is illustrated in the table below.

Table 5-8: Illustration of the structure of the off-line options multi-criteria evaluation system

Overall impact of option	Economic benefit	Environ-mental cost (-ve)	Opportunity costs (if any)	Ease of impleme-ntation (physical feasibility)			
Addresses one issue (1) More than one issue (3) Resolves several issues (5)	Low (1) Medium (3) High (5)	Strong negative (-5) Negative (-3) No impact (0)	Very high (-3) High (-2) (Limited (-1) None (0)	Very difficult (-3) Difficult (-2) Feasible/possible (2) Very feasible (3)	Screened Totals for Options	Screened Totals for Sub-options	Relative scores-Options & Sub-options

This offline options screening tool was developed by Uganda's Directorate of Water Resources Management (DWRM) of the Ministry of Water and Environment under the Water Resources Management and Development Project with funding support from the World Bank. The tool requires input from communities in terms of their perspectives on what they think should be done to address the identified water resources management and development issues in order to meet their livelihood needs.

Seven (7) community-level multi-stakeholder consultation workshops were held with communities at convenient venues (sub-county council halls, schools, churches, etc.) in the sub-counties of Bubaare, Kyanamira, Kitumba, Kamuganguzi, Buhara, Kaharo and Rubaya. The general composition of the participants included LC I, LCII and LCIII/Division Chairpersons, area councilors (LC II, III and V), water and other natural resource users, crop farmers, fish and livestock farmers, brick layers, opinion and religious leaders, elders, traders, community mobilisers, Village Health teams (VHTs), Sub-county Chiefs/Division Town Clerks, Teachers, Students, social workers, Parish Chiefs, Pump mechanics, Health, Community Development, Agriculture extension, NAADS and law enforcement officers at sub-county/Division level. For each workshop, the number of participants ranged between 25-60 persons (except for Kyanamira which had 79 participants), including men, women, youth, the elderly and persons with disability.

After the community consultations, a local team of experts entered the community perspectives into the Excel-based off-line scoring system and computed the scores (an example of the structure is illustrated in the table above).

The system assumes that all community perspectives have been adequately captured, and that the local technical team of experts will not be biased in the scoring. To increase reliability, it requires that a stakeholders' meeting be held to discuss, validate and agree on the scores and priority options. The tool is very relevant to this study as it presents a cheap system to evaluate options and sub-options meant to address identified water resources management and development issues, including identified socio-economic aspects. It presents a system that incorporates stakeholder perspectives as compared to a purely computerized model, which is often quite costly.

For Maziba catchment, the results of the options multi-criteria evaluation were summarized as tabulated below

Table 5-9: Summary results of the multi-criteria evaluation of options

No	Option	Screened Totals for Options	Relative scores for Options
Objective 1: To promote sustainable land management and agricultural production and productivity in the catchments			
1.1	Promoting adoption of improved farming technologies	38	7.1
1.2	Controlling soil erosion and land degradation	35	4.1
Objective 2: To improve the quality and quantity of natural resources in the catchment			
2.2	Improving water quality and quantity	33	2.1
2.3	Reducing wetland and riverbank degradation and rehabilitating critical wetland sections	24	-6.9
Objective 3: To build social, economic and ecological resilience of the livelihoods of the population in the catchment			
3.1	Reducing population pressure	23	-7.9
3.2	Supporting livelihood improvement to catalyze better catchment management	30	-0.9
3.3	Improving environmental sanitation and hygiene	31	0.1
3.4	Addressing climate risks - droughts and floods	34	3.1
Objective 4: To build better natural resource governance and conflict management in the catchment			
4.1	Strengthening NR governance and mainstreaming gender issues	35	4.1
4.2	Addressing potential upstream-downstream conflicts	23	-7.9
4.3	Building capacity for better catchment management	30	-0.9

Source: *Off-line options screening tool for Maziba*

In descending order, the following options scored positive relative scores, and should be considered of high priority: Promoting adoption of improved farming technologies (7.1), Controlling soil erosion and land degradation (4.1), Strengthening NR governance and mainstreaming gender issues (4.1), Addressing climate risks – droughts and floods (3.1), Improving water quality and quantity (2.1), and improving environmental sanitation and hygiene (0.1).

However, it is important to understand that even within the options, certain actions will be more important to undertake first before others within the option; and that even those with low relative scores remain important options that will still need to be implemented, beginning by addressing the existing constraints that caused the low scores (e.g. addressing staff capacity needs, or environmental mitigation concerns).

5.4 Preliminary Environmental and Social Assessment of Options and Sub-Options

The multi-criteria evaluation tool described in section above provides for initial screening of social and environmental impacts of the proposed options and sub-options; and subsequent assignment of scores to these parameters. Results of the preliminary screening indicate that all the options and sub-options have positive social and environmental benefits, except for large water and infrastructure development sub-options (e.g. piped water schemes, valley tanks and dams) that may need further detailed environmental assessment as part of their implementation phase.

Another sub-option that scored negatively (thus potential adverse environmental impact) was supporting the sustainable utilization of already converted wetlands e.g. for aquaculture, regulated sugarcane growing, etc. As mitigation measures, the following were recommended based on this preliminary screening:

Table 5-10: Strategic environmental management plan

Sub-option	Potential adverse environmental/ social impact	Proposed mitigation measures	Responsible Officer
Large water and infrastructure development sub-options (e.g. piped water schemes, valley tanks and dams)	• Abstraction of large volumes of water, reducing stream flow and denying downstream users access to sufficient water • Dam safety concerns e.g. accidental spill-overs and damage to crops, property and lives • Upstream-downstream conflicts over water • Displacement of farms and settlements	• Strict adherence to water abstraction regulations • Adherence to dam safety guidelines • Ensuring fair benefit sharing schemes e.g. extending water supplies to downstream users • Compensation of land and other property owners • Detailed EIA, depending on design and size of project	District Water Officer
Sustainable utilization of already converted wetlands e.g. for aquaculture, regulated sugarcane growing	• Total conversion of wetlands into aquaculture or sugarcane farms • Further alteration of local hydrological conditions	• Strict adherence to the existing wetland edge cultivation guidelines • Farmers to be provided technical guidance from relevant district technical staff e.g. agriculture and Fisheries officers	District Production Coordinator

The guidelines for Strategic Social and Environmental Assessment (SSEA) for Local Government development planning processes in Uganda propose that technical officers should use their best judgment to confidently determine that there is no other potential environmental impact that needs further analysis. Accordingly, a session on further consultation is proposed during the planned stakeholder consultation workshop. In cases like the potentially large water infrastructure schemes where there is uncertainty about potential adverse impacts, further investigation and full EIA is required, and should be budgeted for as part of the schemes.

There are concerns over potential adverse impacts of large water infrastructure schemes. They could result into over-abstraction, causing upstream-downstream conflicts. There are also concerns over reservoir safety, because in case of accidental spill-overs, they could cause destruction of property and lives. These will be addressed by ensuring adherence to water abstraction regulations and dam safety guidelines. Extension of water supplies to reach some downstream communities is proposed so as to address potential upstream-downstream conflicts over water. However, owing to lack of full certainty about potential adverse impacts (as the site conditions are not known at this stage), further investigation and full EIA is required at implementation stage.

The proposed sustainable utilization of already converted wetlands to meet livelihood needs e.g. through aquaculture and sugarcane growing could result into total wetland conversion, which could adversely impact the local hydrological conditions. These concerns will be addressed through provision of technical guidance to farmers by District Environment, Agriculture and Fisheries Officers, and ensuring strict adherence to the existing wetland edge cultivation guidelines.

After review of these proposals /sub-options for compliance with the SEA process, the relevant technical departments will recommend them to the LG Council for approval as part of their implementation process, on condition that the environmental and social conditions are adhered to by the head of department during project implementation.

6. IMPLEMENTATION, INVESTMENT AND FINANCING PLAN

6.1 Key Interventions per Micro-Catchment

For various reasons discussed earlier in chapter 3, five hotspot micro-catchments were selected for intervention through implementatuion of this plan; namely: Hamurwa, Bubaare, Kyanamira-Buhara, Maziba West and Rubaya-Kamugangizi. In this section, an attempt is made to map the key interventions proposed for each of the 5 hotspot micro-catchments. Note that some interventions are not indicated on the individual micro-catchment maps as they are not tangible and specific to any spot but apply across the entire Maziba catchment, e.g. radio public awareness programs.

The proposed interventions are largely similar across the micro-catchments, with some minor variations associated with some unique issues in some areas. Nevertheless, it is anticipated that these interventions bear various potential economic benefits that could spur socio-economic development and associated improvements in standards of living of the beneficiaries. The proposed interventions are mapped and deliberated, and their anticipated economic benefits considered per micro-catchment in the section below.

6.1.1 Hamurwa Micro-catchment

This micro-catchment is 159 km^2 in area, and largely covers Hamurwa, Igomanda, Kakore, Mpungu, Ruhonwa and Shebeya parishes in Hamurwa sub-county; and Bwindi and Nangara parishes in Bubare sub-county. It also covers an estimated 25% of Mushanje, Nyakabungo, Nyaruhanga and Nyamabare parishes in Ikumba sub-county.

Four key IWRM issues are rife in the micro-catchment that need address, namely: loss of natural vegetation cover, soil erosion, stream sedimentation and flood risk. The steep slopes that surround the micro-catchment form the water tower in the North, North-East and North-West, but are associated with high rates of erosivity and erodibility once opened up for cultivation. Soil erosion is aggravated by the rapid removal of natural vegetation cover. The eroded soils are deposited along streams to cause high TSS loads. Flood risk becomes rife where large volumes of sediment displace water along stream beds.

Therefore, in the cultivated mid-slopes in Shebeya, Igomanda, Hamurwa, Nangara, Bwindi, Nyamabare, Mushanje, Hamurwa, Nyakabungo, Nyaruhanga, Nyamabare and Mushanje where elevation is ≥ 45%, and rate of soil loss is high (50-90 t/ha/yr) to extremely high (> 90 t/ha/yr); farmers will need to be encouraged to adopt and plant agro-forestry and other preferred tree species e.g. fruit trees on their farms. It is estimated that 7,042.20 ha of land will be brought under agroforestry and soil and water conservation measures in this micro-catchment.

Introduction of tailor-made Payment for Ecosystem Services (PES) schemes that contribute to household income and livelihood improvement initiatives will catalyse efforts to re-vegetate the micro-catchment. Combined with other tailor-made and already popular soil and water conservation technologies based on lessons from on-going and past projects, these could reduce the rates of soil erosion, stream sedimentation and flood risk. Enabling local policy, legal and agricultural extension frameworks will shoot the proposals to potential success.

In the lowlands along major wetlands and stream banks in Shebeya, Nyaruhanga, Hamurwa, Kakore and Igomanda where elevation is less than 15% and soil type is luvisols and histosols with high water retention capacity, technologies like embankments need to be introduced to protect key infrastructure and farms against floods. A more sustainable approach would be to apply nature-based solutions – demarcating and protecting stream banks

from encroachment and allowing them to naturally regenerate. It is estimated that 1.6 km^2 of critical wetlands that fringe stream and riverbanks will be restored in the micro-catchment. Flood water should also be harvested for dry season irrigation and aquaculture.

However, parts of Nangara, Bwindi, Nyakabu-ngo and Nyaruhanga are characterized by dense populations ≥ 355 persons/km^2 often associated with poor access to safe water, hygiene and sanitation services. These areas will additionally need population control measures, encompassed with water, sanitation and hygiene programs. (*Figure 6-1)*

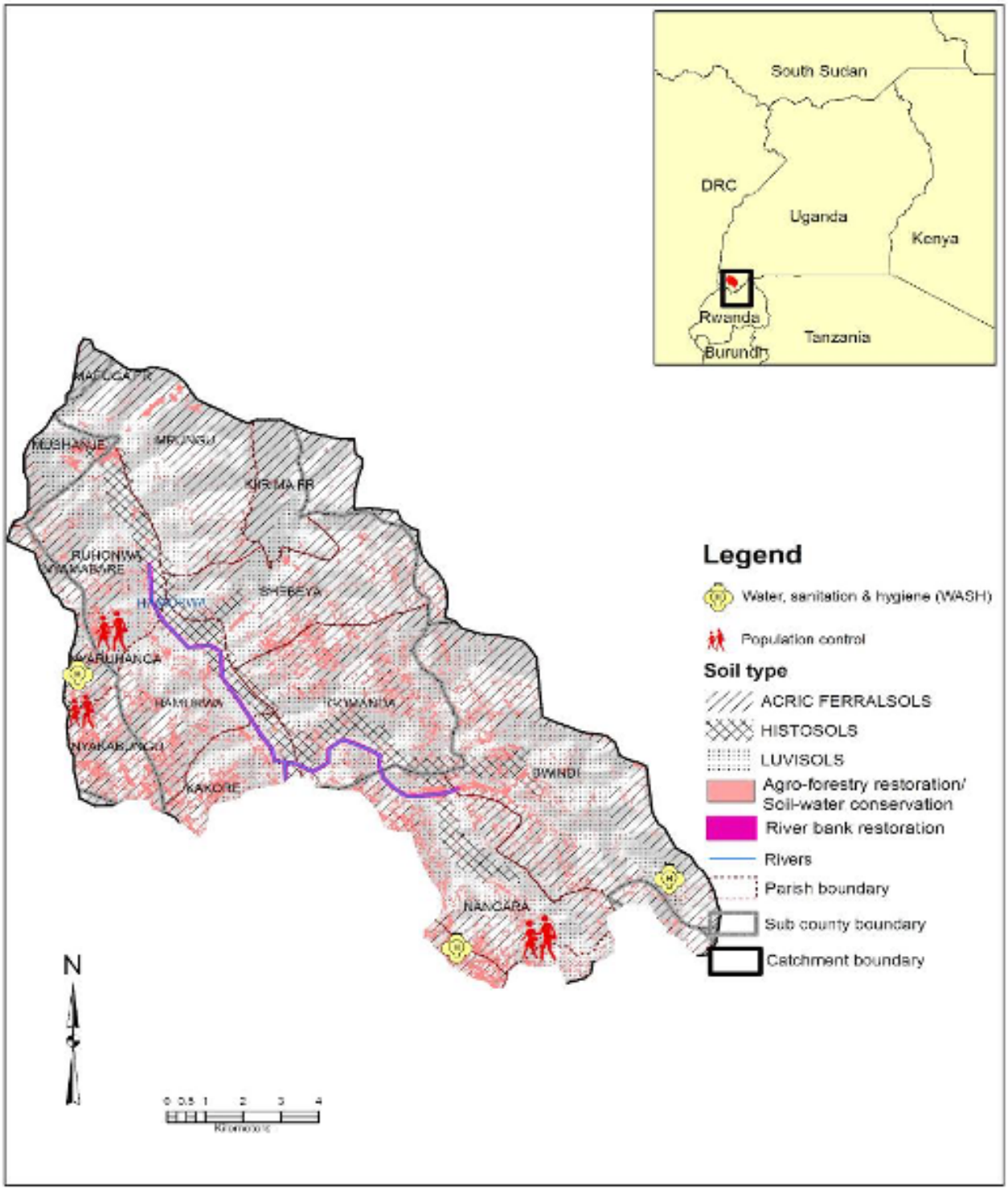


Figure 6-1: Mapping of proposed interventions in Hamurwa micro-catchment

6.1.2 Bubaare Micro-catchment

This micro-catchment covers parts of Butobere, Central and Nyabikoni wards in Kabale central Division, Kijuguta, Rutooma and Upper Bugongi in Kabale Northern Division, Karubanda, Kirigime and Mwanjari in Kabale Southern Division. Additionally, it covers Buranga, Kasheregenyi, Kicumbi, Kisaasa and Mayengo Parishes in Kamugamguzi sub-county; and Bushuro, Kitumba and Mwendo parishes in Kitumba sub-county. In Bubaare sub-county, it covers Bubaare sub-county, Butoboore, Kagarama, Kasheenyi, Muyanje and Nyamiyaga parishes. It also covers parts of Kakore parish in Hamurwa sub-county; Buhara, Rwene and Muyebe in Buhara sub-county and a small patch of Kyenyi parish in Muko sub-county. In all, the Micro-catchment covers 215 km^2.

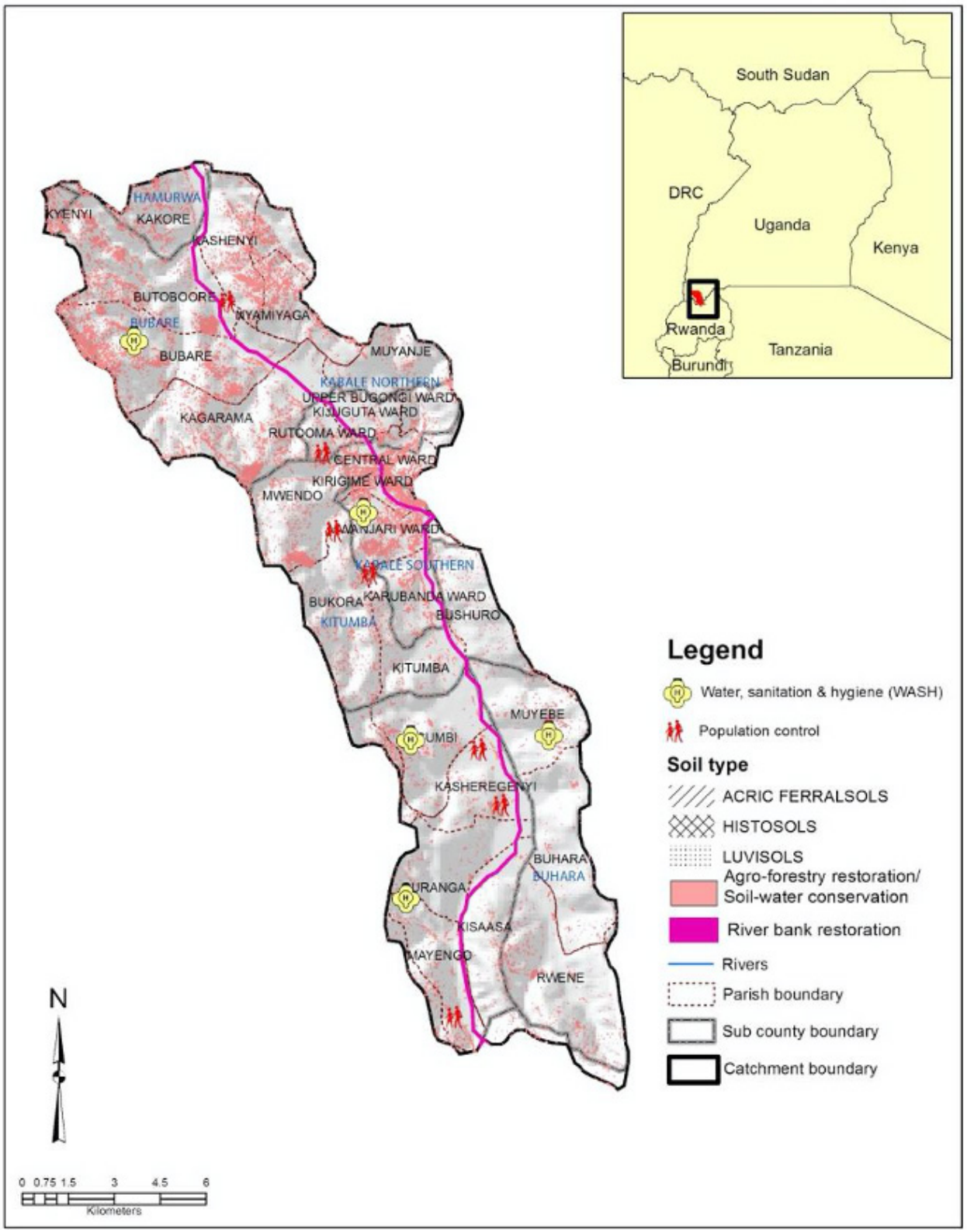


Figure 6-2: Mapping of the proposed interventions in Bubaare micro-catchment

The major issue of concern here is the high population density, particularly within and around Kabale Municipality. This largely poor population exerts immense pressure on the land, water and other resources; and is characterized by insufficient access to safe water, sanitation and hygiene services. The land is quickly cleared of its vegetation to open land for both cultivation and settlement. The steep slopes then easily and quickly get eroded of their soils, and the eroded soils deposited in the valleys, to cause high TSS load along streams. Stream sedimentation often increases flood risk along valleys often damaging farms, settlements and other infrastructure.

Accordingly, a combination of population control, livelihood improvement and natural resources management measures is proposed. Along the steep and eroded hill slopes in Bubaare, Kyenyi, Kakore, Nyamiyaga, Muyanje and Kasheregyenyi; erosion control and improved farming (SLM) technologies are recommended. Muyanje and Kyenyi are particularly recommended for Agro-forestry and PES schemes, considering their upstream locations; and the need to provide buffers to the few existing stands of woody biomass. In all, it is proposed that a total 10,387.50 ha of the land in this micro-catchment will be brought under agro-forestry, soil and water conservation interventions. In the heavily populated areas of Kabale Municipality and the surrounding parishes like Butoboore, Bubare, Mwendo and Mayengo where population density is ≥ 355 persons/km^2, population control, water, sanitation and hygiene programmes are also proposed.

Lowlands, wetland and river banks with histosols and luvisols in Kakore, Kashenyi, Bubaare, Butoboore, Kabale Municipality, Kitumba, Muyebe, Kasheregyenyi, Buranga, Buhara, Kisaasa and mayengo are recommended for demarcation, restoration and wise-use e.g. for aquaculture and regulated wetland edge gardening. It is proposed that a minimum of 2.1 km^2 of wetlands that fringe stream and riverbanks will be restored in this micro-catchment. Income and livelihood improvement interventions are recommended across the micro-catchment to address poverty.

6.1.3 Kyanamira-Buhara Micro-catchment

This micro-catchment covers 123 km^2 in parts of Butobere, Central and Kigongi wards in Kabale central division, Rushaki in Kabale southern division, Bugarama, Kafunjo, Kitanga and Ntarabana parishes in Buhara sub-county; Kanjobe, Katookye, Kigata, Kyanamira, Muyumbu, Nyabushabi and Nyakagyera parishes in Kyanamira sub-county. It also covers parts of Karweru parish in Maziba sub-county and a bit of Muyanje parish in Bubare sub-county.

Considering that the micro-catchment also covers part of the Municipality, high population density has also exerted pressure on the land, water and other catchment resources; and is often characterized by insufficient access to safe water, sanitation and hygiene services, thus water pollution threats. The cultivated and settled hill slopes have been uncovered of their vegetation, and the soils exposed to high rates of erosion. Kabale plantation Central Forest Reserve (CFR) has been encroached upon for farming and settlement by the population. The eroded soils are deposited along streams to explain the high TSS loads along streams in Buhara and Kyanamira. The deposited sediments reduce reservoir capacity and increase flood risk within the low-lying areas.

Accordingly, proposed measures are basically similar to those in Bubaare micro-catchment, because the situation is predominantly similar. Population control, water, sanitation and hygiene programmes are proposed for parishes and wards like Muyanje, Nyabushabi, Kanjobe and sections of the micro-catchment that lie within Kabale Municipality where population density is ≥ 355 persons/km^2. Agro-forestry and PES schemes are proposed for Nyabushabi, Muyumbu, Nyakagyera, Kyanamira and Katookye parishes, owing to their upstream location; and parts of the municipality in order to restore parts of the Kabale plantation CFR.

Agro-forestry and other erosion control measures are also recommended for steep slopes in these parishes, in addition to those in Rushaki, Bugarama and Kanjobe; particularly where elevation is ≥ 45%, and rate of soil loss is high (50-90 t/ha/yr) to extremely high (> 90 t/ha/yr). It is proposed that an estimate of 4,384.10 ha of land will be brought under agro-forestry and soil and water conservation measures in this micro-catchment.

Wetland and riverbank protection measures are proposed for low-lying areas (elevation less than 15%) in Nyabushabi, parts of Butobere, Central, Kigondi and Rishaki wards; Kyanamira, Katookye, Kigata, Kanjobe, Bugarama, Kafunjo, Kitanga Karweru and Ntarabana parishes; characterized by histosols and luvisols associated with high water retention and flood risks. It is proposed that 1.3km^2 of wetlands that fringe the streams and rivers will be restored and protected in this micro-catchment. The protected wetland and river banks are recommended

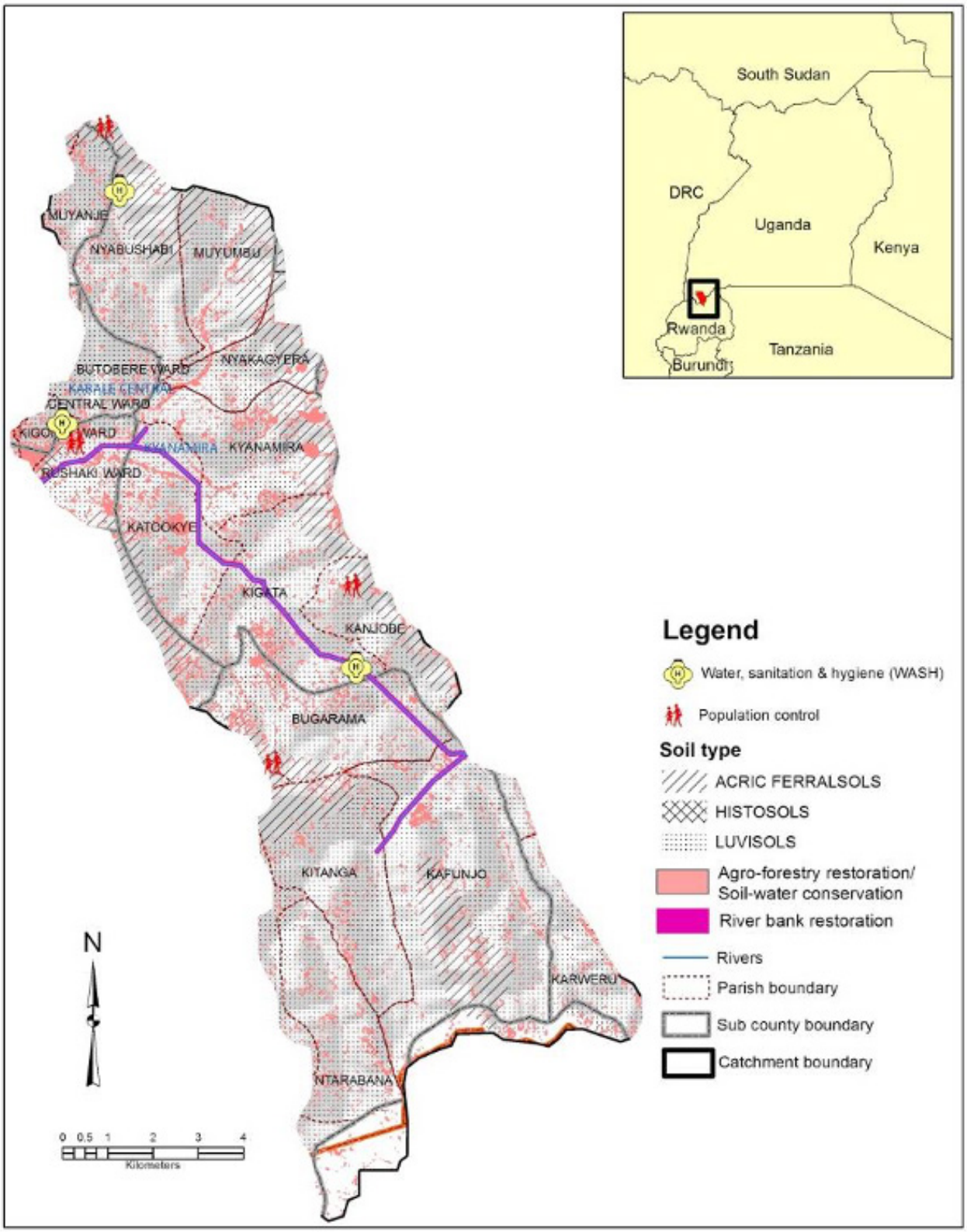


Figure 6-3: Mapping of proposed interventions in Kyanamira-Buhara

for feasible wise-use options that do not adversely affect local hydrological conditions e.g. aquaculture and regulated wetland-edge gardening. Other income and livelihood improvement interventions are recommended for the entire micro-catchment to address poverty, particularly among the urban and peri-urban poor.

6.1.4 Maziba West Micro-catchment

This micro-catchment fully covers Kahondo, Nyanja and Rugarama parishes, and parts of Birambo, Karweru and Kavu parishes in Maziba sub-county; to make a total of 144km^2. It rapidly lost its medium vegetation density,

and is characterized by patches of almost bare ground in some areas. The streams are heavily silted, exposing the downstream areas to flood risk. River sedimentation poses a major threat to functionality and feasibility of Maziba hydropower plant. The priority are interventions that will therefore support protection of the immediate micro-catchments of the Maziba hydropower plant, which is located on River Kiruruma, Eastings 35M 0176094 and Northings UTM 9854762, Birambo Parish, Maziba sub-county, downstream from Kyanamira town council.

Accordingly, parts of the upstream parishes of Rugarama, Birambo, Kahondo and Nyanja are recommended for Agro-forestry and PES schemes, soil erosion control and other SLM interventions. Agro-forestry, soil and water

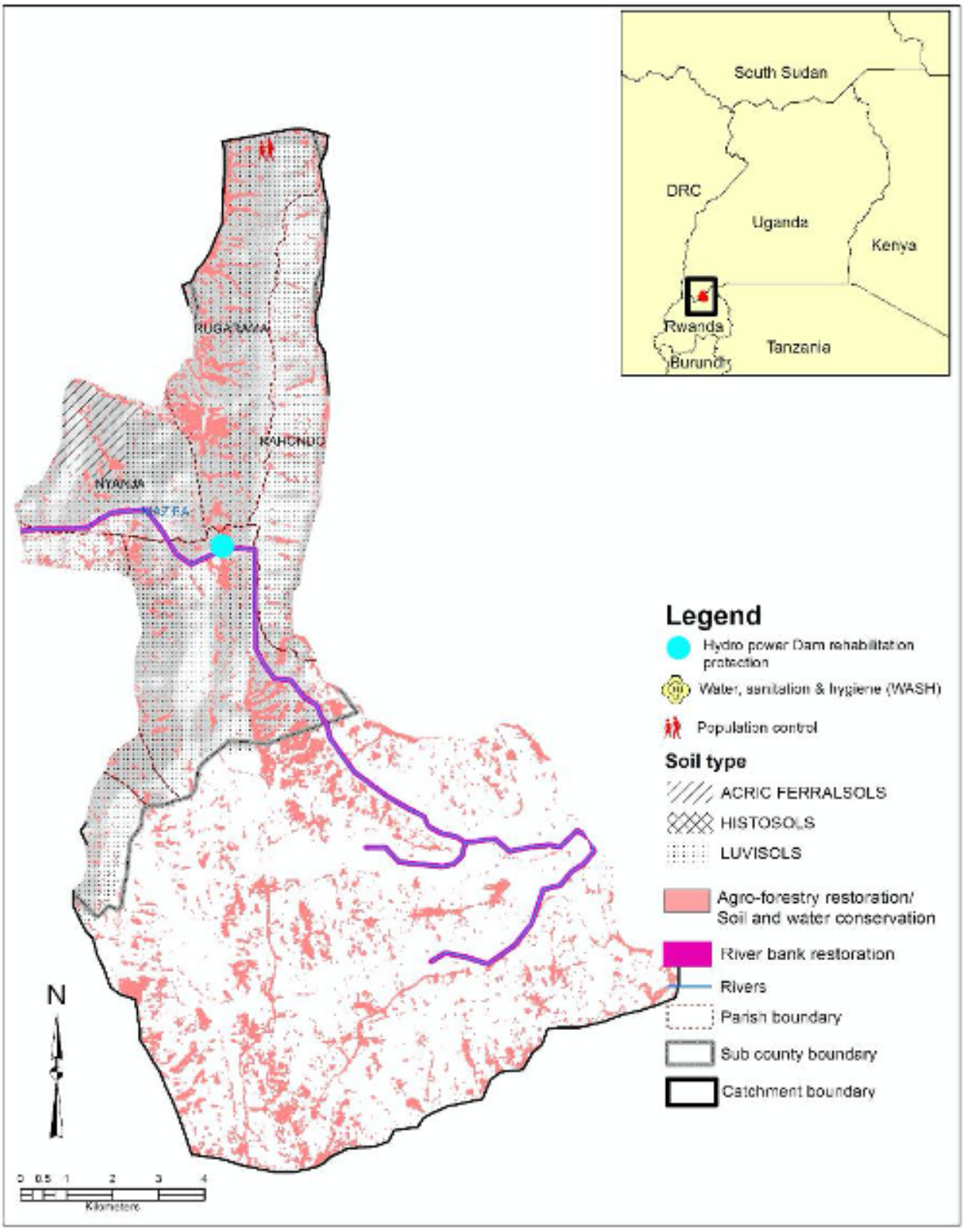


Figure 6-4: Mapping of proposed interventions in Maziba west

conservation interventions will cover an estimated 2,245.7 ha in the catchment. The densely populated upstream part of Rugarama (population density ≥ 355 persons/km^2) is also recommended for population control measures.

Wetland and riverbank demarcation and restoration is recommended for parts of Nyanja, Kahondo, Kavu and Birambo that are traversed by the Kiruruma River and its tributaries. A total of 0.5 km^2 of critical wetlands that fringe the rivers and streams will be restored. This nature-based intervention largely targets to trap silt and protect the hydro-power plant from further sedimentation. It will enhance the buffering and sediment retention capacity of wetlands that fringe the stream banks; and will reduce flood risk. Other engineering solutions like floodwater harvesting are also recommended.

The protected buffer zones can be utilized for aquaculture, traditional grazing, harvesting of mulch and regulated wetland edge gardening to improve income of the land owners; alongside other livelihood improvement interventions that are recommended for the entire micro-catchment so as to address the poverty-environment issue. It is estimated that the interventions will support approximately 14,700 beneficiaries in the micro-catchment; 6,900 being males and 7,800 being females.

6.1.5 Rubaya-Kamuganguzi

This micro-catchment covers Kyasano parish in Kamuganguzi sub-county; Karujanga, Kibuga and Rwanyena parishes in Rubaya sub-county. It is a small micro-catchment which covers 100 km^2, with only a small patch of its northern section located in Uganda, while the rest lies in Rwanda.

The micro-catchment rapidly lost its medium vegetation density, and some patches of the landscape are almost bare. This exposed the land to high and/or extremely high rates of soil loss. It is therefore proposed that the heavily degraded patches of the micro-catchment in Kibuga, Karujanga and Rwanyena be re-vegetated through agro-forestry; and that the soil and water conservation measures that have been proved as preferred by communities be replicated in steep hill slopes of Karujanga and Kyasano where elevation is ≥ 45%, and rate of soil loss is high (50-90 t/ha/yr) to extremely high (> 90 t/ha/yr). it is proposed that an estimated 2,340.20 ha of land will be brought under agro-forestry and soil and water conservation interventions in the micro-catchment.

Figure 6-5: Mapping of proposed interventions in Rubaya-Kamuganguzi (next page)

Population control measures are also recommended for parts of Kibuga and Karujanga that have population density ≥ 355 persons/km^2; combined with water, sanitation and hygiene interventions to serve this dense population. In order to reduce river sedimentation owing to soil erosion along the hillsides, wetlands and riverbanks in Kyasano, Kibuga, Rwanyena and Karujanga should be demarcated and protected, and only used for activities that do not affect the local hydrology, e.g. traditional grazing, harvesting of mulch, aquaculture, etc. It is proposed that an estimated minimum of 0.4 km^2 of wetlands that fringe the stream and riverbanks will be restored and protected. Other income and livelihood improvement programmes are also recommended across the catchment to reduce poverty and associated pressure on the micro-catchment's land and water resources.

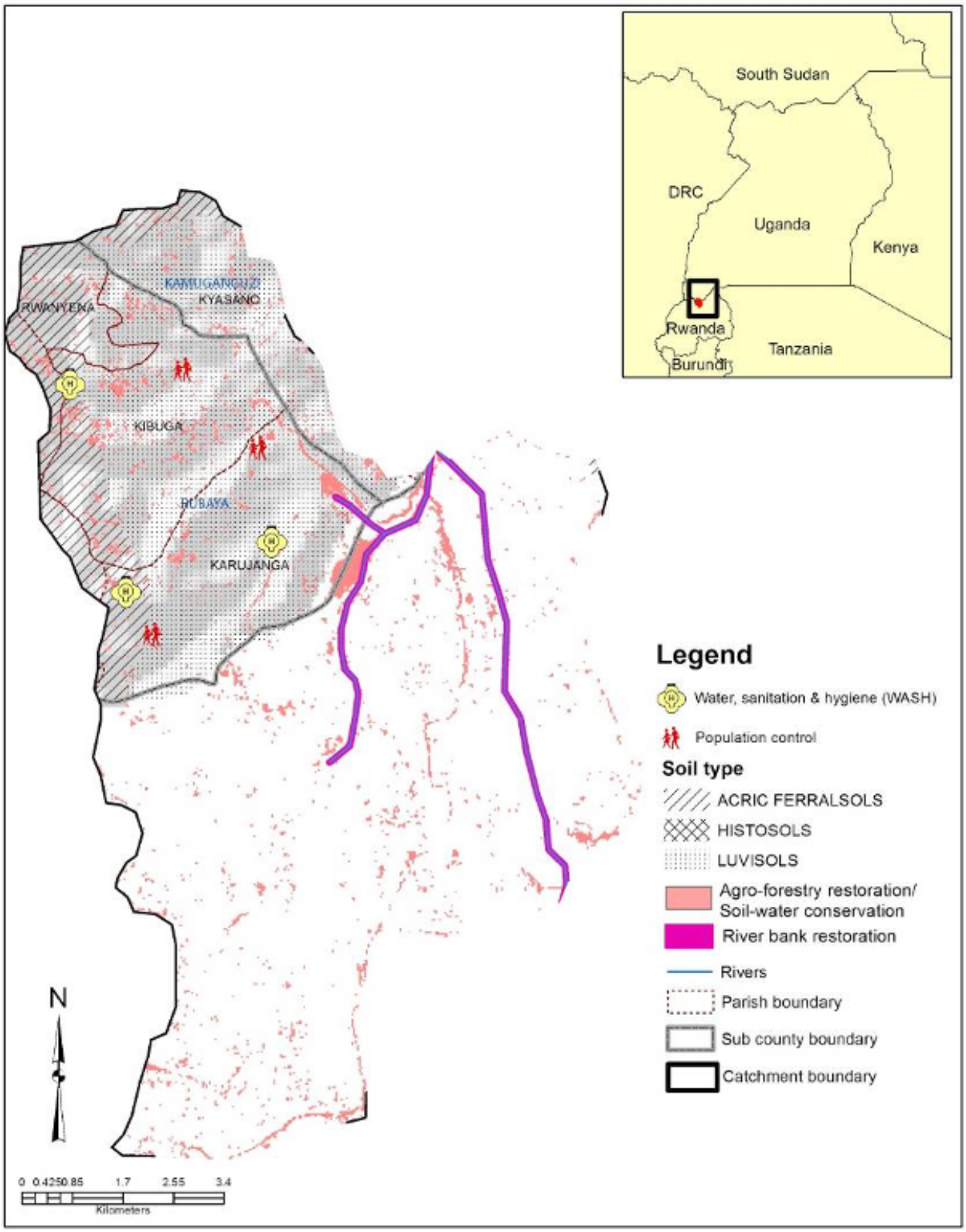


Figure 6-5: Mapping of proposed interventions in Rubaya-Kamuganguzi (next page)

6.2 Specific Climate Change related interventions.

Table 6-1: Climate Change Related Interventions

DISTRICT/ SUB-COUNTY	SITES	ISSUE	OPTIONS
NTUNGAMO DISTRICT			
Ruhaama Sub-county	Kabiga village, Ruhaama cell, Mutojo cell, Rwengoma parish	▪ Run-off causing soil erosion & gullies on bare hills. ▪ Bad tin mining practices ▪ Toxic soils affecting crop production ▪ Flooding affecting food production & people.	• Promote the construction of climate resilient drainage systems. • Promote intensified & sustained afforestation & re-afforestation in degraded areas • Burrow pits need back filling • Remediation to rectify by stopping damage by treating heavy metal loaded waste • Reclamation by stabilization the degraded terrain by foresting landscapes (active restoration) • Rehabilitation to original state (passive restoration) by autochthonous colonization of tin mining areas.
	Kijojo village, Ruhaama sub-county Mwerasandu village, Rwamire parish	▪ Flooding ▪ Bare Ntungamo-Mirama hills ▪ High soil erosion, deep gullies and silting ▪ Submerged surrounding homes ▪ Flooding affecting crops	• Promote the construction of resilient drainage systems • Promote intensified & sustained afforestation & re-afforestation in degraded areas • Ensuring that climate resilient land use plans & building codes for private & public buildings • Plant flood resistant crop varieties
Rukoni Sub-county	Kabutondo & Bihiri villages, Kihanga parish	▪ Gullies & soil erosion ▪ Kabutondo primary school always affected by flash floods ▪ Latrines were washed away by floods ▪ Kabutondo river bursts its banks and flood crop gardens ▪ Homes are flooded ▪ Kabutondo hills are degraded to bare areas	• Promote intensified & sustained afforestation & re-afforestation in degraded areas • Promote the construction of resilient drainage systems • Build flood resistant sanitation facilities • Plant flood resistant crop varieties • Ensuring that climate resilient land use plans & building codes for private & public buildings • Disaster risk reduction fund for response and recovery in the affected areas with climate induced disasters.
	Rwengwe village, Kyamwasha parish	▪ Gullies and soil erosion ▪ Flooded roads ▪ Submerged villages ▪ Flooded gardens	• Promote intensified & sustained afforestation & re-afforestation in degraded areas • Apply updated climate resilient road and transport codes in construction • Ensuring that climate resilient land use plans & building codes for private & public buildings • Plant flood resistant crop varieties.
Rweikiniro Sub-county	Mushasha village, Murambi Parish	▪ Bare hillsides ▪ Soil erosion	• Promote intensified & sustained afforestation & re-afforestation in degraded areas • Promote the construction of resilient drainage systems

SUB-CTYs	SITES	ISSUE	OPTIONS
Rweikiniro Sub-county	Kabirizi village, Murambi parish	▪ Bare hills ▪ Flooding	• Promote intensified & sustained afforestation & re-afforestation in degraded areas • Promote the construction of resilient drainage systems
	Katokye cell/ village, Rushebeya parish	▪ Flooding ▪ Wetland encroachment from crop production ▪ Grazing in wetlands ▪ Planting eucalyptus in wetlands	• Promote intensified & sustained afforestation & re-afforestation in degraded areas • Promote the construction of resilient drainage systems • Enforcement of wetland legislation • Develop framework management plans and governance of wetland systems • Demarcate & gazette wetlands systems • Strengthen wetland management & conservation • Design and implement wetland management action plans with carbon sink potential • Plant climate smart pastures for livestock
Ntungamo sub-county	Nyabitaba village, Butaare parish Kataherwa river/ stream-Nyabitaba bridge	▪ Flooded bridges ▪ Kataherwa stream floods ▪ Flash floods in the surrounding areas	• Promote intensified & sustained afforestation & re-afforestation in degraded areas • Promote the construction of resilient drainage systems • Ensuring that climate resilient land use plans & building codes for private & public buildings • Disaster risk reduction fund for response and recovery in the affected areas with climate induced disasters.
	Mugwanjura village, Butaare parish	▪ Kiziko stream floods ▪ Bridge is cracked ▪ Bridge is submerged during flood regime ▪ Mujwa Primary School gets flooded ▪ Roads are flooded	• Promote intensified & sustained afforestation & re-afforestation in degraded areas • Promote the construction of resilient drainage systems • Ensuring that climate resilient land use plans & building codes for private & public buildings • Disaster risk reduction fund for response and recovery in the affected areas with climate • Establish climate and early warning systems • Buildings should have lightning arrestors installed
Ntungamo Municipaliy	Ntungamo ward	▪ Frequent flooding of the wetland ▪ Urbanization in wetland areas ▪ Solid waste disposal in wetlands as well as oils & fuels	• Promote intensified & sustained afforestation & re-afforestation in degraded areas • Promote the construction of resilient drainage systems • Enforcement of wetland legislation • Develop framework management plans and governance of wetland systems • Demarcate & gazette wetlands systems • Strengthen wetland management & conservation • Design and implement wetland management action plans with carbon sink potential • Encourage climate risk management especially in urban areas • Develop vulnerability maps

SUB-CTYs	SITES	ISSUE	OPTIONS
Rubaare sub-county	Kibonwa village, Rukiri parish	▪ Omuyanja river floods during the rainy season ▪ Roads & bridges are flooded in the rainy season ▪ Crop gardens are flooded ▪ Homes are flooded ▪ Encroachment on river banks ▪ Brick laying along river banks	• Promote intensified & sustained afforestation & re-afforestation in degraded areas • Promote the construction of resilient drainage systems • Build flood resistant sanitation facilities • Plant flood resistant crop varieties • Ensuring that climate resilient land use plans & building codes for private & public buildings • Disaster risk reduction fund for response and recovery in the affected areas with climate induced disasters. • Apply updated climate resilient road and transport codes in construction.
Kayonza sub-county	Rushooka 1 & 2 villages, Ruhega parish	▪ Roads & bridges are flooded in the rainy season ▪ Crop gardens are flooded ▪ Homes are flooded ▪ Encroachment on river banks ▪ People are displaced during floods ▪ Flash floods	• Promote intensified & sustained afforestation & re-afforestation in degraded areas • Promote the construction of resilient drainage systems • Build flood resistant sanitation facilities • Plant flood resistant crop varieties • Ensuring that climate resilient land use plans & building codes for private & public buildings • Disaster risk reduction fund for response and recovery in the affected areas with climate induced disasters. • Apply updated climate resilient road and transport codes in construction.
	Nyakahanga village, Kijubwe parish	▪ Roads & bridges are flooded in the rainy season ▪ Crop gardens are flooded ▪ Homes are flooded ▪ Encroachment on river banks ▪ People are displaced during floods ▪ Flash floods are common	• Promote intensified & sustained afforestation & re-afforestation in degraded areas • Promote the construction of resilient drainage systems • Build flood resistant sanitation facilities • Plant flood resistant crop varieties • Ensuring that climate resilient land use plans & building codes for private & public buildings • Disaster risk reduction fund for response and recovery in the affected areas with climate induced disasters. • Apply updated climate resilient road and transport codes in construction.
	Nyakasharara village, Kijubwe parish	▪ Flash Floods in rainy season ▪ Bridges are washed away in the rainy season	• Construct an Irish bridge • Ensuring that climate resilient land use plans & building codes for private & public buildings • Disaster risk reduction fund for response and recovery in the affected areas with climate induced disasters. • Apply updated climate resilient road and transport codes in construction.
	Kijubwe parish	▪ Wetland degradation is rampant ▪ Water dries up in springs ▪ Conflict over access to wetland products	• Promote the construction of resilient drainage systems • Enforcement of wetland legislation • Develop framework management plans and governance of wetland systems • Demarcate & gazette wetlands systems • Strengthen wetland management & conservation • Design and implement wetland management action plans with carbon sink potential.

SUB-CTYs	SITES	ISSUE	OPTIONS
Kayonza sub-county	Mutaka village, Kijubwe parish	▪ Road and bridges are flooded	• Apply updated climate resilient road and transport codes in construction. • Promote the construction of resilient drainage systems • Disaster risk reduction fund for response and recovery in the affected areas with climate induced disasters.
	Kabasheshe parish	▪ Wetland encroachment and restoration efforts are taking place but need scaling up	• Promote the construction of resilient drainage systems • Enforcement of wetland legislation • Develop framework management plans and governance of wetland systems • Demarcate & gazette wetlands systems • Strengthen wetland management & conservation • Design and implement wetland management action plans with carbon sink potential
Kayonza sub-county	Rwenyerere village, Ruhege parish	▪ Bridge washed away by floods ▪ Crops are submerged in floods ▪ Homes are flooded in rainy season.	• Promote intensified & sustained afforestation & re-afforestation in degraded areas • Promote the construction of resilient drainage systems • Build flood resistant sanitation facilities • Plant flood resistant crop varieties • Ensuring that climate resilient land use plans & building codes for private & public buildings • Disaster risk reduction fund for response and recovery in the affected areas with climate induced disasters. • Apply updated climate resilient road and transport codes in construction.
RUKIGA DISTRICT			
Mparo Town Council	Mparo Town Council, Kasoni village	▪ Flash floods ▪ Bridge flooded	• Ensuring that climate resilient land use plans & building codes for private & public buildings • Disaster risk reduction fund for response and recovery in the affected areas with climate induced disasters. • Apply updated climate resilient road and transport codes in construction.
Rwanucucu Sub-county	Shooko village, Nyarurambi Parish (Omukishenyi)	▪ Stream/river floods ▪ Flash floods are common ▪ Homes are flooded ▪ Gardens are flooded	• Promote intensified & sustained afforestation & re-afforestation in degraded areas • Promote the construction of resilient drainage systems • Plant flood resistant crop varieties • Ensuring that climate resilient land use plans & building codes for private & public buildings • Disaster risk reduction fund for response and recovery in the affected areas with climate induced disasters. • Apply updated climate resilient road and transport codes in construction.
	Nyakafura village, Ibumba parish	▪ Flooding in town council ▪ Roads are flooded ▪ Degraded river banks	• Disaster risk reduction fund for response and recovery in the affected areas with climate induced disasters. • Apply updated climate resilient road and transport codes in construction. • Promote intensified & sustained afforestation & re-afforestation in degraded areas • Promote the construction of resilient drainage systems

SUB-CTYs	SITES	ISSUE	OPTIONS
Mparo town council	Sindi ward	▪ Sindi wetland is drained for agriculture production ▪ SABCO Fish farming investments use unsustainable practices ▪ Rukiri hills are bear with high run-off ▪ Crops are affected by flooding ▪ People have suffered heavy losses of crops and income	• Promote the construction of resilient drainage systems • Enforcement of wetland legislation • Develop framework management plans and governance of wetland systems • Demarcate & gazette wetlands systems • Strengthen wetland management & conservation • Design and implement wetland management action plans with carbon sink potential • Promote climate smart aquaculture practice • Promote intensified & sustained afforestation & re-afforestation in degraded areas • Disaster risk reduction fund for response and recovery in the affected areas with climate induced disasters. • Plant flood resistant crop varieties
Kamwezi sub-county	Nyamabare village, Rwenyagi Parish Kasoni/ Nyakaambu village, Rwenyagi Parish	▪ Gullies ▪ Flash floods ▪ Crop flooded ▪ Homes submerged in floods ▪ Eucalyptus planted in wetlands and along streams	• Promote the construction of resilient drainage systems • Enforcement of wetland legislation • Develop framework management plans and governance of wetland systems • Demarcate & gazette wetlands systems • Strengthen wetland management & conservation • Design and implement wetland management action plans with carbon sink potential • Promote intensified & sustained afforestation & re-afforestation in degraded areas • Disaster risk reduction fund for response and recovery in the affected areas with climate induced disasters. • Plant flood resistant crop varieties
	Rwamatunguru village, Kashaka Parish	▪ Bridges are affected by flooded ▪ Domestic water supply affected by flooding ▪ Water is not clean for domestic purposes. ▪ Rwenkore primary school gets flooded in the rainy season ▪ Bridges are washed away by floods	
	Kankiro village, Kyabuhangwa parish	▪ Deep gullies and sections of the road are cut off	
	Kyogo village, Kyabuhangwa parish	▪ Deep gullies	
Bukinda Sub-county	Nyamabare cell/ village, Nyakasiku parish	▪ Landslides and bare hills	• Promote intensified & sustained afforestation & re-afforestation in degraded areas • Terraces/grass bands

KABALE DISTRICT			
Kamuganguzi sub-county	Kicucu parish	▪ Wetland encroachment ▪ Dairy farming in wetlands ▪ Crop production wetlands ▪ Fish farming ▪ Eucalyptus plantations in wetlands	• Promote the construction of resilient drainage systems • Enforcement of wetland legislation • Develop framework management plans and governance of wetland systems • Demarcate & gazette wetlands systems • Strengthen wetland management & conservation • Design and implement wetland management action plans with carbon sink potential • Promote climate smart aquaculture practice • Promote intensified & sustained afforestation & re-afforestation in degraded areas e.g. Napier grass, Grevillia & calliandra • Disaster risk reduction fund for response and recovery in the affected areas with climate induced disasters. • Plant flood resistant crop varieties • Promote climate smart livestock production systems • Promote climate smart agricultural production systems.
Kamuganguzi sub-county	Rwakakobe village, Mayengo parish	▪ Flash floods in Kamuganguzi trading centre ▪ Contaminated water supplies ▪ Water source chambers are blocked with silt	• Promote intensified & sustained afforestation & re-afforestation in degraded areas • Promote the construction of resilient drainage systems • Construction climate smart of Wastewater treatment plants • De-silting
Rubaya sub-county	Kanyante village, Kibuga parish	▪ Flashfloods ▪ Bridge flooded ▪ Kanyante trading village & center submerged in water ▪ Water springs affected by floods ▪ Fallowing due to Land fragmentation ▪ High population ▪ Hills are degraded	• Promote intensified & sustained afforestation & re-afforestation in degraded areas • Disaster risk reduction fund for response and recovery in the affected areas with climate induced disasters • Construction climate smart of Wastewater treatment plants • Use contraceptives to manage population pressure on natural resources • Terraces/ grasslands • Promote climate smart soil and water conservation practices. • Promote the construction of resilient drainage systems • Build flood resistant sanitation facilities • Ensuring that climate resilient land use plans & building codes for private & public buildings
Kabale Municipality	Mukirwa cell, Kijuguta ward	▪ Flooding of Ruboroga river ▪ Hakizaji bridge flooded ▪ Cultivation in river banks ▪ Eucalyptus trees planted along river banks	• Promote intensified & sustained afforestation & re-afforestation in degraded areas • Promote the construction of resilient drainage systems • Build flood resistant sanitation facilities • Plant flood resistant crop varieties • Ensuring that climate resilient land use plans & building codes for private & public buildings • Disaster risk reduction fund for response and recovery in the affected areas with climate induced disaster

SUB-CTYs	SITES	ISSUE	OPTIONS
Kabale Municipality		▪ Schools affected by flooding ▪ Homes and farms in wetlands ▪ Silting	• De-silting • Promote climate smart agricultural landscapes • Enforcement of wetland legislation • Develop framework management plans and governance of wetland systems • Demarcate & gazette wetlands systems • Strengthen wetland management & conservation • Design and implement wetland management action plans with carbon sink potential • Promote intensified & sustained afforestation & re-afforestation in degraded areas.
	Kijuguta ward Musasizi, Rugarama & Muruhita villages	▪ Bridges are washed away by floods ▪ Kibikura, Katojo and Kirwa Villages are submerged by floods	
	Kijuguta ward Rugarama cell	▪ Rugarama hills flooded ▪ Rugarama hospital gets flooded	
Central Division	Upper Bugongi ward, Pida/ Kakabano villages	▪ Silting ▪ Stream causes flooding of homes ▪ Stream is the source of water yet silted ▪ Wetland drained	• Promote intensified & sustained afforestation & re-afforestation in degraded areas • Promote the construction of resilient drainage systems • Build flood resistant sanitation facilities • Plant flood resistant crop varieties • Ensuring that climate resilient land use plans & building codes for private & public buildings • Disaster risk reduction fund for response and recovery in the affected areas with climate induced disaster • De-silting • Promote climate smart agricultural landscapes • Enforcement of wetland legislation • Develop framework management plans and governance of wetland systems • Demarcate & gazette wetlands systems
			• Strengthen wetland management & conservation • Design and implement wetland management action plans with carbon sink potential • Promote intensified & sustained afforestation & re-afforestation in degraded arease.g. Napier grass, Granvilla and callindra
	Pida cell	▪ Spring is silted ▪ Eucalyptus trees planted which dry up the water sources ▪ Wetland used for solid waste disposal ▪ Vegetable growing in wetlands ▪ Agro-chemicals pollute water sources	• De-silted • Construct climate smart Wastewater treatment plant for the clean water supply • Promote climate smart agricultural landscapes. • Promote green approaches for solid waste disposal

SUB-CTYs	SITES	ISSUE	OPTIONS
Central Division	Upper Bugongi, Muyanje village	▪ Cultivation in the wetland ▪ Flooding ▪ Use of agro-chemicals which pollute water sources.	• Develop framework management plans and governance of wetland systems • Demarcate & gazette wetlands systems • Strengthen wetland management & conservation • Design and implement wetland management action plans with carbon sink potential • Promote intensified & sustained afforestation & re-afforestation in degraded arease.g. Napier grass, Granvilla and callindra • Construct climate smart Wastewater treatment plant for the clean water supply • Promote climate smart agricultural landscapes. • Promote green approaches for solid waste disposal • Apply climate smart land use plans and building codes • Encourage climate resilient asset management • Apply climate smart updated road, bridge & transport codes for the infrastructure. • Construct climate smart Wastewater treatment plant for the clean water supply.
	Makaga ward, Bigombe cell	▪ Springs have contaminated water ▪ Wetland degradation rampant ▪ Town and slum settlements in wetland areas ▪ Eucalyptus trees lowering the water table.	
	Nyakahita ward, Nyakahita village/ cell	▪ Wetland encroachment and it is a site used by National Water & Sewage Corporation ▪ Dairy farms drain the wetlands ▪ Eucalyptus trees lowering the water table. ▪ Wetland areas used for cultivation ▪ Gardens covered by floods ▪ Treatment lagoons covered by floods	
	Butobere ward, Nyakahita & Nyakijumba villages	▪ Wetland encroachment for agriculture production systems. ▪ Biodiversity corridor area of migratory birds disturbed by wetland encroachment ▪ Butobere-Nyakahita bridge submerged ▪ River water very turbid	
Kyanamira Sub-county	Komyo village, Nyabushabi parish	▪ Wetland encroachment for crop cultivation ▪ Rwagaju and Myerambiko hills bare ▪ Flooding ▪ Use of agro-chemicals which pollute water sources	• Develop framework management plans and governance of wetland systems • Demarcate & gazette wetlands systems • Strengthen wetland management & conservation • Design and implement wetland management action plans with carbon sink potential • Promote intensified & sustained afforestation & re-afforestation in degraded areas e.g. Napier grass, • Apply climate smart land use plans and building codes • Construct climate smart Wastewater treatment plant for the clean water supply.

SUB-CTYs	SITES	ISSUE	OPTIONS
Kyanamira Sub-county	Nyakahita village, Nyabushabi parish	▪ Flooding ▪ Deep gullies and soil erosion ▪ Landslides ▪ Road submerged in water ▪ Villages flooded ▪ Spring water contaminated ▪ Gardens flooded ▪ Tree cutting rampant on hill sides	• Promote the construction of resilient drainage systems • Promote intensified & sustained afforestation & re-afforestation in degraded areas e.g. Napier grass • Plant flood resistant crop varieties • Apply climate smart updated road, bridge & transport codes for the infrastructure • Apply climate smart land use plans and building codes • Construct climate smart Wastewater treatment plant for the clean water supply
	Kyanamira village, Kyanamira parish	▪ NARO fish pond hatchery	• Promote climate smart models of aquaculture production systems.
Maziba sub-county	Kabanyinyi village, Kabanyonyi parish	▪ Wetland degradation	• Develop framework management plans and governance of wetland systems • Demarcate & gazette wetlands systems • Strengthen wetland management & conservation • Design and implement wetland management action plans with carbon sink potential
	Kahondo parish, Muvumbe village	▪ Bridge flooded	• Apply climate smart updated road, bridge & transport codes for the infrastructure
	Muhanga parish, Kahondo village	▪ Landslides ▪ Silting ▪ Flooding ▪ Crop cultivation on the hills ▪ Dam infrastructure damaged by floods	• Promote intensified & sustained afforestation & re-afforestation in degraded areas e.g. Napier grass, • De-silting • Apply climate smart land use plans and building codes • Plant flood resistant crop varieties
Maziba sub-county	Kahondo parish, Kamuhingi village	▪ Deep gullies and soil erosion is high ▪ Gardens flooded ▪ Power house infrastructure at high risk of flooding	• Promote intensified & sustained afforestation & re-afforestation in degraded areas e.g. Napier grass, • Apply climate smart land use plans and building codes
RUBANDA DISTRICT			
Hamurwa Town Council	Hamurwa Ward, Hamurwa cell	▪ Flash floods from Hangaro hills ▪ Encroachment on Harurwa wetland ▪ Crop gardens flooded ▪ Highway flooded	• Promote intensified & sustained afforestation & re-afforestation in degraded areas e.g. Napier grass, • Develop framework management plans and governance of wetland systems • Demarcate & gazette wetlands systems • Strengthen wetland management & conservation • Design and implement wetland management action plans with carbon sink potential • Apply climate smart land use plans and building codes • Apply climate smart updated road, bridge & transport codes for the infrastructure.

SUB-CTYs	SITES	ISSUE	OPTIONS
Bubare Sub-county	Ihanga parish, Kyotoro village	▪ Flooding ▪ Kabale-Kisoro highway flooded	• Promote intensified & sustained afforestation & re-afforestation in degraded areas e.g. Napier grass, • Apply climate smart land use plans and building codes • Apply climate smart updated road, bridge & transport codes for the infrastructure.
	Nyamiyaga parish, Rwembu-ga village/ Hamurwa village	▪ Wetland degradation ▪ Silting ▪ Dairy farms in wetlands ▪ Ecaulyptus trees planted ▪ Loss of crops due to flooding ▪ Flooding of the river ▪ River Rujuga-part of upper Maziba flooded	• Promote intensified & sustained afforestation & re-afforestation in degraded arease.g. Napier grass, • Develop framework management plans and governance of wetland systems • Demarcate & gazette wetlands systems • Strengthen wetland management & conservation • Design and implement wetland management action plans with carbon sink potential • De-silting • Promote intensified & sustained afforestation & re-afforestation in degraded areas e.g. Napier grass, • Apply climate smart land use plans and building codes • Apply climate smart updated road, bridge & transport codes for the infrastructure.

6.3 Potential Economic Benefits of the Interventions

It is estimated that the proposed interventions will benefit a total of 232,025 people in Maziba catchment; of whom 109,250 (47%) will be males and 122,775 (53%) will be females, Table 6-2.

Table 6-2: Estimated number of beneficiaries per priority micro-catchment

Micro-catchment	Males	Females	Total
Hamurwa	21,925	25,625	47,550
Bubaare	50,500	55,275	105,775
Kyanamira-Buhara	20,725	22,775	43,500
Maziba west	6,900	7,800	14,700
Rubaya-Kamuganguzi	9,200	11,300	20,500
Total	**109,250**	**122,775**	**232,025**

Source: *Based on area population, UBOS (2012)*

In each of the 5 hotspot micro-catchments, more women will benefit from the interventions as compared to men, owing to the existing population structure, composed of more women than men. This should be a fairly good and representative scenario, considering the gender roles and responsibilities of women, and how they interact more closely with and utilize water, land, forest and other catchment resources as compared to men in the catchment.

A whole option has been planned to build economic, social and ecological resilience of the livelihoods of the population in the catchment. This presents various economic opportunities. It integrates population control

measures that target to promote reduction in family size and thus increase in access to land and other productive resources.

The direct livelihood improvement interventions seek to support increase in agricultural production and productivity per hectare (e.g. introducing high-yielding seed varieties, promoting use of farmyard manure and fertilizers, etc.). They seek to create alternative and nature-friendly income streams to reduce the stress natural resources (e.g. coffee and fruit tree growing, bee-keeping, aquaculture, goat rearing, sustainable milk production, poultry rearing, etc.). Re-engineering and building the capacity of economic groupings and cooperatives; e.g. women economic groups; farmer cooperative societies, etc. will further present opportunities for self-organization to tap into various economic prospects. Supporting savings and small-scale local lending schemes will increase access to micro-credits to finance of-farm activities and address poverty.

Adoption and replication of the improved farming technologies (e.g. integrated pest, disease and fertility management, use of bio-fertilizers, farm-yard manure, improving livestock breeds, adopting higher yielding crop varieties and other better farming technologies/practices) will improve agricultural production and productivity; and thus improved farm income. Controlling soil erosion and promoting on-farm rainwater harvesting, channeling and storage will potentially retain fertile soils on farms and improve soil moisture to further improve agricultural production and productivity, and associated farm incomes.

Promoting tree species with high value products, establishing tree nurseries as enterprises and planting of agro-forestry and other multi-purpose tree species interspersed with crops, or on plot boundaries will diversify and optimize production and productivity on the small land holdings; thereby generating farm income from a variety of enterprises, including tree products e.g. fruits, poles, fodder, timber, etc. It is proposed that Arabica coffee be adopted and interspersed with crops to increase the medium density vegetation cover on farmlands, while increasing farm income. Providing incentives for on-farm tree conservation e.g. value addition and market linkages to tree products, simple reward systems, carbon trade and PES schemes will also present a variety of economic benefits.

Promoting energy-saving technologies and introducing affordable alternative renewable sources of energy e.g. low-cost solar panels for lighting, radios, and cell phones, biogas for cooking and lighting, etc. will reduce household expenditure on firewood, charcoal and other unsustainable sources of energy.

Promoting Community-Led Total Sanitation (CLTS) interventions, increasing access to safe water, sanitation and hygiene services and reduced water pollution will potentially reduce incidences of water-borne diseases, reduce household expenditure and increase labour productivity, while making finances more available for investment in productive ventures e.g. farming, off-farm trade and other activities.

The mapped, demarcated and protected strips of wetlands and riverbanks could initially imply a cost to individual farmers affected by this intervention; for they may have to forego some strips of farmland. However, they will retain ownership of these sections of the land, and will have access rights to utilize it for economically viable wise-use activities that do not have adverse impact on the local hydrology. These uses could include aquaculture, regulated wetland-edge gardening (Irish potatoes, carrots, cabbages, beetroot, onions, etc.); traditional grazing, harvesting of mulch, etc. These alternative wise use activities will present a number of economic benefits, especially if the products are considered for value addition (e.g. processing and packaging of Irish potato chips).

In addition, the ecological functions of the restored strips of wetlands and riverbanks e.g. flood regulation, floodwater harvesting; and the resultant reduction in seasonal damage of crops and property will also bear economic benefits. Establishment of protection buffer zones along streams and rivers will also protect Maziba hydropower plant against chocking and damage by sediment; thereby increasing chances to generate and supply hydro-electric power that could spur local economic development.

Adoption of such nature-based solutions will present opportunities for saving costs and making the meagre finances more available for investment in other economically productive projects. A recent example was demonstrated in the Upper Aswa sub-catchment in Okwang sub-county, Otuke District in Northern Uganda, where a rehabilitated wetland was able to harvest, store and make available water for dry season use at a cost of approximately $ 20,000 only; as compared to an alternative engineering solution (Akwera dam) that cost $ 2.6 million to virtually serve the

same purpose in the neighboring sub-county of Adwari.

Addressing drought and flood risks, including adoption of drought/flood resistant crop and livestock varieties will reduce crop, livestock and other property losses, while increasing production. Floodwater harvesting and innovative dry season irrigation initiatives have potential to double crop production and improve farm income. The planned capacity-building programmes (e.g. trainings in enterprise development, book keeping, etc.) will better prepare the beneficiaries to optimally tap into these various economic opportunities that will present themselves.

6.4 Budget Estimates and Available Financing Options

6.4.1 Budget Estimates

The costing tool used was developed by Uganda's Directorate of Water Resources Management (DWRM) of the Ministry of Water and Environment under the Water Resources Management and Development Project with funding support from the World Bank. It is an Excel-based tool into which unit costs are entered, computed and analyzed. Various formulae are utilized to automate and quicken computations, thus making it quite user-friendly. For each option and sub-option, the tool provides for computation of personnel, consultants', travel, operating, stakeholder meeting/workshop, equipment and capital costs. Details of the tool are presented as an annex to this plan, showing details of the cost build up, the quantities and unit rates used assumptions for costing and time frames.

It is estimated that it will cost US$ 42,007,300, Table 6-3, to implement the plan in the top 4 hotspot micro-catchments of Hamurwa, Kyanamira-Buhara, Bubaare and Rubaya –Kamuganguzi, in addition to placing some special attention to protection of the micro-catchment around the Maziba hydropower plant which is known to have silted and failed due to excessive soil loss and poor land use in the micro-catchment. The proposed amount covers personnel (technical employees), consultants, travel, stakeholder meetings/workshops, and equipment and capital costs. Note that the budget excludes operational costs for an office on the assumption that the existing Victoria WMZ office will serve as the secretariat for Maziba catchment management committee and technical committee (ref. proposed institutional arrangements).

Table 6-3: The budget estimates

No	Activity	Personnel	Consultant	Travel	Stake-holders	Equipment	Capital	Total (US$)
Objective 1: To promote sustainable land management and agricultural production and productivity in the catchments								
1.1	Promoting adoption of improved farming technologies	$145,000	$210,000	$190,000	$322,500	$80,000	$140,000	$1,267,500
1.2	Controlling soil erosion and land degradation	$225,000	$135,000	$235,000	$210,000	$305,000	$480,000	$1,590,000
1.3	Promote climate smart capture fisheries & aquaculture development	$180,000	$240,000	$30,000	$750,000	$9,000,000	$500,000	$10,700,000
1.4	Develop Greenhouse monitoring systems	$120,000	$100,800	$126,000	$125,000	$275,000	$125,000	$871,800
Objective 2: To improve the quality and quantity of natural resources in the catchment								
2.1	Increasing vegetation cover and reducing its further loss	$195,000	$180,000	$187,500	$112,500	$190,000	$540,000	$1,405,000
2.2	Improving water quality and quantity	$90,000	$45,000	$90,000	$112,500	$40,000	$120,000	$497,500
2.3	Reducing wetland and riverbank degradation and rehabilitating critical wetland sections	$180,000	$345,000	$175,000	$240,000	$165,000	$585,000	$1,690,000
2.4	Increase carbon stock assessment (carbon credits)	$300,000	$100,800	$126,000	$250,000	$7,500,000	$250,000	$8,526,800
Objective 3: To build social, economic and ecological resilience of the livelihoods of the population in the catchment								
3.1	Reducing population pressure	$55,000	$60,000	$32,500	$105,000	$20,000	$80,000	$352,500
3.2	Supporting livelihood improvement to catalyze better catchment management	$165,000	$210,000	$132,500	$210,000	$450,000	$575,000	$1,742,500
3.3	Improving environmental sanitation and hygiene	$225,000	$315,000	$232,500	$217,500	$3,000,000	$940,000	$4,930,000
3.4	Addressing climate risks – droughts and floods	$140,000	$525,000	$135,000	$240,000	$1,340,000	$4,200,000	$6,580,000
3.5	Increase climate change adaptation & mitigation options	$24,000	$42,000	$25,200	$12,500	$20,000	$250,000	$373,700

No	Activity	Personnel	Consultant	Travel	Stake-holders	Equipment	Capital	Total (US$)
Objective 4: To build capacity for better natural resource governance and conflict management in the catchment								
4.1	Strengthening NR governance and mainstreaming gender issues	$60,000	$120,000	$32,500	$120,000	$0	$200,000	$532,500
4.2	Addressing potential upstream-downstream conflicts	$57,500	$105,000	$40,000	$135,000	$0	$520,000	$857,500
4.3	Building capacity for better catchment management	$80,000	$225,000	$72,500	$150,000	$390,000	$0	$917,500
4.4	Promote sectoral climate risk management (assessment, analysis & evaluation)	$120,000	$126,000	$126,000	$25,000	$50,000	$250,000	$697,000
4.5	Strengthen law enforcement & framework plans	$120,000	$40,000	$126,000	$250,000	$100,000	$250,000	$886,000
4.6	Promote green accounting of natural resources for ecosystems	$120,000	$120,000	$126,000	$250,000	$100,000	$250,000	$966,000
4.7	Develop climate smart management plans for green business models in the catchment	$6000	$25200	$6300	$25000	$20000	$10000	$92500
	TOTAL (USD)	**2,607,500**	**3,269,800**	**2,478,400**	**3,862,500**	**23,340,000**	**10,265,000**	**42,007,300**

Source: *Maziba actions costing tool*

6.4.2 Financial Prioritization and Analysis of Options and Sub-options

Of the total $ 42 million budgeted for implementation of Maziba catchment management plan, promoting climate smart capture fisheries & aquaculture development will take the biggest share of $ 10.7 million, followed by increasing carbon stock assessment (carbon credits) with $ 8.53 million. The key reason is that these options involve direct livelihood improvement aspects and high capital costs of constructing 1000 fish ponds and planting of 5 million indigenous trees.

The next biggest share of the budget is allocated to Addressing climate risks – droughts and floods $ 6.58 million this cost includes constructing dams, rain water harvesting, over 20 models predicted that the catchment faces severe flood and drought risks, owing to climate change; and sufficient funding is needed for both climate risk preparedness and management purposes. The other big share of the budget is improving environmental sanitation and hygiene with $4.93 million. Sanitation is key in preventing diseases. This will involve waste management and construction of sanitation facilities including toilets and latrines.

It is believed that once livelihoods are improved, the pressure on the natural resources will reduce. Supporting livelihood improvement to catalyze better catchment management is allocated $ 1.74 million, Reducing wetland and riverbank degradation and rehabilitating critical wetland sections is allocated 1.69 million, controlling soil erosion $ 1.59 million, increasing vegetation cover and reducing its further loss is allocated additional $ 1.4 million, improving farming technologies $ 1.27 million, promoting green accounting of natural resources for ecosystems 0.97 million, capacity building $ 0.92 million, strengthen law enforcement & framework plans allocated 0.89 million, developing Greenhouse monitoring systems $0.87, conflict management $ 0.86 million, promote sectoral climate risk management $0.7 million, governance and gender $ 0.53 million, improving water quality and quantity increasing $0.5 million, climate change adaptation & mitigation options $ 0.37 million and reducing population pressure $ 0.35 million and developing climate smart management plans for green business models in the catchment allocated 0.09 million. The budget share by option is further illustrated in *Figure 6-6: The budget estimates by option (US$)* below.

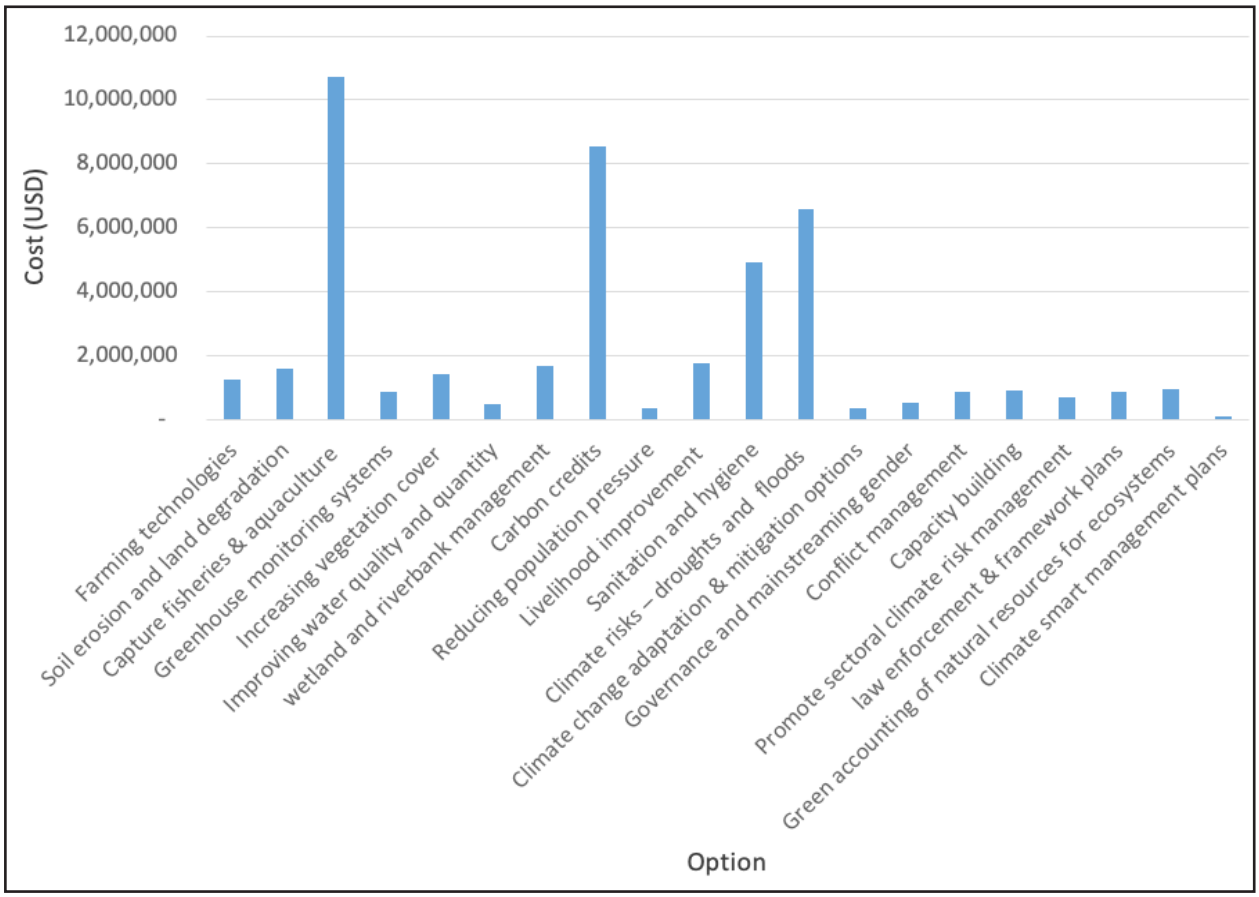


Figure 6-6: The budget estimates by option (US$)

6.4.3 Time-frame and Phasing of Options and Sub-options

Four major phases are proposed for plan implementation, namely very sort (1-2 years), short (3-5 years), medium (6-10 years) and long (11-26 years) terms. The long term is proposed to rhyme with Uganda's long-term vision of 2040, a framework to which this catchment management plan should contribute.

It is estimated that in the very short term, the initial activities will require $ 1.9 million. These will be scaled up to require $ 2.6 million in the short term, $ 4.2 million in the medium term, and $ 13.58 million in the long term, Table 6-4.

Table 6-4: Proposed interventions by time frame and budget

Period/Interventions	2014-2016 (Very short term)	2016-2019 (short term)	2019-2024 (Medium term)	2024-2040 (Long term)
SLM & agricultural productivity	342,115	393,173	505,288	1,616,923
Improving quality & quantity of NRs	1,081,154	1,565,481	2,609,135	8,349,231
CC resilience & livelihoods	177,500	266,250	443,750	1,420,000
NR governance & conflict management	299,423	411,635	686,058	2,195,385
Total	**$1,900,192**	**$2,636,538**	**$4,244,231**	**$13,581,538**

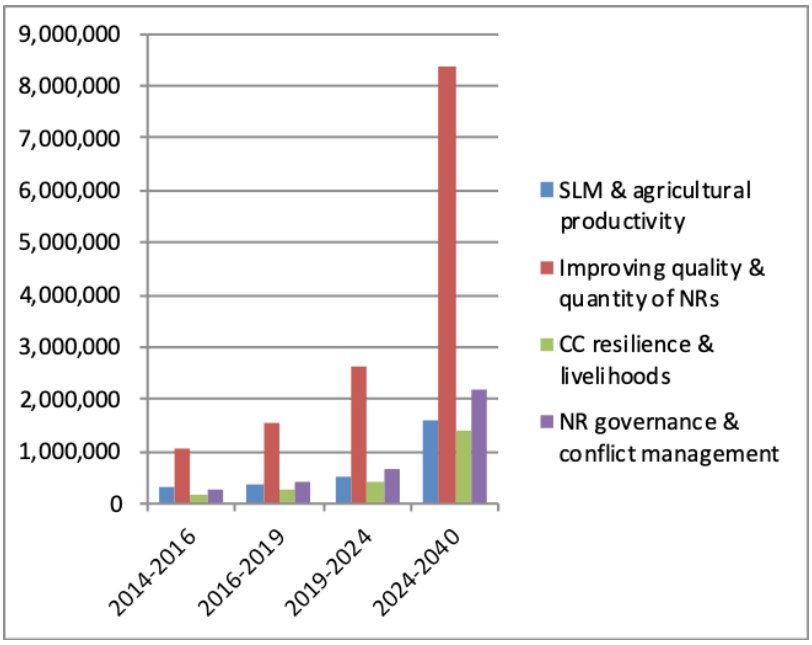


Figure 6-7: Proposed interventions by budget and time frame

6.4.4 Costs of the Interventions per Micro-Catchment

An attempt was made to apportion the budgets by micro-catchment, based on the nature of the planned interventions and; particularly, the proportion of the beneficiaries to be served per micro-catchment. Principally, the proportion of the beneficiaries was considered because the issues and proposed interventions are basically similar across the micro-catchments; and that a number of interventions (e.g. radio awareness programmes; development & operationalization of enabling policy, legal and institutional frameworks; preparation of various guidelines, etc.) are not specific to given micro-catchments, but apply across the board. The beneficiaries are the people whom the interventions target; and they are the ones who would otherwise impact adversely on the micro-catchments and their resources if their resource use, livelihood and development aspirations are not addressed. Beneficiary numbers are therefore a good proxy indicator of the magnitude of the issues to be addressed.

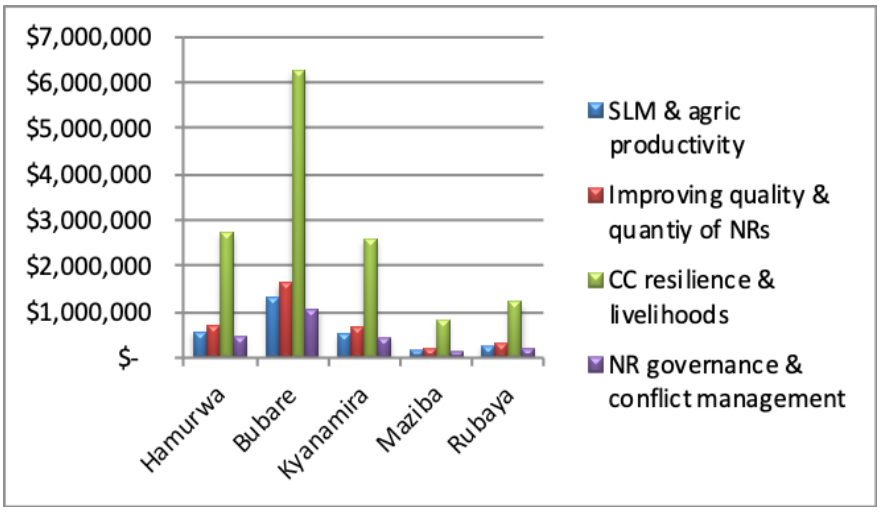


Figure 6-8: Budgets by option and micro-catchment

Hamurwa micro-catchment contains 20% of the beneficiaries, Bubare 46%, Kyanamira-Buhara 19%, Maziba West 6%, and Rubaya-Kamuganguzi 9% of the beneficiaries. Accordingly, it is proposed that Hamurwa micro-catchment will take a budget of $ 4,472,500; Bubaare $ 10,286,750; Kyanamira-Buhara $ 4,248,875; Maziba west $ 1,341,750 and Rubaya-Kamuganguzi $ 2,012,625. Across the five hotspot micro-catchments, promoting resilient livelihoods is allocated more funds in order to address the poverty-environment nexus. The thinking is that once the people's poverty and livelihood needs are addressed, this will reduce pressure on the catchment's resources. Details of the budgets are presented in Table 6-5 below, and an annexed budgeting tool.

Table 6-5: Budget by option and micro-catchment

Option/ Micro-catchment	Hamurwa	Bubaare	Kyanamira -Buhara	Maziba West	Rubaya Kamuganguzi
SLM & agricultural productivity	$571,500	$1,314,450	$542,925	$171,450	$257,175
Improving quality & quantity of NRs	$718,500	$1,652,550	$682,575	$215,550	$323,325
CC resilience & livelihoods	$2,721,000	$6,258,300	$2,584,950	$816,300	$1,224,450
NR governance & conflict management	$461,500	$1,061,450	$438,425	$138,450	$207,675
Total	**$4,472,500**	**$10,286,750**	**$4,248,875**	**$1,341,750**	**$2,012,625**

Presenting the budgets by micro-catchment gives an opportunity for any interested partner to select and finance interventions in a micro-catchment of their choice, considering that resources are meager and may not be available to cover the entire catchment at once.

6.4.5 Available Financing Options

The CMP will be a government framework that should guide the planning and programming of various partners

in Maziba catchment. Accordingly, this provides an opportunity for various financing options (or a combination of them), based on the variety of stakeholders (and their interests) present in the catchment. Based on this, the following 5 potential financing options are proposed to be explored for implementation of the Maziba CMP, Table 6-6.

1. Leverage from on-going related interventions

This option seeks to build synergy with, and realize leverage from already on-going projects and programmes that have objectives that relate to Catchment-based Water Resources Management. Examples include Kagera TAMP, Kigezi Diocese, LVEMP, etc. These could implement components of the Maziba CMP that are aligned to

their project and programme objectives. For example, Kagera TAMP could leverage implementation of Objective 1 on SLM- promoting adoption of soil and water conservation technologies, and other better land management methods that increase agricultural production and productivity while maintaining the quality of land resources in the catchment. On-going regional programmes like LVEMP could support stream bank and wetland conservation intervention, improving water quality and stream flow; soil erosion control, etc. – particularly interventions whose larger-scale impacts would ultimately bear positively on the L. Victoria ecosystem in general.

2. Local government financing

The Local Governments receive funds from the Central Government on an annual basis, and also collect some little local revenue to fund their recurrent and development budgets. The Forest, Environment, Agriculture, Water, Community Development, Health and other relevant departments could contribute to financing of selected priority options in the CMP. To successfully exploit this financing option, those priority options in the CMP ought to be integrated into the DDPs and SCDPs of the Local Governments that are covered by Maziba catchment. The sub-counties and relevant district departments need to prioritise these options during their annual planning and budgeting cycles. They could, for example, contribute to the financing of SLM activities (Agriculture Dept.), Natural Resources Management (Forestry and Environment Depts.); Governance and legislative frameworks (Council), and water and sanitation activities (Water and health Depts.).

3. New support projects

Once established, one key role of the Catchment Management Committee (CMC), with support from the Catchment Technical Committee (CTC), will be to raise funds for implementation of the CMP. The CMC is charged with responsibility to not only oversee development of a CMP, but also its subsequent implementation. Accordingly, the CTC should support the CMC to come up with proposals for implementation of priority investment and management options immediately the CMP is officially endorsed. A number of development partners in Uganda (and beyond) are interested in supporting CbWRM, and could be a source of financing for such proposals. These include the Austrian Development Agency (ADA), UNDP, GEF, FAO, DANIDA, AfDB, The World Bank, etc.

4. Central Government financial support

In order to operationalize the decentralized WMZs, the Government of Uganda (GoU) annually, through the Ministry of Finance, channels funds to support CbWRM in the WMZs. This could be another feasible financing option to support implementation of the Maziba CMP. GoU is a key beneficiary of this catchment planning process, and should be interested in taking up the recommended options in the CMP for implementation. Accordingly, on an annual basis, the SCTC at the Victoria WMZ should take lead in prioritizing options for implementation under this financing option. Examples of options which could be financed under this arrangement could include catchment restoration interventions, operationalizing the governance structures, water resources monitoring, etc.

5. Supplementary innovative financing schemes

Other new financing mechanisms like Payment for Ecosystem Services (PES) could also be explored to support implementation of the Maziba CMP. Particularly, the private sector and large water development projects located downstream (e.g. Hydropower development, large-scale irrigation, domestic and industrial water supply schemes, etc.) should be encouraged to invest in better management of the upstream micro-catchments that are a source of water that they seek to use. This would assure them of water security on a sustainable basis; and would save their investments from being under/unproductive. Other similar financing schemes could include global carbon trade and Clean Development Mechanisms (CDMs). The funds from such schemes could be managed by the SCMC, which evaluates the qualifying micro-catchment management structures and disburses the funds to them based on adoption of best catchment management practice.

6. Community contributions

Communities will also make significant financial and/or in-kind contribution towards various interventions for catchment development and management. Their input will be in the form of direct cash contribution, say towards operation and maintenance of water sources, or natural (e.g. land and locally available construction materials), physical (e.g. agricultural implements, bicycles, water tanks, etc.), human (e.g. traditional skills and labor force) and social resources (e.g. Church groups and Farmer associations). Quite often, this input is not quantified in monetary terms, but once done; it is usually substantial and comparable to external monetary contributions.

Table 6-6: The proposed financing options

Proposed financing option	Potential options that could be funded	Proposed fundraising lead
Leverage from on-going related interventions	Various, depending on objectives of the project/ programme	The SCMC with support from the SCTC
Local Government financing	Water and sanitation, environment and natural resources management, SLM, governance, gender and capacity building, etc.	Relevant LG Departments (Water, health, Forestry, ENR, Agriculture, and Community Development)
New support projects	Various, depending on priorities of the identified donor	The SCMC with support from the SCTC
Central Government financial support	Catchment restoration, operationalizing the governance structures, water resources monitoring, etc.	Victoria WMZ and the SCTC
Supplementary innovative financing schemes e.g. PES, carbon trade, CDM, etc.	Catchment restoration, stream bank protection, water quality monitoring and improvement, governance and conflict management, etc.	The SCMC with support from the SCTC
Community contribution	Operation and maintenance of water sources, construction of new water sources, catchment restoration, riverbank demarcation using locally available materials, etc.	Community leaders in collaboration with the micro-catchment management committee

6.5 Monitoring and Evaluation Mechanisms

It will be in the interest of all stakeholders in Maziba catchment that success towards achievement of the set vision and objectives be measured. It is against the findings of this kind of monitoring that the CMC and other stakeholders will determine whether they are progressing towards achievement of what they set out to achieve, or not; and whether they have ultimately achieved their vision or nor, and what will need to be changed to aid success in future. With this, they will be able to put in place corrective and adaptive management measures to keep the implementation process on track towards achievement of the ultimate vision.

Accordingly, a monitoring and evaluation matrix has been prepared and presented in Table 6-7. It clearly shows the proposed key success indicators against the set proposed intervention options, the issues that the interventions seek to address, and the objectives sought..

Table 6-7: The Monitoring and evaluation matrix

Option	Key success indicators	Source of M&E information?	Who will take lead?
Reducing soil erosion and land degradation	• Positive change in KAP (Knowledge, Attitudes & Practices) • Increase in No. of farmers adopting soil and water conservation technologies • Reduction in rates of on-farm soil loss • Increase in No. and length of gullies rehabilitated	• Survey and other progress reports • Field monitoring reports • Bye-law enforcement records from local leaders	• District Agricultural Officer
Increasing adoption of improved farming technologies	• Improvement in KAP • Effectiveness of new farming technologies introduced (e.g. improved yield) • Increase in number of farmers adopting improved farming methods	• Farmer group and demo-nstration site records • Survey reports • Field monitoring reports • District development reports	• District Agricultural Officer

Option	Key success indicators	Source of M&E information?	Who will take lead?
Reducing loss (while increasing amount) of vegetation cover	• Improvement in Knowledge, Attitudes and Practices (KAP) • Increase in No. and hectares of trees planted and grown or conserved • No. of households adopting energy-saving tech. and alternative renewable energy sources • Decrease in reported cases of unsustainable tree cutting	• KAP survey and other progress reports • Field monitoring reports • Bye-law enforcement records from local leaders	• District Forestry Officer
Improving water quality & quantity	• Increased compliance with wastewater treatment and discharge conditions • Improvement in water quality & quantity parameters • Increased access to safe water • Reduction in poor water quality related ailments	• Compliance monitoring reports • Water quality monitoring reports • Flow monitoring reports • District water & health reports	• Victoria WMZ and the District Water Officer
Reducing wetland and riverbank degradation	• Positive change in KAP • Increase in No. of farmers adopting sustainable use of wetlands • Length of riverbanks and wetlands demarcated and protected • No. of ha of wetlands rehabilitated and/or under protection • Reduction in reported cases of wetland and riverbank abuse	• Field survey reports • Riverbank and wetland mapping & inventory reports • Local leaders' records	• District Environment/ Natural Resources Officer
Reducing population pressure	• Positive change in KAP • Increase in number of men and women adopting family planning methods • Gradual decrease in Total Fertility Rate (TFR)	• Population & Family planning survey reports • Project progress reports • District Development plans and reports	• The District Director of Health Services
Supporting livelihood improvement	• Increase in No. of alternative & nature-friendly livelihood activities adopted by farmers • Increase in production and household income from both farming and new alternative income streams • Increase in household access to micro-credit facilities as a source of capital	• SACCO records • Farm and other group enterprise records • Field survey reports • District development plans and reports	• District Commercial and Community Development Officers

Option	Key success indicators	Source of M&E information?	Who will take lead?
Improving environmental sanitation and hygiene	• Improvement in KAP • No. of ODF villages declared in the catchment • Increase in No. of gazetted waste dumping sites and skips introduced and are operational • Increase in No. of households and individuals adopting the 3Rs strategy • Reduction in sanitation-related disease outbreaks	• Survey reports • Field monitoring reports • Annual sector performance reports	• District health Inspector
Addressing climate risks - Drought and floods	• Increased public awareness about CC and associated risks • Operational real-time early warning systems in place • No. of farmers adopting climate-smart agriculture • No., quality and effectiveness of adaptation and resilience building interventions implemented	• Survey and other progress reports • Early warning reports generated • Field monitoring reports • National meteorological reports	• District Water and Agriculture Officers
Strengthening NR governance and mainstreaming gender issues	• Functional catchment management structures • At least 30% representation of women on catchment governance structures • Increased community & women's participates in the governance and management of the catchment	• Catchment management committee meeting minutes and other records • Other local leaders' records	• Secretary of the Catchment management committee and Victoria WMZ
Addressing potential upstream-downstream conflicts	• Decrease in reported conflicts/ complaints over downstream-upstream resource use and management issues	• CMP implementation reports • Local leaders' reports • Meeting minutes • Survey reports	• Secretary of the Catchment management committee and Victoria WMZ
Building capacity for better catchment management	• Improvement in skills for better catchment management • Availability of necessary equipment • Availability of supportive local policy and legal frameworks for catchment management • Improved performance of LG, Victoria WMZ and other partners' staff in delivery of catchment management services	• Project and programme delivery reports • Performance evaluation reports • Physical and spot-check/ verification reports • Beneficiary satisfaction survey reports	• Secretary of the Catchment management committee and Victoria WMZ

Option	Key success indicators	Source of M&E information?	Who will take lead?
Increase the functionality & usage of meteorological information systems	• Number of DLGs mainstreaming climate change in sectors plans & budgets • Number of DLGs with climate change focal persons • Number of climate change & monitoring reports produced • Number of climate & early warning notices issued. • Number of research findings & recommendations disseminated & adopted • Number of domesticated climate change laws & reforms enacted in the catchment	• District Development Plans • Department of Natural Resource Management hosts the climate change focal points in DLGs • District reports on climate change impacts and vulnerability by sectors in the catchment • Reports with sector specific climate & early warning products in support of climate change adaptation • Publications & recommendations in journals/newsletters etc • Reports about research on future climate trends & its impacts in the catchment • Report on the number of degradation, governance & conflict management cases	• District Planner • District Natural Resource Officer (DNRO) • DNRO • District Agriculture Officer (DAO) • DNRO & ICT • DNRO, DAO, DWO
Increase sectoral CC mitigation & adaptation options through sustainable actions in the catchment	• Number of community & institutional based (NR) natural resources (forest, wetland etc) groups formed • Number of sustainable development of commercial including value addition of natural resources • Number of NR management plans, strategies & costed action plans developed in the DLGs	• Reports on community & public NR management & development groups • Environmental, economic & social Progressive reports on NR management & development • Area (Ha) of wetland/ forest established • Functional NR monitoring system in place	• CDO • DNRO, DAO • Wetland officer, Forest Officer • DNRO • DLG Top Policy Committee • District Engineer
	• NR emissions reference level (ERL) • Number of climate smart strategies developed by sector developed	• Report on GHG emissions & Certified Emissions Reduction (CER) from crop, wetlands and forest sectors computed • Reports on climate proofed sectors (crop, forest, wetland, animal, road) in the catchment	

To ensure efficiency and effectiveness, specific and mandated institutions /departments /officials are recommended to take lead in precise and relevant aspects of the monitoring and evaluation process. For example, progress with, and achievements under the SLM and soil erosion control interventions will be monitored by the District Agricultural Officer, while the Secretary of the Catchment management committee and Victoria WMZ will take lead in periodic monitoring and evaluation of the governance, conflict management and capacity building aspects.

In total, a 5-year period is proposed for implementation of the plan. Accordingly, it is proposed that annual progress monitoring exercises will be conducted to provide opportunity for corrective measures to be integrated as annual implementation plans are prepared. A mid-term evaluation exercise will then be conducted after 2.5 years of plan implementation, and a terminal evaluation exercise to determine the extent to which the overall objectives, outcomes and impacts have been achieved. Additionally, the proposed terminal evaluation will also assist Maziba's stakeholders to:

1) To identify program strategies, structures, systems and interventions that contributed to or impeded the achievement of intended program outcomes/impacts and establish plausible links between inputs and outcome/impacts of program interventions
2) To assess the effectiveness of the CbWRM project approaches in achieving strategic objectives and intermediate results and link with the wider CbWRM framework for Uganda
3) To assess the effectiveness and efficiency of technical, managerial and resource management approaches and systems established to support program implementation in terms of their impact on program results
4) To identify key lessons learned and assess the sustainability of the programs' positive impact
5) Make specific practical recommendations on improving strategies and program interventions for future programming

6.6 Organisational & Capacity Building Needs of the Beneficiary Communities

There is a growing awareness of the links between organizational capacity and capital investments. Investments in physical capital such as public toilets, check dams and the re-vegetation of lands in the catchment for instance are relatively easy to achieve. The returns to physical investments of this type however will rapidly decline if organizational capacity is not built to sustain these investments.

In order to sustain the physical assets, there is need for appropriate investments in social and human capital. This will entail developing sustainable and equitable, systems, structures and institutions to manage these physical assets. During consultations, it was indicated that the terraces instituted in 1940s are now wasting away because of the demise of social and human institutions, systems and structures put in place by colonial masters.

The consultations with communities identified the following as organizational issues that have to be dealt with in order to address the sub catchment concerns in Maziba catchment: Poor coordination of actors in sub catchment management; weak policy and legislative framework for sub catchment management; weak enforcement (due to limited resources & political and family pressures); inadequate data for management caused by low capacity of management agencies; inadequate involvement of the local community and other stakeholders in decision-making and management processes; unresolved conflicts around land tenure; limited livelihood opportunities in maziba catchment area; and negative political influences on processes. There is therefore need to establish and support governance structures e.g. Local Environment and Catchment Committees, to implement project activities. Based on these stakeholder consultations, and on the proposed catchment management and development interventions, an assessment of the capacity building needs of the beneficiary communities was conducted with respect to natural resource management and livelihood improvement activities in the Catchment.

Accordingly, District, sub-county, NGOs officials and communities will be trained in various relevant capacity building topics. Among others, these topics will include the use of the hand-held GPS, GIS mapping; water quality data collection using simple hand-held toolkits, application of Climate Vulnerability and Capacity Assessment (CVCA) and Climate Risk Assessment Tool – Adaptation and Livelihoods (CRISTAL) tools; stakeholder analysis, resource mapping and other PRA tools. Through demonstrations, farmers will be taught practical soil erosion

control, rainwater harvesting, soil fertility management, land carrying capacity evaluations, conservation agriculture, value addition, establishing market linkages, book keeping, and how to establish and operationalize farmer cooperatives and SACCOs.

Additionally, local government and NGO staff will be taught to appreciate and conceptualize recent WRM policy reforms in Uganda, the legal frameworks, the need for IWRM, principles of IWRM, basic steps in the catchment planning processes; stakeholder engagement, their roles and responsibilities in catchment-based WRM. Community leaders and relevant catchment committees will have their capacity built in topics like key natural resource conflicts in WRM; the common causes, how to resolve them, roles and responsibilities in resolving them; rights to resource access and use. Additionally, their capacity will be built to establish effective institutional arrangements; ensuring representation and gender integration; responsiveness and accountability; reporting and feedback mechanisms. To ensure effective, efficient and sustainable implementation of the plan, local community leaders and LG staff will also have capacity built in identification of performance indicators; data collection and analysis for participatory M&E; feedback mechanisms and application adaptive management styles. A summary of proposals for capacity building are presented in table 27 below, showing the target group per topic and what is to be covered per topic, Table 6-8:

Table 6-8: Capacity gaps and proposed interventions to address them

Capacity gap	Capacity building topic	Targeted group	What to be covered under the topic
Lack of data and the skills in data collection and management for water resources planning and decision making	Water resources data collection and management	District, sub county, NGOs officials and communities	Use of the hand-held GPS, GIS mapping; water quality data collection using simple hand-held toolkits, etc. Establishment of a water resources data bank for maziba
Low skills in use of participatory and other catchment planning tools	Participatory catchment planning tools	District, sub county, NGOs officials and communities	Application of Climate Vulnerability and Capacity Assessment (CVCA) and Climate Risk Assessment Tool – Adaptation and Livelihoods (CRISTAL) tools; stakeholder analysis, resource mapping and other PRA tools
Inadequate skills in Integrated and sustainable land management (SLM) and livelihood improvement	Practical Sustainable land Management (SLM) skills	Farmers, community leaders, extension staff, natural resource managers	Practical soil erosion control, rainwater harvesting, soil fertility management, land carrying capacity evaluations, conservation agriculture, agro-forestry, integrated pest management, village-based seed banks, integrated nutrient management (use of legumes and green manures) etc.
Ignorance about Value addition and market linkages to agro and nature-based products	Value addition to agro and nature-based products; and creating market linkages for the products	Extension staff, Crop and livestock farmers, bee keepers, loggers and other producers	Micro-enterprises development, value addition, establishing market linkages, book keeping, farmer cooperatives and SACCOS, etc.
Inadequate conceptualization of the catchment approach to IWRM	The catchment approach to IWRM	Local government officials, NGOs and community leaders	Recent WRM policy reforms in Uganda, the legal frameworks, the need for IWRM, principles of IWRM, basic steps in the catchment planning processes; stakeholder engagement, roles and responsibilities, etc.

Capacity gap	Capacity building topic	Targeted group	What to be covered under the topic
Inadequate skills in resolving conflict over natural resources	Conflict resolution and management	Sub and Micro-catchment manage-ment committees, beneficiary communi-ties and their leaders	Key natural resource conflicts in WRM; the common causes, how to resolve them, roles and responsibilities in resolving them; rights to resource access and use; and negotiation skills for benefit sharing
Inadequate governance arrangements and capacity for sub catchment management	Good and operational governance for effective catchment management	Communities, local leaders and relevant catchment committees	Effective institutional arrangements; ensuring representation and gender integration; responsiveness and accountability; roles and responsibilities; reporting and feedback mechanisms; group dynamics and effective community-based leadership for catchment management; and how to financially sustain catchment governance arrangements
Inadequate skills in Participatory monitoring and evaluation of sub catchment initiatives	Participatory learning, monitoring and impact assessment of sub catchment initiatives	Local government and NGO staff and communities	Identification of performance indicators; data collection and analysis for participatory M&E; process mapping and impact evaluation, feedback mechanisms, adaptive management; roles and responsibilities, etc.
Low extension capacity – equipment (soft and hardware), etc. –to support beneficiary communities	Procurement, O&M maintenance of equipment for effective extension service delivery	Local government extension staff	Procurement, operation and maintenance of hard and software e.g. motorcycles, vehicles, computers and relevant software (e.g. GIS); water quality testing toolkits, etc.
Limited enabling environment for natural resource law enforcement	Wetland and forest legislations	Communities, local leaders, local government natural resource staff	Strengthening of climate smart natural resource (Forest & wetland management) and development institutions
Inadequate climate risk management	Policy formulation, recognize and consider climate risks	All staff at the district local governments & communities in the catchments	Develop impact & vulnerability maps based on better data & climate change impacts at sectoral and regional levels
Low knowledge to develop a robust climate change capacity building plan for the catchment	Integration of climate change considerations including gender in catchment activities	All staff at the district local governments & communities in the catchments	Entry points & opportunities for climate change planning in sector policies, plans and budgets

ANNEXES

Annex 1: REFERENCES

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Annex 2: Models used for Water Resources Modelling and Climate Change Projections

Models used for hydrological modelling and water allocation		
Model	**Model Description**	**Institute**
NAM	Nedbor-Afstromings-Model (NAM) is a conceptual hydrological model that simulates the rainfall-runoff processes occurring at the catchment scale	DHI
Mike Hydro Basin	Mike Hydro (the successor of Mike Basin), is a river basin modelling tool for planning and management of water resources with two main modules; Mike Hydro Basin and Mike Hydro River.	**DHI**

Models used for Climate change projections		
Modeling Center	**Institute**	**Model Name**
BCC	Beijing Climate Center, China Meteorological Administration	bcc_csm1_1
BCC	Beijing Climate Center, China Meteorological Administration	bcc_csm1_1_m
NSF-DOE-NCAR	National Science Foundation, Department of Energy, National Center for Atmospheric Research	cesm4
NSF-DOE-NCAR	National Science Foundation, Department of Energy, National Center for Atmospheric Research	cesm1_cam5
CSIRO-QCCCE	Commonwealth Scientific and Industrial Research Organisation in collaboration with the Queensland Climate Change Centre of Excellence	csiro_mk3_6_0
FIO	The First Institute of Oceanography, SOA, China	flo_esm
NOAA GFDL	Geophysical Fluid Dynamics Laboratory	gfld_cm^3
NOAA GFDL	Geophysical Fluid Dynamics Laboratory	gfld_esm^{2}m
NASA GISS	NASA Goddard Institute for Space Studies	giss_e2_h
NASA GISS	NASA Goddard Institute for Space Studies	giss_e2_r
IPSL	Institut Pierre-Simon Laplace	ipsl_cm5a_mr
MIROC	Japan Agency for Marine-Earth Science and Technology, Atmosphere and Ocean Research Institute (The University of Tokyo), and National Institute for Environmental Studies	miroc_esm
MIROC	Japan Agency for Marine-Earth Science and Technology, Atmosphere and Ocean Research Institute (The University of Tokyo), and National Institute for Environmental Studies	miroc_esm_chem
MIROC	Atmosphere and Ocean Research Institute (The University of Tokyo), National Institute for Environmental Studies, and Japan Agency for Marine-Earth Science and Technology	miroc5
MRI	Meteorological Research Institute	mri_cgcm^3
NCC	Norwegian Climate Centre	noresm1_m

Annex 3: *Matrix of WRM Functions and Services De-Concentration through WMZ*

Water Resources Functions		► ► Level of Decentralisation ►►►					
		Central	**Regional**	**Catchment**	**District**	**Lower Government**	**NGOs**
		MWE/DWRM/DWD	**WMZ offices working with TSUs, WSDF, WMD, UWSs**	**Catchment Management Organisation (CMO)**	**Council/ Environment Committee/DWSCC**	**Local Council/ Local Env'mt Committee**	
Monitoring, Assessment and Information Services	**Monitoring**	National consolidated database and info mgt & dissemination systems National Reference WQ Lab and standards WR monitoring network planning & Dev't	Supervision of data collection Zonal WR database management Real-time updates transfer to centre Regional WQ laboratories	Coordinate activities for community awareness and info mgt & dissemination Coordinate WR monitoring stations observation & mgt Data transfer to WMZ	Community awareness and collaboration for data collection and information dissemination and management Gauging stations operation and maintenance Data Collection & transfer	Community awareness and mobilisation Data collection & transfer Information dissemination	Public awareness and mobilisation Contribution and support in developing IEC strategies Data collection & transfer Capacity building
	Assessment	National and transboundary water resources assessment, planning and coordination	Regional WR mapping, assessment and planning. Contribution to national and transboundary assessments and planning	Contribution to regional assessments and planning	District-level water resources assessment	Data collection	Data collection
Planning and Regulation	**Planning**			Stakeholder-driven catchment-based water resources assessment and planning	District-level water resources planning	Prepare local environment work plans	Capacity building
	Regulation and Compliance	Formulation and review of legislation, policies, standards and procedures Technical support & advisory services to stakeholders National-level enforcement activities Allocation	Assessment of applications for abstraction and easement permits Data collection, storage and transfer to centre Zonal-level enforcement Compliance monitoring	Development and coordination of community education and sensitisation campaigns on relevant laws and regulations; allocation procedures; and benefits of compliance	Community education and sensitisation campaigns on relevant laws and regulations Encourage compliance with regulations and permitting through community engagement Enforcement (later stage)	Community education and sensitisation campaigns on relevant laws and regulations Encourage compliance with regulations and permitting through community engagement Data collection: uses requiring permits, compliance	Public education and sensitisation campaigns on relevant laws and regulations Data collection: uses requiring permits, compliance
Advice and Facilitation	**Coordination of Development Activities**	National and transboundary planning and prioritisation Liaison with other relevant ministries and agencies	Facilitation of regional planning, including through CMOs in the Zone Contribute to national planning and coordination	Forum for stakeholders, and coordination of implementation activities & agencies	District-level coordination and planning Community mobilisation	Community mobilisation	Community mobilisation
	Technical Assistance and Facilitation	Technical assistance and facilitation to the WMZs	Technical assistance and facilitation to relevant stakeholders	Pro-active engagement of WMZ staff and chanelling of technical assistance and facilitation provided Technical assistance and facilitation of relevant stakeholders where possible	Contibution to facilitating CMO activities Chanelling of technical assistance & facilitation to lower councils	Extension services Supporting community activities	Aspects of capacity building services Supporting community and even public activities
	Implementation of Development Activities	Leadership and coordination of implementing agencies	Quality assurance and oversight	Mobilisation and coordination	Implementation	Implementation	Implementation
	Policy and Legislation	Formulation and review of national policies and technical standards Secretariat to the Water Policy Committee Contribution to keeping water-related legislation and regulations up-to-date	Recommendations to centre on policies and legislation	Advocacy and contribution of stakeholder perspectives to policy/legal formulation and review processes Creating awareness Coordinating harmonisation of local bye-laws and ordinances	Contribution of local government perspectives to policy/legal formulation and review processes Enacting bye-laws and ordinances to support relevant plans and/or activities at local level	Creating awareness	Advocacy

Annex 4: ***Area Covered by each Vegetation Category (M2) in the seven (7) Delineated Micro-catchments***

Year	Micro-catchment	Water body/ Bare / Roads	Low vegetation density	Medium vegeta-tion density	High vegetation density
2000	1		117,426,075	36,642,327	
2002	1		69198991.17	54225349.35	31675619.37
2004	1		31853488.49	38019355.81	85797085.32
2006	1		16965768.22	76149328.51	61282935.94
2008	1		1346212.053	98213076.85	54251473.61
2010	1		147975697.8	6849822.253	
2000	2		8106671.209	982656.2074	
2002	2			8098715.713	982649.4036
2004	2				8261016.858
2006	2			1965309.013	7124018.404
2008	2			8098715.713	982649.4036
2010	2		8261016.858		
2000	3	2354315.567	169503084.6	38511165.86	
2002	3		154767554.8	36143897.1	20182101.03
2004	3		48019047.48	85982044.89	73219818.9
2006	3		24864193.52	68624377.63	115910774.2
2008	3		47867401.24	123702352	38344149.6
2010	3		208514653.8	2595531.765	
2000	4		107229997.7	16869395.45	
2002	4		114296517.7	9519258.843	
2004	4		46895746.1	51605047.07	24502037
2006	4		7509222.443	41351930.65	75276150
2008	4		14232987.09	91095932.85	17924844
2010	4		113923541.8	10703558.45	
2000	5		50567945.89	10434928.12	
2002	5		11768521.99	45451871.59	2043887.624
2004	5		1612020.548	5562210.09	52852032.23
2006	5			11404997.03	49205494.8
2008	5			37955188.81	20750649.15
2010	5		47268397.42	12602935.63	
2000	6		47955637.74	38868236.06	
2002	6		24802713.91	34791883.46	26887647.99
2004	6		2749217.094	16166629.66	68512947.46
2006	6			18465151.6	68456220.12
2008	6			37420760.47	49550649.44
2010	6		71999227.91	14797275.98	
2000	7		41065809.71		
2002	7		23440521.98	15877534.02	
2004	7		13179689.4	20079421.97	10310596.31
2006	7		5277739.452	10314721.08	23449070.89
2008	7		7110209.535	25643089.89	6510753.818
2010	7		26843973.09	11623710.44	

Annex 5: *Selected Physico-Chemical Properties of Water in Maziba Micro-catchment*

Eastings	Northings	Village	Parish	Sub-county	EC (µS/cm)	pH	DO (mg/l)	Temp (°C)	TSS (105°C) mg/l	TSS (500°C) mg/l
824226	9874680	Karukara	Shebeya	Hamurwa	222	6.7	6.4	19.6	1072	974
826035	9868058	Ihanga town council	Kashenyi	Bubare	219	6.8	7.1	18.5	57	38
831819	9862178	Northern ward	Rwakaraba northern division	Kabale town	218	7	9	18.2	78	57
833189	9860692	Central ward	Kigonji	Kabale town	227	6.9	7.1	18.3	71	52
833867	9857134			Kitumba	120	7	7.7	18.4	302	256
167553	9848594	Kisasa	Nyakyonga	Kamuganguzi	119	6.8	6.9	18	70	57
168430	9851662	Rwakihirwa	Buhara	Buhara	117	6.6	13.6	17.9	120	98
833398	9859466	Southern ward	Rushaki	Rugyendaira	121	6.8	7.1	18.4	42	29
169219	9860544		Kyanamira town council	Kyanamira	157	6.8	6.2	18.8	289	246
176094	9854762	Maziba dam	Birambo	Kamuronko	131	6.8	6.6	18.3	552	480
177286	9856014		Burambira	Kaharo	196	6.9	7.1	18.2	748	649
Limits for drinking water					250	6.5-8.5		20.0	1000	200

Annex 6: *Kabale District Population by Sub-County and Sex*

Kabale (including Rubanda and Rukiga)	Population census 2002			Proportional share			Population projection 2008			Population projection 2010		
	Male	Female	Total	% male	% female	% Total	Male	Female	Total	Male	Female	Total
Kabale district total	214,552	243,766	458,318				223,811	257,904	481,715	228,546	261,681	490,227
Kabale Municipality	20,584	20,760	41,344	0.10	0.09	0.09	21,472	21,964	43,436	21,927	22,286	44,212
Kabale Central	7,646	7,446	15,092	0.04	0.03	0.03	7,976	7,878	15,854	8,145	7,993	16,138
Kabale Northern	5,194	5,738	10,932	0.02	0.02	0.02	5,418	6,071	11,489	5,533	6,160	11,692
Kabale Southern	7,744	7,576	15,320	0.04	0.03	0.03	8,078	8,015	16,094	8,249	8,133	16,382
Ndorwa	71,662	81,933	153,595	0.33	0.34	0.34	74,755	86,685	161,440	76,336	87,954	164,290
Buhara	11,385	12,945	24,330	0.05	0.05	0.05	11,876	13,696	25,572	12,128	13,896	26,024
Kaharo	8,533	9,441	17,974	0.04	0.04	0.04	8,901	9,989	18,890	9,090	10,135	19,224
Kamuganguzi	11,389	13,146	24,535	0.05	0.05	0.05	11,881	13,908	25,789	12,132	14,112	26,244
Kitumba	7,794	8,434	16,228	0.04	0.03	0.04	8,130	8,923	17,054	8,302	9,054	17,356
Kyanamira	9,140	10,188	19,328	0.04	0.04	0.04	9,534	10,779	20,313	9,736	10,937	20,673
Maziba	8,581	9,550	18,131	0.04	0.04	0.04	8,951	10,104	19,055	9,141	10,252	19,393
Rubaya	14,840	18,229	33,069	0.07	0.07	0.07	15,480	19,286	34,767	15,808	19,569	35,377
Rubanda	79,175	93,605	172,780	0.37	0.38	0.38	82,592	99,034	181,626	84,339	100,484	184,823
Bubare	20,891	23,831	44,722	0.10	0.10	0.10	21,793	25,213	47,006	22,254	25,582	47,836
Bufundi	13,992	17,136	31,128	0.07	0.07	0.07	14,596	18,130	32,726	14,905	18,395	33,300
Hamurwa	12,094	14,020	26,114	0.06	0.06	0.06	12,616	14,833	27,449	12,883	15,050	27,933
Ikumba	14,486	18,130	32,616	0.07	0.07	0.07	15,111	19,182	34,293	15,431	19,462	34,893
Muko	17,712	20,488	38,200	0.08	0.08	0.08	18,476	21,676	40,153	18,867	21,994	40,861
Rukiga	43,131	47,468	90,599	0.20	0.19	0.20	44,992	50,221	95,213	45,944	50,956	96,901
Bukinda	9,568	9,844	19,412	0.04	0.04	0.04	9,981	10,415	20,396	10,192	10,567	20,760
Kamwezi	11,021	12,172	23,193	0.05	0.05	0.05	11,497	12,878	24,375	11,740	13,067	24,806
Kashambya	11,024	12,646	23,670	0.05	0.05	0.05	11,500	13,379	24,879	11,743	13,575	25,318
Rwamucucu	11,518	12,806	24,324	0.05	0.05	0.05	12,015	13,549	25,564	12,269	13,747	26,016

Ntungamo District population census 2014			
Sub-County	**Males**	**Females**	**Total**
Bwongyera	16,260	18,907	18,907
Ihunga	12,316	13,999	26,315
Kibatsi	9,067	10,565	10,565
Nyabihoko	10,537	11,358	21,895
Rwashamaire Town Council	3,565	4,123	4,123
Central Division	4,088	3,777	7,865
Eastern Division	2,910	2,825	2,825
Western Division	2,716	2,538	5,254
Itojo	11,290	12,073	12,073
Kitwe Town Council	8,662	9,518	18,180
Ntungamo	15,077	16,219	31,296
Nyakyera	18,360	20,408	38,768
Ruhaama	20,528	22,804	43,332
Rukoni East	11,323	12,391	23,714
Rukoni West	7,873	8,999	16,872
Rweikiniro	17,450	19,170	36,620
Kayonza	13,597	14,466	28,063
Ngoma	13,317	13,632	26,949
Rubaare	12,905	13,357	26,262
Rubaare Town Council	6,491	6,849	13,340
Rugarama	15,912	17,101	33,013

Annex 7: *Annual Livelihood Beneficiary Assessment Form*

Year of assessment .....(e.g. 2013)

Household no.: ..... Name of H/H head:.....

Beneficiary's name:.....

A) Location

County .....

Sub county.....

Parish..... Village: .....

Distance to track/road: .....

B) Household Characteristics

1) Number of people in H/H.....
2) Number of absent numbers in H/H.....
3) Reason Why absent (seasonal labour migration, education, staying with family elsewhere, start own household)? .....
4) Ethnicity .....
5) Religion.....

Characteristics of household members

No	Name	Age	Education completed	Main (economic) activity	Other (economic) activities
1					
2					
3					
4					
4					
6					

D) Household History

1) When and how started the economic activity .....
2) Where was that?.....
3) What where your main economic activities?.....

.....

E) Farm Characteristics and Land Tenure

1) Do you own land? .....
2) Do you farm?.....
3) Do you also farm land that you do not own? .....
4) Under what arrangement do you use this land.....
5) Do you farm all the land you own? .....
6) What do you do with the land you own and do not farm? .....

Farm Plots ***Hoe farmer ----/ bullock farmer----- / tractor farmer-----***

Plot no	Size (acres)	Use last year	Distance from home	How Acquired?	Tenure situation	Crops (inorder of importance	Harvest qty
1						1	
						2	
						3	
						4	
						5	
2						1	
						2	
						3	
						4	
						5	
3						1	
						2	
						3	
						4	
						5	

A. Use (past year)

1) Food crop
2) Cash crop
3) Grazing
4) Fallow
5) Not used
6) Given out
7) Other (specify)

F) Livestock

1) Do you own animals? .....
2) Did you own animals in the past? .....

Animal Form

Type	No. of Grown animals	No. of young animals	No. of animals 5 years ago	Use (a)
Chickens				
Guinea fowls				
Ducks				
Rabbits				
Goats				
Sheep				
Donkeys				
Cattle				
Pigs				

A. Use of livestock

1) Meat (consumption) 5) Manure 9) Slaughter to hire farm labour
2) Milk/eggs (consumption) 6) Saving 10) Other (specify)
3) Meat (selling) 7) Animal traction
4) Milk/eggs (selling) 8) Social obligations

G) Income Generating Activities

a) cash income

Household member (who?)	Activity (source of income)	Estimate of income level per time unit
	Pension	
	Farm labour	
	Labour migration	
	Crop sales	
	Animal sales	
	Casual labour	

***b) Noncash* Income Generating Activities**

1. Is any household member part of a farming group? .....
2. Did any of you work on other people's farms in exchange for food? .....
3. Did other people come to work on your farm just as much?.....
4. Did you get any food out of hunting/fishing (specify)?.....
5. Did you get any food out of gathering (specify)?.....
6. Did you get any food out of other activities (fruit trees, gardening)?.....
7. Did you get any goods (incl. foodstuff) by exchanging them for other goods (bartering)?.....

Other non-cash sources of income e.g. firewood gathering ……..…. (probe for estimates of cash equivalent)

c) Trends in Income Generating Activities

Has your nonfarm income increased, decreased or stayed the same over time (describe the trend)?

.....

Has the number of income sources for your household increased, decreased or stayed the same over time (describe the trend)?

.....

Cash Expenditure

Type of expenditure		Estimate of costs
Staple	Millet:	
	Maize	
	Rice	
	Staple foods	
	Bananas	
Other food	Prepared food	
	Soup ingredients	
Beer		
Education		
Health		
Consumer goods: …	**clothes**	
	shoes	
	cosmetics	
Firewood / kerosene		
Transport		
Weddings / funerals		
Gifts		
Housing: repairs & improvements		
Productive investments		
Repay of loans		
Others:		

Possessions (Estimate current value)

Item	*Value*	*Item*	*Value*	*Item*	*Value*
Car:		Lantern		Plough	
Cart		Modern furniture		Bicycle	
Motorcycle		Radio		Iron sheet roofing	
Sewing		*Bank saving*		Other	

Annex 8: *Stakeholders Consulted*

Hamurwa sub-county (upstream)

NAME	ZONE/TITLE
Tumukunde Edward	Kigana
Mufungirehe Hattaba	Shebeya
Paka Kamara	Rwabkyenga
Torinawe Tofiri	Rwabkyenga
Ariwetwe J	Shebeya
Rwenderie Vicent	Rwabkyenga
Kyarimpa Vastine	Igomand
Gauda TAMAKRIIRO	Igomand
Ngabirano Nicholas	Shebeya
Tumuhambise Koreta	Shebeya
Twikirize Bibian	Shebeya
Koshaba Irene	Shebeya
Atuyambe Lemmy	Igomand
Tumusime Margret	Igomand
Tumuherwe ROSO	Rwabkyenga
Karabahite D	Rwabkyenga
Mwiine COLLINS	Internishi
Kabatrereine James	C/M LC111
MUTUNGIREHI evaristo	
Twikirize Bibian	Councilor LCIII
Koshaba WENCE	Councillor
Kyarimpa Vastina	Councilor
Tumukunde Edward	Councilor LC V
Kenganzi Joyce	

Sothern Division (Midstream)

NAME	CELL
Tumushabe Vicky	Rushaki
Karwemera Cristine	Rugyendira
Aidah Kacetero	Omwibare
Turinawe Placseda	Omwibare
Mutahunga Barnabus	Mwanjani
Kyansimire Magret	Rushaki
Tukamushaba Charity	Omwibare
Tibingana Erigorite	Omwibare
Dinavens Kibira	Omwibare
Turinawe Vicent	Ruhuta
Rwambayeho Dominic	Kamukira
Tihiwayo Andie	Omwibare
Akampurira Godfly	Omwibare
Peace Kanyakore	Rushaki
Habasa Judith	Omwibare

NAME	CELL
Kakuru Maria	Omwibare
Turihohawe Jastina	Omwibare
Tusiime Agnes	Omwibare
Twebaze Dinavens	Omwibare
Kebirungyi Gloria	Omwibare
Nyakishiki Fridah	Omwibare
Happy Ivace	Omwibare
Kato Jonson	Kirigime
Muhwezi Jastus	Kirigime
Bibangamba Yona	Omwibare
Kyarimpa Janet	Omwibare
Asiimwe Jane	Omwibare
Kiconco Roset	Omwibare
Kyengabire Jackline	Rushaki
Ahimpisa Jastino	Rushaki
Tumwine Hope	Omwibare
Tugabirano Denis	Omwibare
Mutabazi Ambrose	Ruhuta
Mbabazi Christiina	Omwibare
Kabatesi Christina	Omwibare
Komusasi Maria	Rushaki
Tumushabe Christina	Omwibare
KYARISIMA H	Rushaki
KEBIRUNGI M	Omwibare
Tussime K	Omwibare
Tusiime R	Ruhuta
Kebirungi G	Omwibare
Vastina T	Omwibare
Kyogabire H	Rushaki
Magara Silver	Omwibare
Biryomuhendo Victor	Omwibare
Tihwato Andrew	Ruhuta
Kiconco Peace	Asst Com Devt
Kato Jonson	Ruhuta
Katembira P	Ruhuta
Musiimenta PATIENCE	Ingabiro
Bangirana Alex	Town Clerk
Bazirake Lous	C/M LC111
Kyoshabire P	Health ASST
KYOBUTUNGI A	Rushaki

Maziba sub-county (Downstream)

NAME	CELL
Kirenzi Fred	Birambo
Asimwe Onesmas	Birambo
T.okello	Birambo
Bemanya A	Birambo
Biramahire. D	Birambo
Rwabisire E	Birambo
Twinomugisha.s.	Birambo
Mugarura J	Birambo
Koburonde	Nyanja
Mwagabe Barnabas	Birambo
Tuhirirwe A	Nyanja
Akakwansa Florence	Maziba S/C
Nwamanya James	Nyanja
Turyakira Jusstus	Birambo
Mwiine Collins	Birambo
Tumusime Dina	Birambo
Tibikanye Jovelta	Birambo
Nyakerivna	Nyanja
Siamon Tungamredo	Birambo
Muhingire He Fositino	Nyanja
Joy Nimpanga	Birambo
Jos.line	Maziba S/C
Twinobusingi	Kamusonko
Reachel Ahakundine	Kamusonko
Turinawe	Nyanja
Mani Alex	Nyanja
Kapere J	Birambo
Turyansingura G	Birambo
Turyamureeba Edson	Maziba S/C
Bazairawe	Nyanja
Titmwane	Nyanja
Twagirayezu	Nyanja
Manderwa James	Birambo
Twinomujini	Nyanja
Mwenguzi Joseph	Birambo
Kenyanyi Chrisep	Kigarama
Habaasa Jackline	Kayakubana
Kyarikunda	Kigarama
Karyeya	Burambire
Rareeba Casimar	Birambo
Basimoomuha	Nyanja
Byamushija Bosco	Burambire
Turinawe D	Nyanja

KITUMBA			
s/n	**NAME**	**TITLE**	**PARISH**
1	MUHUMUZA PETER	C.L.O	Kitumba
2	MUBANGIZI HERBERT	LC1	Bushuro
3	RUGAMBWA JOHN BOSCO	Opinion Leader	Kitumba
4	TWESIGYE WYCLIFFE	LC1	Kitumba
5	AYEBALE PAUL	Farmer	Kitumba
6	TWESIGYE ISAAC	Farmer	Kitumba
7	BAHEMUKA DASSY	Farmer	Kitumba
8	KWIKIRIZA PATRICIA	Farmer	Bushuro
9	KIHEMBO ISAAC	Farmer	Kitumba
10	AKAMPURIRA JOVENTA	Farmer	Bushuro
11	KASIGAIRE DAVID	Farmer	Kitumba
12	ARIHO KENNETH	Farmer	Kitumba
13	TURINAWE JOSEPH	Farmer	Kitumba
14	TUMUSHABE TEDDY	Farmer	Kitumba
15	TWESIME PURISIRA	Farmer	Kitumba
16	RWAKARI FAUSTA	LC1	Kitumba
17	ASIIMWE EVAS	Farmer	Kitumba
18	MUGWENYI ARCHANGEL	Catechist	Rushorozo
19	TAYEBWA DRAKE	Youths Secretary	Kitumba
20	TUKAMUSHABA VICKY	CSO/ C/Person	Kitumba
21	KYOMUHENDO KATE	Mobilizer	Kitumba
22	TINDIWEGYI PRUDENCE	Mobilizer	Kitumba
23	RUGASIMBANA .P	Farmer	Kitumba
24	RUGASIMBANA .W	Farmer	Bushuro
25	TWEBAZE SILVER	Brick Layer	Kitumba
26	TWESIGOMWE SILVER	Farmer	Kitumba
27	ENSINKWERI EVARSITO	Defence	Bushuro
28	BYARUHANGA GAD	Security	Kitumba
29	AKANKUNDA LOYDAH	Agric Officer	Kitumba
30	NYESIGIRE ELIAS	Peasant	Bushuro
31	MUHOOZI GILBERT K	Builder	Bushuro
32	ABANGIRA FELIX	Peasant	Bushuro
33	KABACENGA JACKSON	LC1	Bushuro
34	OWOMUGISHA FRED	Plumber	Bushuro
35	TUMUSHABE GLORIA	Farmer	Bushuro
36	ARINETWE STUART	Opinion Leader	Kitumba
37	ANNAH MUGURUSI	Shop Owner	Bushuro
38	ATUKWASE DAPHINE	CDO	Kitumba
39	KWKIRIZA YONA	COISO	Mwendo
40	MWESIGYE PATRICK	PCC Bushwo	Bushuro
41	RUKUNDO ENOCK	AASP. Crop	Kitumba
42	MUSIIMENTA ALLEN K	SAS	Kitumba

KAHARO			
S/N	**NAME**	**TITLE**	**PARISH**
1	TUMUKURAIHIRA GRACIOUS	LC1	Nyakasharara
2	KANYIMA BENON	LC1	Lyamujungu
3	KAMAMURA JOHN	LC1	Omuruhita
4	RUBARAMIRA ELISAN	Repigous Leader	Kahoro
5	KAHIND PATAREO	LC1	Kyamakamba
6	KAMUSHEMEE DEOGRATIUS	Teacher	Kaharo
7	BAMUTURAKI D	Vice	Kyamakamba
8	ARIBANKOHA F	LC1	Rukoma
9	S. BAKAHAHWENDE	LC1	Kahita
10	BAMWETIIRIZE .A	LC1	Kinyara
11	SCOT SILVESTER	LC1	Kabaraga
12	MUCHOLI NERSON	LC1	Nyamushangywa
13	KABEISIRE JOHNSON	LC1	Ryarubuugo
14	TURGAMUREBA CHEISTOPHER	LC1	Nyakatare
15	MBAGIRWOHA FUDEL	LC1	Nyakasharara
16	KABEGAMBIRE DENNIS	LC1	Rwamugasha
17	JENINAH TINDMURAGABE	LC1	Nyakasharara
18	AIPBAYEMNDA MICHAL	OC	Kaharo
19	KAKONGI FRANK	LC1	Rwabashenyi
20	BIKORWOMUHANGI WILLY	LC1	Nyakasharara
21	RUKAYAKARE SILVER	LC1	Nyakasharara
22	BWAMBIZO GEOFFREY	LC1	Nyakasharara
23	TWAMWIYUKA	LC1	Ahamwambi
24	TUKOMUGISHA S	LC1	Nyabitabo
25	KANAMAWAKI V	LC1	Nyakasharara
26	JACKLINE TIBENDENA	Lady Leader	Nyabitabo
27	NATURINDA BRIGHTON	Naads Coordinator	Kaharo
28	TWEYONGERE BONIFEE	Parish Chief	Kaharo
29	KATO RUDOUNITE	LC1	Nyakasharara
30	KABEISA	LC1	Kaharo
31	AKANKWASA WILSON	LC1	Kaharo
32	BIMAKWE FRED	LC1	Kaharo
33	KARANI APPOHENE	LC1	Kaharo
34	BYABUGABA E	LC1	Nyakasharara
35	BYAMUGISHA BOSCO	Parish Chief	Kaharo
36	FLAVIA KANAGIZI	District Councillor	Nyakasharara
37	MUHEREZA DASTN	LC3	Kaharo
38	TUMWINE GRACIOUS KABETH	Assist Councillor	Kaharo
39	BEN MWANGYA	LC1	Kaharo
40	RWAMAMAZI ROERT	LC1	Kaharo
41	MUTUNGI GAD	LC1	Kaharo
42	AKANKWASA J	LC1	Kaharo
43	BYOMUHANGI G	Catechist	Nyakasharara
44	KADIYA FRECIOUS	LC1	Nyakasharara

45	MUBANGIZI ADRROC	LC1	Nyakasharara
46	MUGYEMA	LC1	Nyakasharara
47	TISASIRANA JULIUS	LC1	Nyakasharara

KAMUGANGUZI			
S/N	**NAME**	**TITLE**	**PARISH**
1	NISIMA ESTER	V.H.T	Kasheregyenyi
2	NANZIRIZARI JAMES	MOBILIZER	Kasheregyenyi
3	TUKWASIIBWE JULIUS	C/MAN	Kasheregyenyi
4	PATRICK NDIREYO	FARMER	Kasheregyenyi
5	ALLEN BAKANDEMA	FARMER	Kasheregyenyi
6	MUHWEZI NICHOLAS	FARMER	Kasheregyenyi
7	TURYAMUREBA	FARMER	Kasheregyenyi
8	TUMWESIGYE ELIAS	FARMER	Kasheregyenyi
9	MUHERZA GODFREY	V.H.T	Kasheregyenyi
10	TIBEESIGWA MILTON	FARMER	Kasheregyenyi
11	RUHITA GODFREY	FARMER	Kasheregyenyi
12	RUGORA TINYEBA	FARMER	Kikumbi
13	MALEBAYEMA JOHN	V.H.T	Kikumbi
14	TURYSTEMBE JESCA	C/MAN	Kikumbi
15	KATEBALEMA MPOZIT	C/MAN	Kikumbi
16	TUMWIRIZE OBED	V.H.T	Kikumbi
17	KATAREIHA SIMPSON	FARMER	Kikumbi
18	MUHEREZE HENRY	FARMER	Kasheregyenyi
19	RICHARD .Z	FARMER	Kasheregyenyi
20	ISAYA DAMPABWA	FARMER	Kasheregyenyi
21	TINDIWWEBWA WILLIAM	COUNCILOR	Kasheregyenyi
22	CODRE BUSABIRI	FARMER	Kasheregyenyi
23	MUTUNGI JAMES	FARMER	Kasheregyenyi
24	HABAASA ROBERT	FARMER	Kisasa
25	KATABAIRWE PATRICK	FARMER	Kikumbi
26	KABOROOGA TURUTINI	V.H.T	Kasheregyenyi
27	TURYATAMUEEBA WALLEN	V.H.T	Kasheregyenyi
28	KASHUGYERA FABIANO	C/MAN	Kasheregyenyi
29	ZINSHANGA WILLIAM	FARMER	Kasheregyenyi
30	NDAGIJE ALLEN	V.H.T	Kasheregyenyi
31	TUMWEBAZE GAUDO	LC1	Kikumbi
32	MUGYESWA WINNIE	FARMER	Nyakasharara
33	BINYOMUMEISHA FRANCIS	FARMER	Kasheregyenyi
34	TUNYASINGARA PENINAH	V.H.T	Kasheregyenyi
35	MWEBESA DEUS	LC3	Kikumbi
36	BAKEIHAHWENKI DONATUS	PEER LEADER	Kyasaano
37	AKANKWASA BENON	LC1	Kisaasa
38	TUKAMUSHABA VIRIGI	V.H.T	Kisaasa
39	GLORIA KAMPA	LC1	Kisaasa
40	TUKAMUBANA ENID	V.H.T	Kisaasa

41	BEIJABOROBI EUNICE	PARASOCIAL WORKER	Kisaasa
42	BYAMUKAMA CATHERINE	VICE PERSON	Kasheregyenyi
43	BUSINGYO ELESIE	FARMER	Kasheregyenyi
44	AKANKUNDA JOLLY	MEMBER	Kisaasa
45	PEACE RUTARAKA	V.H.T	Kisaasa
46	KYARIKUNDA VALERIAN	ELDER	Kisaasa
47	BAZIRAKYE GEORGE	FARMER	Kisaasa
48	NUBANGIZI HERBERT	LC2	Kisaasa
49	TURYAGUMANE JULIUS	LC1	Kisaasa
50	KARIYO PETER	LC1	Kisaasa
51	RUTIRAMIRWA JACKSON	POLICE	Kasheregyenyi
52	GWEEGO DONALD	ACCOUNTANT	Kasheregyenyi
53	KINONO NORAH	AAASP	Kasheregyenyi
54	OWORWAWE ELIAS	STUDENT	Kasheregyenyi
55	NDABWINE JACKSON	ELDER	Burange
56	TWEBAZE JACLINE	V.H.T	Kasheregyenyi
57	RWABINGE BONIFACE	RETIRED TEACHER	Kasheregyenyi
58	MANZI GORDON	CDO	Kasheregyenyi
59	TWESIGOMWE ELIUS	LC3 CHAIR PERSON	Kamugaguzi

BUHARA			
S/N	**NAME**	**TITLE**	**PARISH**
1	MBAHINGUZA GORDON	C/MAN	Muyebe
2	NIGUMABWE YEHO	V.H.T	Buharu
3	TUWINEMUGISHA STEPHEN	V.H.T	Buharu
4	TUDAMANYIRE CHARLES	C/MAN	Muyebe
5	AKAMPURIRA GAS		Muyebe
6	BARYAMUJARA JOSEPH	PARISH CHIEF	Buharu
7	NDIHEIHI JEHNSTONE	PARISH CHIEF	Buharu
8	AINEHENRY KABEIREHO	C/MAN	Muyebe
9	ABE JULIUS	V.H.T	Buharu
10	NIWAGAA WINNIE	C/MAN	Buharu
11	BYOMUHANGI P	C/MAN	Buharu
12	KATO EMAS	C D O	Buharu
13	NASHEMERERWA JULIUS	AAASP COPERATOR	Buharu
14	BAMUGWENDANA WILSON	REV	Buharu
15	MWESIGYE ISAAC	V.H.T	Nyamirima
16	TUMUSHABE GODFREY	C/MAN	Muyebe
17	TURYASHEMERWRA EVA	V.H.T	Buharu
18	PATRICK TUGUMISIRE	C/MAN	Buharu
19	MUSINGUZI FRANCS	O/C POST	Buharu
20	TURYAREEBA JAMES	MOBILISER	Buharu
21	TINDAMANYRE JAMES	MOBILISER	Buharu
22	TUKAHIRWA EVAS	V.H.T	Buharu
23	NKERABIGWI ALFRED	S/C CHIEF	Buharu
24	TUMUHIMBISE JOHN	FARMER	Buharu

25	MAGEZI GOD	V.H.T	Muyebe
26	TWENOMUHEZE SEND	MOBILISER	Buharu
27	BUSINGYE ANITA	FARMER	Muyebe
28	TWIMUKYE LILLIAN	FARMER	Buharu
29	TURYAMWIJUKA JUSTINE	FARMER	Buharu
30	KUMUHANGI EDITH	FARMER	Buharu
31	TIBENDERANA JOSEPH	FARMER	Buharu
32	KYOMHANGI GLORIOUS	V.H.T	Muyebe
33	TUSINGWIRE JOLLY	WOMAN MOBILIZER	Muyebe
34	TUKAMSHABA VARARY	WOMAN MOBILIZER	Muyebe
35	NASINGUZA ALLEN	MOBILISER	Buharu
36	NIWARIMPA ANNET	FARMER	Muyebe
37	GLORIOUS BETEISE	FARMER	Buharu
38	AKORAGYE CONSTANCE	MOBILISER	Muyebe
39	NATUMAIVYA GLADYS	MOBILISER	Muyebe
40	BURYAHIKA PATRCK	C/MAN	Muyebe
41	ORIBOKIRIHO ERINEO	MOBILISER	Kyasea
42	ATWEBEMBERE GIDEON	MOBILISER	Buharu
43	ASHABA ALICE	MOBILISER	Muyebe
44	SSAJJABI JOHNSON	MOBILISER	Buharu
45	TUNDAMANYIRE CHARLES	C/MAN	Muyebe
46	AKAMPURIRA GAS	C/MAN	Muyebe
47	BETTY MATSIKO	V.H.T	Muyebe
48	TWINOMUHEZI SADRESS	V.H.T	Buharu
49	BYARUHANGA NICHOLAS	PARISH PRIEST	Buharu
50	ANYIJUKIRE DISMAS	OPINION LEADER	Buharu
51	NEEMA SCOVIA	V.H.T	Buharu
52	EKYANSIMIRE GORETTI	FARMER	Ntabarana

RUBAYA			
S/N	**NAME**	**TITLE**	**PARISH**
1	SATURDAY MERCY	COMMUNITY MOBILLIZER	Mugandu
2	EUNICE BAKEHIHA	PEASANT	Mugandu
3	NYIRAKAJE FILINI	FARMER	Mugandu
4	NSHEMIRIRWE J	VICE C/MAN	Mugandu
5	KEMIGISHA LYDIA	PEASANT	Mugandu
6	ATUKWASE ONESMUS	YOUTH LEADER	Mugandu
7	PROVIA BIGHERO	FARMER	Mugandu
8	AKAMPURIRA JANET	FARMER	Mugandu
9	ABARIBABARIO JULIET	LC1	Rukore
10	NTEGYEREIZE APOFIA	FARMER	Mugandu
11	BANONERA JOHNSON	FARMER	Mugandu
12	MUKARAGYE	FARMER	Mugandu
13	TUGUME ABEL	FARMER	Mugandu
14	KAYAREDOKY B	POLICE	Rubaya
15	BETUNGURA LIVINGSTONE	FARMER	Mugandu
16	NDINGA EDWARD	LC1	Rubaya

17	KAKURU ALEX	TEACHER	Buramba
18	MASHAIJA BENON	FARMER	Mugandu
19	EKANSIMIRE	FARMER	Mugandu
20	OWOYESIGYE VICTOR	FARMER	Rubaya
21	KABAHIZI VICENT	POLICE	Kibuga
22	BYONABEBYE LILLIAN	TEACHER	Buramba
23	BYONABEBYE KENNETH	FARMER	Mugandu
24	MURRISI EDISON	FARMER	Buramba
25	TURYAHEWA WILBERFORCE	FARMER	Mugandu
26	TUMWESIGYE FRANCIS	FARMER	Mugandu
27	TWINOMUJUNI MERCY	STUDENT	Mugandu
28	NATUKWASA DIANNAH	DRUG DEALER	Buramba
29	LOVINA BIREKYERAHO	FARMER	Buramba
30	EVAS HABARWASHA	FARMER	Buramba
31	KAGWA JOHN	TEACHER	Mugandu
32	KASIGAZI ALEXANDER	OFFICER	Mugandu
33	BAHGAMUSI ALEX	FARMER	Kibuga
34	MUHIMBISE DORAH	TEACHER	Kibuga
35	NDYAMUHAKI EUGENE	TEACHER	Mugandu
36	NAMANYA LADEN	TRADER	Kibuga
37	BYAMANYEBE YANAL	PEASANT	Mugandu
38	ARINATWE EVALYNE	POLICE OFFICER	Rubaya
39	RINDABO ZERADO	C D O	Mugandu

BUBARE			
S/N	**NAME**	**TITLE**	**PARISH**
1	Rwamushana Yosam	C/MAN	Kanjobe
2	MUGISHA JOHNSON	C/MAN	Kanjobe
3	BESIGYE MATTHIAS	C/MAN	Kigata
4	TINYATABA JAMES	LC3	Kanjobe
5	BARUHUKA JOHNSON	LC1	Rwempera
6	BESIGYE LOUIS	LC1	Kigata
7	BAKAMA INNOCENT	COUNCILLOR	Kanjobe
8	TUMWIJUKYE DAVID	C/MAN	Kigata
9	BYAMUGISHA E	C/MAN	Kanjobe
10	ANKAKWASA ANNET	C/MAN	Rugarama 1
11	MBABAZI EDISON	C/MAN	Kigata
12	BAZIRAKYE S	C/MAN	Nyamiyaga
13	KABAZIGURUKA WILSON	C/MAN	Kigata
14	BYARUHANGA P	C/MAN	Kanjobe
15	AHIMBISIBWE JAMES	C/MAN	Nyamiyaga
16	MUBANGIZI PETER	C/MAN	Kanjobe
17	BAGUMA JAMES	C/MAN	Kihanga
18	SUNDAY POLECARIPO	C/MAN	Kanjobe
19	TINDOMANYIRE COSTANCE	C/MAN	Rugarama 1
20	BYORUGANDA PANCRAS	C/MAN	Kihanga
21	KARUGAHE PATALLEO	C/MAN	Kayanja

22	TIBYEITU FRANCIS	C/MAN	Kigata
23	BILLAKAZI FABIANO	C/MAN	Kanjobe
24	MAFUMBE JOHN	C/MAN	Kanjobe
25	TURYAMUREBA PASCAL	C/MAN	Kanjobe
26	RWAMPIGI ANNET	C/MAN	Kanjobe
27	KATUSINGIZI J	C/MAN	Kanjobe
28	BAZONGOZA J	C/MAN	Kanjobe
29	KATAMBAZI STEVEN	C/MAN	Kanjobe
30	KIHEMBO GODFREY	C/MAN	Kigata
31	KAMUGISHA FRANCIS	C/MAN	Kanjobe
32	KEMIGISHA REACHEL	CDO	Kyanamura
33	TUKWASIIBWE SAMSON	C/MAN	Kanjobe
34	KYORIBONA DEO	C/MAN	Kanjobe
35	KAMUGISHA DEUS	LC3 c/m	Kyanamura
36	BYARUNGA F	C/MAN	Kyanamura
37	TWINAMASIKO JOHN	C/MAN	Kyanamura
38	TUMUHIMBISE GASTON	C/MAN	Kyanamura
39	BYARUGABA LAZURUS	C/MAN	Kyanamura
40	KAMUHANDA JUSTUS	C/MAN	Kyanamura
41	NZINGA LEOPALD	LC1	Kyanamura
42	BYORUGABA FRANCIS	C/MAN	Kyanamura
43	RWEKIHUNDE J	C/MAN	Kanjobe

KYANAMIRA			
S/N	**NAME**	**TITLE**	**PARISH**
1	Rwamushana Yosam	C/MAN	Kanjobe
2	MUGISHA JOHNSON	C/MAN	Kanjobe
3	BESIGYE MATTHIAS	C/MAN	Kigata
4	TINYATABA JAMES	LC3	Kanjobe
5	BARUHUKA JOHNSON	LC1	Rwempera
6	BESIGYE LOUIS	LC1	Kigata
7	BAKAMA INNOCENT	COUNCILLOR	Kanjobe
8	TUMWIJUKYE DAVID	C/MAN	Kigata
9	BYAMUGISHA E	C/MAN	Kanjobe
10	ANKAKWASA ANNET	C/MAN	Rugarama 1
11	MBABAZI EDISON	C/MAN	Kigata
12	BAZIRAKYE S	C/MAN	Nyamiyaga
13	KABAZIGURUKA WILSON	C/MAN	Kigata
14	BYARUHANGA P	C/MAN	Kanjobe
15	AHIMBISIBWE JAMES	C/MAN	Nyamiyaga
16	MUBANGIZI PETER	C/MAN	Kanjobe
17	BAGUMA JAMES	C/MAN	Kihanga
18	SUNDAY POLECARIPO	C/MAN	Kanjobe
19	TINDOMANYIRE COSTANCE	C/MAN	Rugarama 1
20	BYORUGANDA PANCRAS	C/MAN	Kihanga
21	KARUGAHE PATALLEO	C/MAN	Kayanja
22	TIBYEITU FRANCIS	C/MAN	Kigata

23	BILLAKAZI FABIANO	C/MAN	Kanjobe
24	MAFUMBE JOHN	C/MAN	Kanjobe
25	TURYAMUREBA PASCAL	C/MAN	Kanjobe
26	RWAMPIGI ANNET	C/MAN	Kanjobe
27	KATUSINGIZI J	C/MAN	Kanjobe
28	BAZONGOZA J	C/MAN	Kanjobe
29	KATAMBAZI STEVEN	C/MAN	Kanjobe
30	KIHEMBO GODFREY	C/MAN	Kigata
31	KAMUGISHA FRANCIS	C/MAN	Kanjobe
32	KEMIGISHA REACHEL	CDO	Kyanamura
33	TUKWASIIBWE SAMSON	C/MAN	Kanjobe
34	KYORIBONA DEO	C/MAN	Kanjobe
35	KAMUGISHA DEUS	LC3	Kyanamura
36	BYARUNGA F	C/MAN	Kyanamura
37	TWINAMASIKO JOHN	C/MAN	Kyanamura
38	TUMUHIMBISE GASTON	C/MAN	Kyanamura
39	BYARUGABA LAZURUS	C/MAN	Kyanamura
40	KAMUHANDA JUSTUS	C/MAN	Kyanamura
41	NZINGA LEOPALD	LC1	Kyanamura
42	BYORUGABA FRANCIS	C/MAN	Kyanamura
43	RWEKIHUNDE J	C/MAN	Kanjobe
44	RWEHIRIKA LUKA	C/MAN	Kyanamura
45	TISHEMBWA SILVER	C/MAN	Nyamiyaga
46	TINAKO GERVAS	C/MAN	Kyanamura
47	MUHWEZI YOSAMU	C/MAN	Kyanamura
48	SANYU LAMELI	C/MAN	Kigata
49	NKARAGABAYA LEWIS	C/MAN	Kigata
50	MBBARINDA JOHN	C/MAN	Rwemishire
51	RUBAREMA GIDEON	C/MAN	Nyakabingo
52	RWAMUHANDA AMBROSE	C/MAN	Kyanamura
53	EGAD BIRIISA	COUNCILOR	Kanjobe
54	NIWAMANYA LAZARO	C/MAN	Muyumbu
55	BYORUGANDA FRED	C/MAN	Nyakiga
56	RUTASIKWA ANATORI	COUNCILOR	Kyanamura
57	MUNUHURA JOHN	FISH FARMER	Kyanamura
58	KYAKWERA BETTY	V.H.T	Kanjobe
59	BAYIGINYWA GODDY	C/MAN	Kanjobe
60	GABOOYA DENISS	C/MAN	Nkombe
61	BANSIGERKO LOUIS	C/MAN	Katokye
62	BITAKAMIRE ANATORIO	C/MAN	Katokye
63	ASYLESTO MAGARAGESI	C/MAN	Katokye
64	MUJUNI EDWARD	C/MAN	Katokye
65	BIRUNGI ELIAS	C/MAN	Katokye
66	TUMUKIRE ELIAS	C/MAN	Katokye
67	TUMWAKIRE ALIFONSINA	PARISH CHIEF	Katokye
68	ASIMWE BEATRICE	PARISH CHIEF	
69	KANYESIGWE JULIUS	PARISH CHIEF	Muyumbu

70	ARIMWAANI PATRICK	PARISH CHIEF	Nyakagera
71	BYARUGABA DEO	PARISH CHIEF	Kanjobe
72	RWEGOO GEORGE	PARISH CHIEF	Kyanamura
73	KAMUGISHA N	C/MAN	Kigata
74	TURYAMUREBA ALEX	C/MAN	Kyanamura
75	CHRISTINE NIWAMANYA	COUNCILLOR	Kanjobe
76	KARUZZA VALENTINO	C/MAN	Kyanamura
77	RUTAGONYA KILIMBAD	C/MAN	Kyanamura
78	KAGAMBE BERNAD	C/MAN	Kanjobe
79	KYOMUHANGI LYDIA	S/C CHIEF	Kyanamura

Stakeholders consulted during the current (2020) Update

	NAME	TITLE	DISTRICT	CONTACT
1	KATUSHABE PAMELA	Environment Officer	Rubanda District	0774062164
2	OTIKA DAVID	District Water Officer	Rubanda	0782787978
3	SABIITI TREOPH	D/Community Dev't Officer	Rubanda	0782800184
4	MUHANGI POLLY	LC II Chairperson	Hamurwa Parish	0772946303
5	KICONCO OLIVIA	CDO	Hamurwa S/C	0772086071
6	KWARIJA ANNET	Social Dev't Officer	EURECCCA-VWMZ	0782656393
7	TUMUSHENGYE DISMAS	Ag. District Water Officer	Ntungamo District	0774512116
8	MUGABE ABEL	District Fisheries Officer	Ntungamo	0772886842
9	MATSIKO CALLIST	Subcounty Councillor	Ntungamo	0787780801
10	BERNAD MURASA	District Councillor	Ntungamo	0784125132
11	TUMWEBAZE DINAH	Senior Environment Officer	Ntungamo	0772643221
12	BYABASHEIJA MOHAMED	S/C Chairperson	Kayonza Subcounty Ntungamo	0771416437
13	AYAMBE GUSTERVAS	Assistant Water Officer	Ntungamo	0783454472
14	AHUMUZA GILBERT	Ag. Water Officer	Rukiga District	0774141503
15	DOROTH MBAGUTA	DCDO	Rukiga	0702949911
16	AGUMISIRIZA NELSON	DNRO	Rukiga	0783829986
17	KATWESIGYE LEORNARD	DPMO	Rukiga District	0781723277
18	AGABA AMON	District Fisheries Officer	Rukiga District	0782090694
19	TUMUHEIRWE HARRIET	Senior Environment & Production officer	Kabale DLG	0782730166
20	TWEBAZE JENNIFER	Senior Fisheries Officer	Kabale District	0772593312
21	KAMUGISHA HENRY	DCDO	Kabale DLG	0772854861
22	TUSIIME GILBERT	Water Officer	VWMZ-Kabale Office	0772640136
23	AKATWIJUKA ROGERS	District NRO	Kabale DLG	0772670508

Annex 9: *Estimated Number of Beneficiaries per Prioritized Micro-Catchment*

Hamurwa micro-catchment

Sub-county/ Parish	Population 2012		
	Male	Female	Total
Bubare Sub County			
Bwindi	3,800	4,400	8,200
Nangara	2,700	3,100	5,800
Hamurwa Sub County			
Hamurwa	2,000	2,400	4,400
Igomanda	2,400	2,700	5,100
Kakore	1,900	2,400	4,300
Mpungu	2,600	2,800	5,400
Ruhonwa	1,900	2,300	4,200
Shebeya	2,300	2,600	4,900
Ikumba Sub County (25%)			
Mushanje	425	575	1,000
Nyakabungo	650	775	1,425
Nyaruhanga	625	775	1,400
Nyamabare	625	800	1,425
Total	**21,925**	**25,625**	**47,550**

Bubaare micro-catchment

Sub-county/ Parish	Population 2012		
	Male	Female	Total
Kabale Central Division	**4,200**	**4,250**	**8,450**
Butobere 50%	950	750	1,700
Central 50%	1,150	1,300	2,450
Nyabikoni	2,100	2,200	4,300
Kabale Northern Division	**4,100**	**4,500**	**8,600**
Kijuguta	1,900	2,000	3,900
Rutooma	700	800	1,500
Upper Bugongi	1,500	1,700	3,200
Kabale Southern Division	**7,200**	**6,900**	**14,100**
Karubanda	1,700	2,100	3,800
Kirigime	2,800	2,400	5,200
Mwanjari	2,700	2,400	5,100
Kamuganguzi Sub County	**8,400**	**9,600**	**18,000**
Buranga	1,700	1,900	3,600
Kasheregenyi	1,400	1,800	3,200
Kicumbi	1,900	2,100	4,000
Kisaasa	1,000	1,200	2,200
Mayengo	2,400	2,600	5,000
Kitumba Sub County	**5,900**	**6,300**	**12,200**
Bushuro	2,200	2,300	4,500
Kitumba	900	1,100	2,000
Mwendo	2,800	2,900	5,700

Bubare Sub County	**15,625**	**17,775**	**33,400**
Bubare	2,900	3,400	6,300
Butoboore	2,800	3,300	6,100
Kagarama	4,700	5,200	9,900
Kashenyi	1,700	2,000	3,700
Muyanje	1,725	1,875	3,600
Nyamiyaga	1,800	2,000	3,800
Hamurwa Sub County	**1,425**	**1,800**	**3,225**
Kakore 75%	1,425	1,800	3,225
Buhara Sub County	**3,200**	**3,650**	**6,850**
Buhara 50%	1,000	1,150	2,150
Rwene 50%	1,350	1,550	2,900
Muyebe 50%	850	950	1,800
Muko Sub County	**450**	**500**	**950**
Kyenyi 25%	450	500	950
Total	**50,500**	**55,275**	**105,775**

Kyanamira-Buhara micro-catchment

Sub-county/ Parish	Population 2012		
	Male	**Female**	**Total**
Kabale Central Division			
Butobere	950	750	1,700
Central	1,150	1,300	2,450
Kigongi	1,000	1,000	2,000
Kabale Southern Division			
Rushaki	600	650	1,250
Buhara Sub County			
Bugarama	1,400	1,500	2,900
Kafunjo	2,100	2,500	4,600
Kitanga	1,100	1,300	2,400
Ntarabana	1,400	1,500	2,900
Kyanamira Sub County			
Kanjobe	1,000	1,200	2,200
Katookye	1,300	1,500	2,800
Kigata	2,000	2,300	4,300
Kyanamira	1,500	1,600	3,100
Muyumbu	1,300	1,500	2,800
Nyabushabi	2,000	2,100	4,100
Nyakagyera	800	900	1,700
Maziba Sub County			
Karweru	550	550	1,100
Bubare Sub County			
Muyanje	575	625	4,800
Total	**20,725**	**22,775**	**47,100**

Maziba west

Sub-county/Parish	Population 2012		
	Male	Female	Total
Maziba Sub County			
Birambo 50%	900	950	1,850
Kahondo	1,400	1,700	3,100
Karweru 50%	550	550	1,100
Kavu 50%	950	1,100	2,050
Nyanja	1,800	2,000	3,800
Rugarama	1,300	1,500	2,800
Total	**6,900**	**7,800**	**14,700**

Rubaya-Kamuganguzi

Subcounty/Parish	Population 2012		
	Male	Female	Total
Kamuganguzi Sub County			
Kyasano	2,100	2,600	4,700
Rubaya Sub County			
Karujanga	2,600	3,200	5,800
Kibuga	2,100	2,500	4,600
Rwanyena	2,400	3,000	5,400
Total	**9,200**	**11,300**	**20,500**

REPUBLIC OF UGANDA

MINISTRY OF WATER AND ENVIRONMENT

DIRECTORATE OF WATER RESOURCES MANAGEMENT