IWRM Programme Rwanda

TR25 - Catchment Plan Muvumba 2017-2023

March 2017



Kingdom of the Netherlands

Issue and revision record

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2	2 March 2017	F.Hakizimana B. Zaake R. Nieuwenhuis	R. Mugunga K. Bulder	E. Smidt VdP. Kabalisa C. Bäcker	Final version for Focal Group (note: CBA data still to be completed before Focal Group meeting)
3	15 March 2017	R. Nieuwenhuis	K. Bulder	E. Smidt	Updated with feedback from Focal Group: landscape rehabilitation map and roadmap
4	29 March 2017	B. Zaake	R. Nieuwenhuis	E. Smidt	Updated legends of water demand figures

Water for Growth Rwanda is a platform to promote improved management of Rwanda's water resources. A joint Rwanda-Netherlands initiative, Water for Growth is supported by the IWRM Programme Rwanda, implemented by Euroconsult Mott MacDonald (lead partner) in association with SNV and SHER. www.water.rw

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List of Abbreviations

CCPA	Climate Change Programme of Action
CTF	Catchment Task Force
EDCL	Energy Development Corporation Ltd
EDPRS-2	Economic Development Poverty Reduction Strategy - 2
EKN	EKN Embassy of the Kingdom of the Netherlands (in Rwanda).
EIP	Early Implementation Project
EUCL	Energy Utility Cooperation Ltd
GIS	Geographical Information System
GoR	Government of Rwanda
IWRM	Integrated Water Resources Management
M&E	Monitoring and Evaluation
MIDIMAR	Ministry of Disaster Management and Refugee Affairs
MIGEPROF	Ministry of Family and Gender Promotion
MINAFFET	Ministry of Foreign Affairs and Cooperation
MINAGRI	Ministry of Agriculture and Animal Resources
MINALOC	Ministry of Local Government
MINECOFIN	Ministry of Finance and economic Planning
MINEDUC	Ministry of Education
MINICOM	Ministry of Commerce
MININFRA	Ministry of Infrastructure
MINIRENA	Ministry of Natural Resources
MIS	Management Information System
NCEA	Netherlands Commission for Environmental Assessment
NGO	Non-Governmental Organization
NWCC	National Water Consultative Commission
NWRMP	National Water Resources Master Plan
PASB	Planning by Administrative and Sectoral Boundaries (alternative)
PCB	Planning by Catchment Boundaries (alternative)
RAB	Rwanda Agriculture Board
RDB	Rwanda Development Board
REMA	Rwanda Environment Management Authority
RMA	Rwanda Meteorological Agency
RNRA	Rwanda Natural Resources Authority
RURA	Rwanda Utilities Regulatory Authority
RWFA	Rwanda Water and Forestry Authority
SDG	Sustainable Development Goals
SEA	Strategic Environmental Assessment
WASAC	Water and Sanitation Corporation
WIC	Water Inter-Ministerial Committee

Executive Summary

The need for a catchment plan for Muvumba

The Muvumba catchment (Figure 1) in north-eastern Rwanda is one of the nation's transboundary catchments. A diverse catchment, with high mountains in the west and lower and flatter conditions in the east. Almost all economic growth in the catchment is linked to water use, be it in agriculture, livestock, industry, or plainly related to providing drinking water to urban and rural areas. The transboundary nature of the catchment demands careful planning and close collaboration with Uganda, where a catchment plan already is in place for their two parts of the catchment (both discharge into Rwanda, but at separate points).

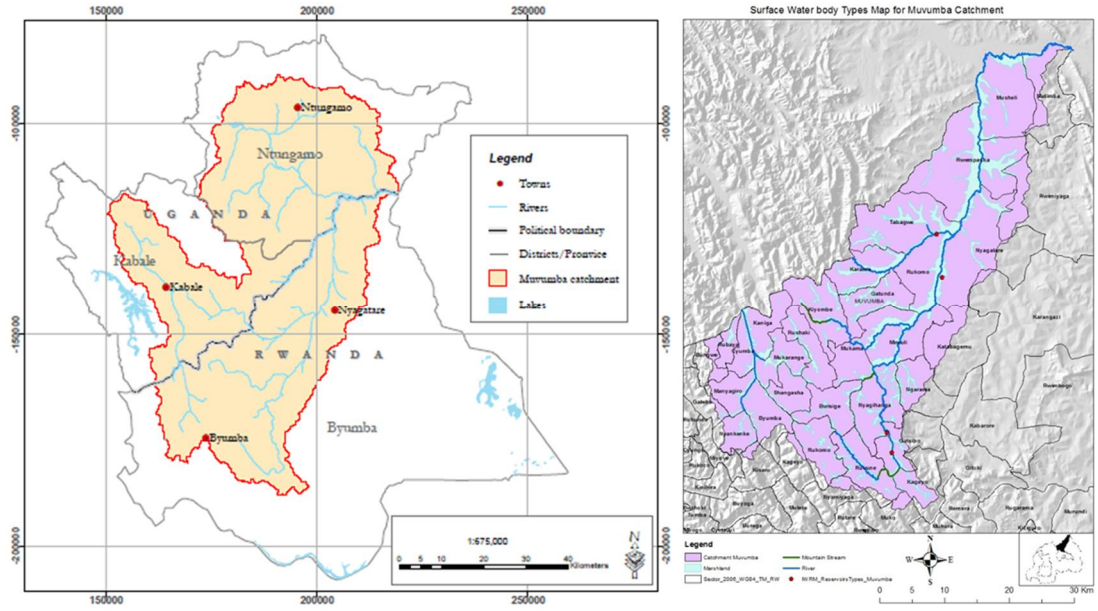


Figure 1: Muvumba catchment map and geographic location in Rwanda and Uganda

Home to some 0.6 million inhabitants – of which 92% rural – and circa half of the population living in poverty, it is clear that development needs are high. The region has been identified as a high potential area for large scale irrigation projects and multi-purpose dam development. Cattle rearing and milk production is one of the catchment's fortes. In 2016 the eastern part of Rwanda, including areas in downstream Muvumba, suffered long droughts. Water shortages are likely to worsen in the future. Developments beyond the control of water managers, such as population growth, climate change, and macro-economic development, rapidly lead to increased water demands, and subsequently to water shortages (Figure 2) that may hamper economic development and jeopardize water, energy, and food security.

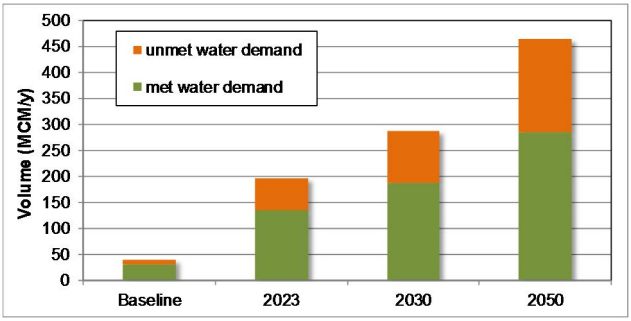


Figure 2: Projections of met and unmet water demand (water shortage) up to 2050, if no measures are taken

Such future scenarios call for an integrated approach to land and water management, considering the principles of Integrated Water Resources Management (IWRM). To this end, the IWRM Department of RNRA (now RWFA) embarked on the development of a catchment plan, supported by the Netherlands-funded programme 'Water for Growth Rwanda'.

No time to waste

Even though current water shortages in the catchment are limited in time and space (mainly in the long dry season), there is no time to waste in the implementation of the catchment plan. Climate change impacts are already occurring in Rwanda. The analyses in this plan reveal that planning that is not coordinated at catchment level and that is not considering IWRM principles, will lead to more water shortages already in the very near future.

The current catchment plan 2017-2023 therefore includes measures that can be implemented immediately. Some of these are already ongoing, under the auspices of plan partners. Opportunities for further optimisation of these interventions from a catchment perspective will be explored in several catchment dialogues that are planned to be held in the coming months. Other interventions may be started up already, using existing financing modalities such as the available funds from the IWRM Investment Fund (IIF), a basket fund with a starting capital of 18.6 million Euro contributed by the Government of the Netherlands of which a fair share is earmarked for Muvumba catchment. A feasibility study and detailed design for a potential IIF funded landscape rehabilitation and land husbandry Early Implementation Project have already been completed.

Programme of Measures

A series of development alternatives, consisting of specific combinations of measures, has been developed, as per the Strategic Environmental Assessment (SEA) process requirements. Their effectiveness and impacts were assessed using a water balance and allocation model (Figure 3) as well as expert judgment based multi-criteria assessment. Results were discussed with the Catchment Task Force and the group of Water for Growth's Focal Points from partner ministries. Different sets of weights were defined and tested, and the scores given be expert judgement were refined.

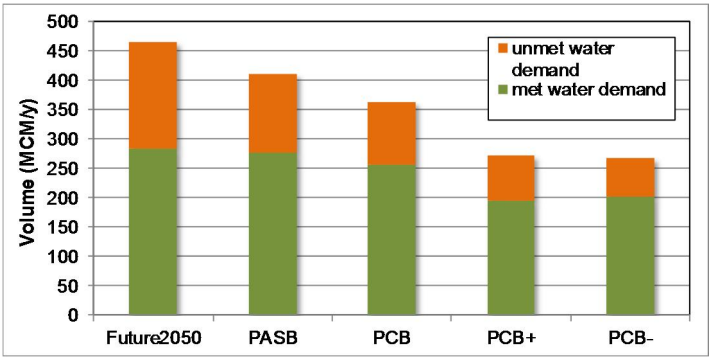


Figure 3: Realised water demand and water shortage (unrealised water demand) in different alternatives[1]

The 'Planning by Catchment Boundaries minus' (PCB-) alternative (see footnote) was selected as preferred alternative for the first plan implementation period up to 2023, as the result of the multi-criteria assessment. This alternative is based on planning at catchment level, in which the existing Irrigation Master Plan is implemented only up to 25% in the period up to 2023, and up to 50% afterward, to account for limitations in water resources availability. This Catchment Plan version 1.0 preferred alternative constitutes the starting point for the alignment phase in 2017, in which all stakeholders will jointly work towards a final preferred alternative for version 2.0 of the catchment plan. This alternative may incorporate elements of PCB+, PCB-, and more interventions to minimize water shortages and maximise the contribution of water to economic development and poverty reduction.

Endorsement of the catchment plan

The current catchment plan 2017-2023, developed within the framework of Water for Growth Rwanda, will be endorsed by the Programme's Steering Committee (PSC). This is also the body that decides on selection of Catchment Plan Implementation Projects (CPIPs) to be funded from the IIF. This is a rapid approval process, geared towards expedition of catchment plan implementation. Eventually the official catchment plan 2018-2023, which will be fully aligned with sectoral and district 5 year strategic plans, will have to be endorsed by the Cabinet of the Government of Rwanda. The new Water Law, supported by Water for Growth Rwanda, sets out the legal background of catchment plans, which includes the governmental endorsement process.

Contents of this document

This catchment plan for Muvumba first introduces the catchment, the institutional environment for catchment planning, and an explanation of the methodology followed to develop this catchment plan in a participatory manner that fully integrates the process and requirements of a Strategic Environmental Assessment, abiding by the regulations of REMA. In the second chapter, the status of the catchment is described, providing details on physical and socio-economic characteristics, water resources, stakeholders, a consistency analysis of related policies, plans, and programmes, an analysis and

[1] Legend of Figure 3: Future2050: medium projection scenario incorporating climate change, population growth, and macro-economic development but no catchment planning. PASB: Planning by Administrative and Sectoral Boundaries. PCB: Planning by Catchment Boundaries. PCB+: PCB interventions are implemented at elevated level, with more water storage and enhanced water savings in all sectors, to cater among others to strong irrigation development but also to make more water available to meet water needs of e.g. industry. PCB-: as PCB, with interventions at same level as PCB but with limited (50%) implementation of the Irrigation Master Plan, in order to minimise water shortages in all sectors. The objective for the alignment process for version 2.0 of the catchment plan is to arrive at a newly combined, improved preferred alternative that minimises water shortages, while maximising the contribution of water to economic development and poverty reduction.

prioritisation of issues and opportunities, and an overview of ongoing activities in the catchment. The actual catchment plan is presented in chapter 3, along with a report on its development process and implementation arrangements. A final chapter 4 highlights the way forward: the current catchment plan is ready for immediate implementation of priority measures, yet a full alignment with other strategic plans currently under development is foreseen. Ultimately, an updated version, fully aligned with e.g. the 5 year strategic plans of sectoral ministries and districts in the catchments, will be developed side-by-side with these sectoral and district strategic plans. These will jointly form the basis for joint performance contracts for all stakeholders in the catchment, thus optimising the implementation modalities for the plan.

Water for Growth Rwanda

Introduction to catchment planning within Water for Growth Rwanda

This document is one in a series of catchment plans for Rwanda. In an effort to introduce integrated land and water management within hydrological units (catchments), the Government of Rwanda, through Water for Growth Rwanda, has commenced the development of catchment plans. Water for Growth Rwanda, a platform to promote improved, integrated management of Rwanda's water resources (IWRM), is supported by the Embassy of the Kingdom of the Netherlands. Over the course of 2015-2019 this platform receives technical assistance from an international IWRM support unit within the Rwanda Water and Forestry Authority (RWFA)[2].

Water for Growth Rwanda operates along five components and a number of cross-cutting themes (including climate change adaptation and gender) as visualized in Figure 4. Component 3 of the programme is focused entirely on the introduction of catchment planning and management in four so-called *demonstration catchments*. The IWRM Investment Fund, supported in Component 4, is a basket fund, holds an initial contribution from the Embassy of the Kingdom of the Netherlands of 18 million Euro dedicated to the implementation of investment projects in the four demonstration catchments of Component 3. The enabling environment for catchment planning is supported through Component 1 (enhancement of institutional frameworks for IWRM); Component 2 (capacity strengthening of staff at central, catchment, and district level); and Component 5 (knowledge management, including the development of water resources monitoring, the implementation of dedicated studies, surveys, and research, and the sustainable embedding of learning processes in the organisations involved in IWRM).

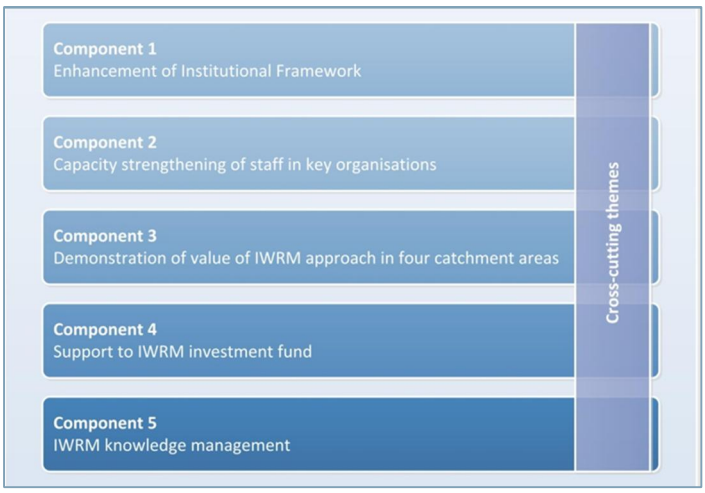


Figure 4: Programme components of Water for Growth Rwanda

[2] Was up until the 31st of January 2017 the Rwanda Natural Resources Authority (RNRA)

Demonstration catchments in the Programme

As mentioned above, Water for Growth Rwanda incorporates targeted activities in four demonstration catchments (Figure 5). The current document constitutes the first version of the catchment plan for the Muvumba. Located in the Kagera sub basin, the Muvumba catchment is part of the most upstream parts of the Nile Basin, with its ultimate outflow into the Mediterranean Sea.

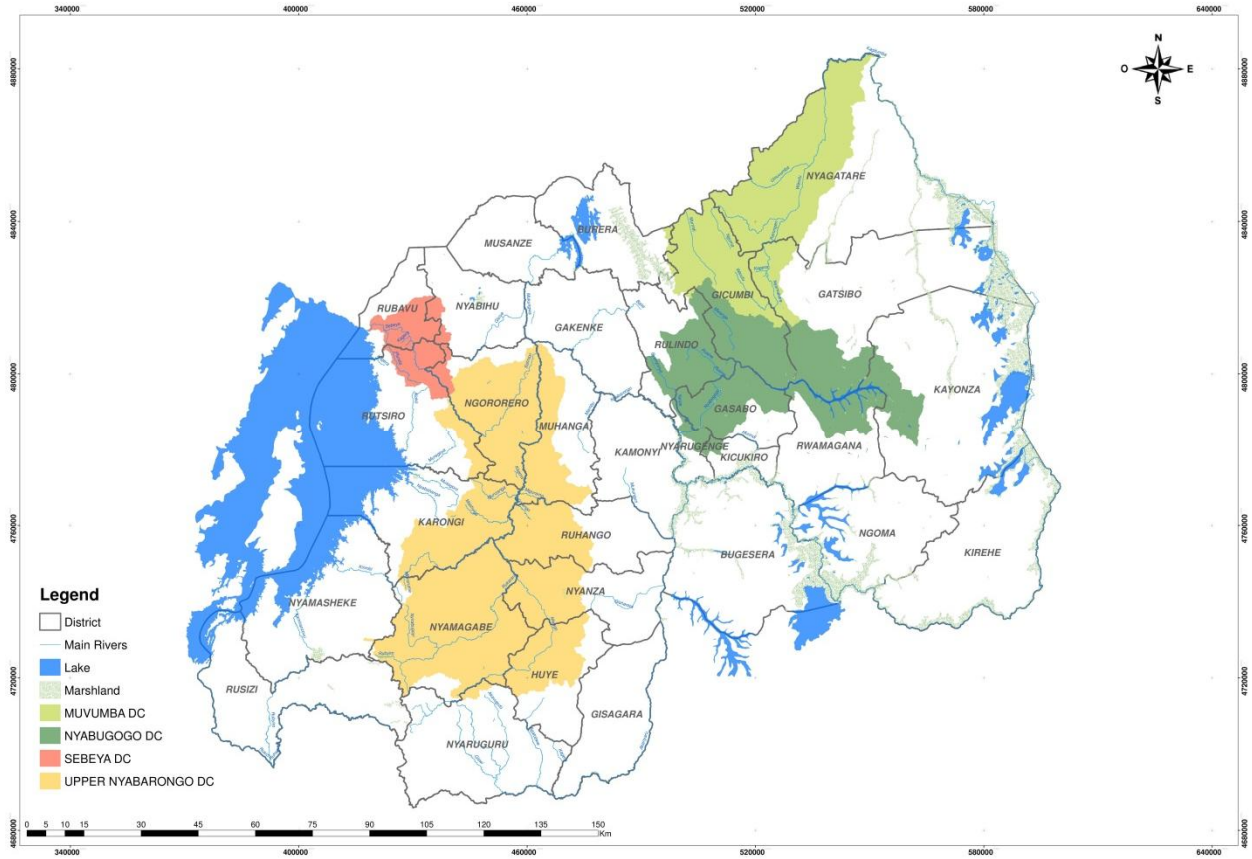


Figure 5: Demonstration catchments of Water for Growth Rwanda

The development process for the Muvumba catchment plan (and for the other demonstration catchments) commenced in September 2015. The current version of the catchment plan (this document) represents version 1.0, including the vision, overall objective, and specific objectives of the plan. Version 1.0 forms the starting point of a profound process of wide consultations and alignment. In the remainder of 2017, Water for Growth Rwanda will support a process of alignment with sectoral and district 5 year strategic plans, which will lead to a catchment plan version 2.0. That version will contain a further detailed programme of measures that will be fully aligned with the mentioned 5 year plans. This process, and the resulting catchment plan, will be an important vehicle for the development of joint performance contracts between national level ministries, their agencies, and the districts in the catchment.

1. Introduction to catchment planning process

1.1 Introduction to the catchment

1.1.1 Geography

The Muvumba catchment is part of the Nile basin and located in the north of the Eastern Province of Rwanda between:

- latitudes: 01° 27' 59.70" and 01° 03' 27.35" degrees South (57.025 km);
- longitudes: 30° 21' 29.65" and 30° 13' 27.64" degrees East (70.401).

The total surface area of the Muvumba catchment within Rwanda is 1,567.8 km² which represents 5.95 % of the total surface area of Rwanda (26,338 km² including water bodies). The Muvumba River is transboundary with Uganda which registers an additional hydrological catchment area of 2,146 km² for a total hydrological catchment area of 3,714 km²

The Muvumba Catchment finds its source in Rwanda on the Mulindi River that is located in the mountainous and high rainfall central northern part of the country at an altitude of 2030 m. The Mulindi River flows North over a length of 22.5 km to Uganda onto a flat wetland zone near Kabale from where a complex flow pattern originates that ultimately joins the Muvumba River before it eventually flows back into Rwanda at an altitude of 1 460 m above sea level. The length of the Muvumba river in Rwanda is about 56.3 km. Just south of Nyagatare the Ngoma River with a number of tributaries contribute their flow to the Muvumba River which flows in a north easterly direction to follow the border between Rwanda and Uganda before finally joining the Akagera River in the North East where the borders of Uganda, Rwanda and Tanzania meet. The final altitude of the Muvumba River is about 1280 meter. The typology map of major water bodies and elevation range is shown in Figure 6. The Muvumba catchment in Uganda and Rwanda is depicted in Figure 7 below.

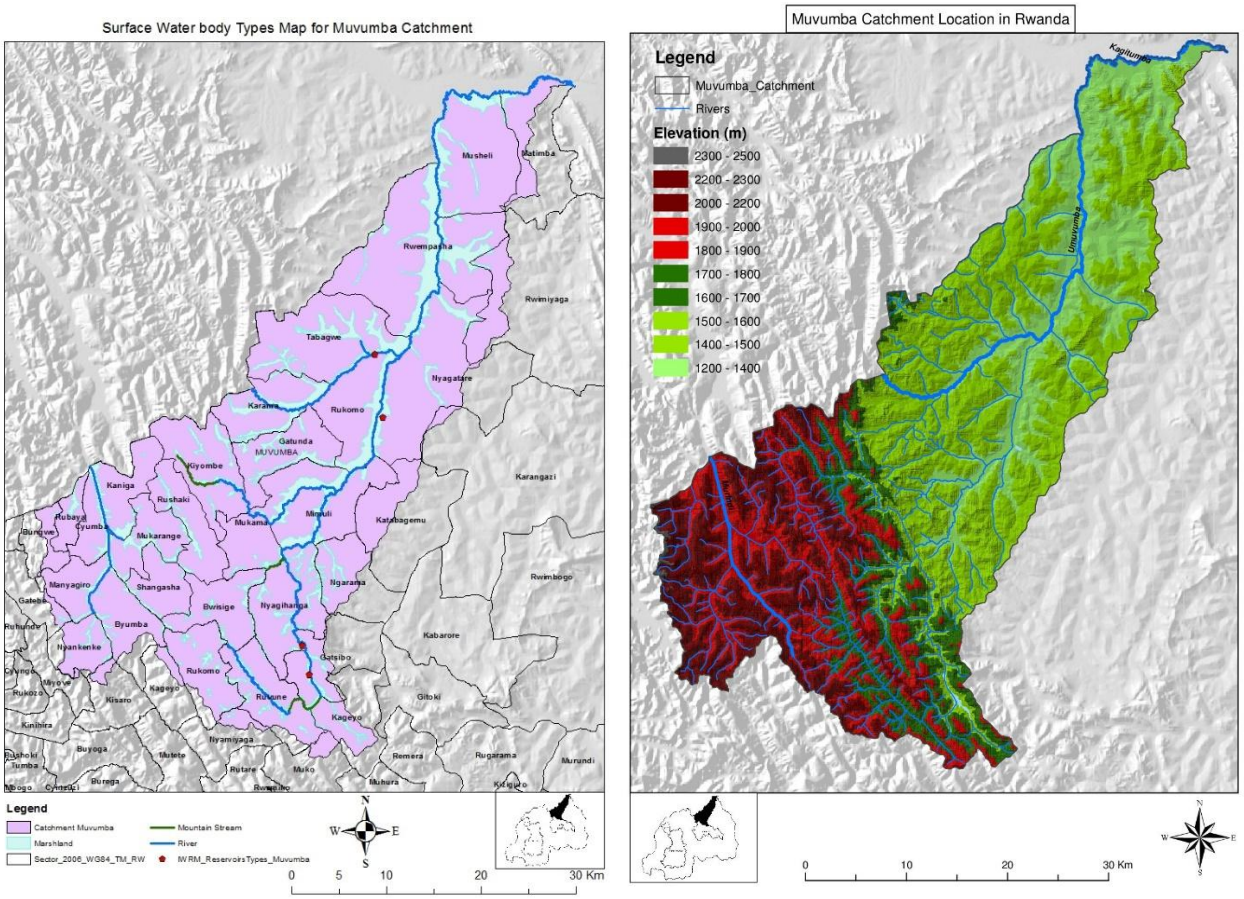


Figure 6: Typology of main water bodies and the elevation range of the catchment

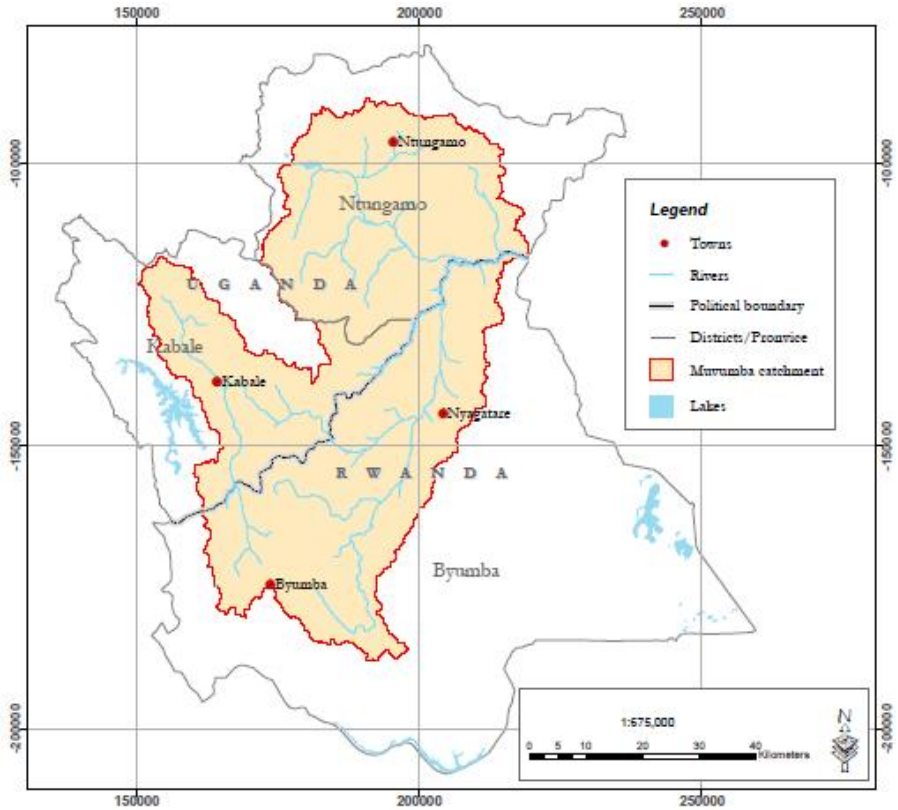


Figure 7: Overlay of administrative and hydrological (catchment) boundaries

1.1.2 Administrative division

Water, perhaps the most important of natural resources, does not respect administrative boundaries. A typical aspect of integrated water resources management (IWRM) is that the hydrological units (catchments, rivers, lakes) frequently (partly) overlay with multiple administrative units. The overlay of the catchment and the districts and sectors is presented in Figure 8, along with selected main infrastructure for ease of the reader's understanding of the map.

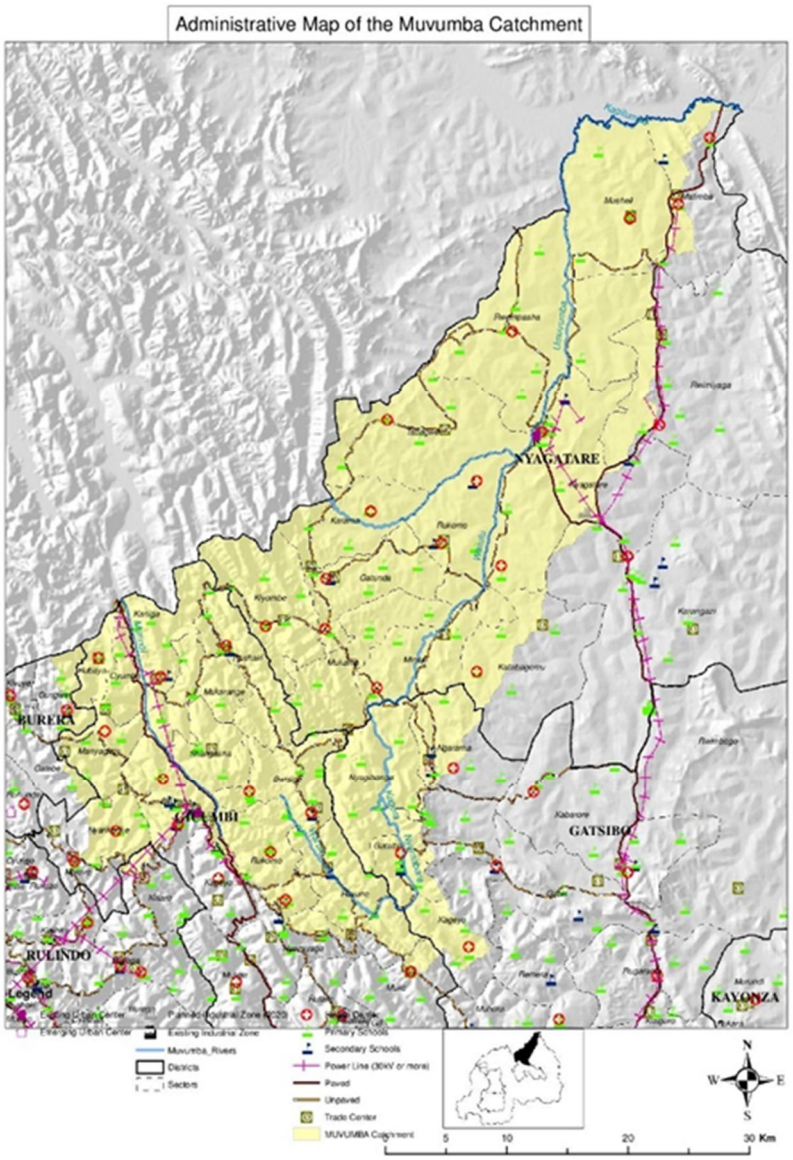


Figure 8: Administrative map of Rwandan part of Muvumba catchment, with main infrastructure

Table 1 below shows the overlap between administrative units and the catchment. Nyagatare and Gicumbi have about half of their surface area located within the catchment area and contain the largest share of the catchment with 60 and 30 % respectively. Population densities are very high around Byumba and have been reported to be in excess of 500 persons per square kilometre. The source of the table is the NWRMP.

Table 1: Overlay of districts and catchment surface areas

Catchment		District		Overlap between district & catchment		
Name	Area km²	Name	Area km²	Area km²	% catchment	% district
Muvumba	1 568	Nyagatare	1 920	940	60.0%	49.0%
		Gicumbi	830	455	29.0%	54.9%
		Gatsibo	1 582	152	9.7%	9.6%
			Total:	1,547[3]	98.7%	n.a.

1.2 Enabling Institutional Frameworks, National and local level

1.2.1 Institutional / legal context for catchment plans

The Water Law (2008) and the National Water Resources Management policy (2011) of the Ministry of Natural Resources provide a sound basis for integration of land and water management at the catchment level. The overall goal pursued in the policy is: *"to manage and develop the water resources of Rwanda in an integrated and sustainable manner, so as to secure and provide water of adequate quantity and quality for all social and economic needs of the present and future generations, with the full participation of all stakeholders in decision affecting water resources management."* According to international best practice, this translates into the development of catchment plans in a participatory manner, and the subsequent implementation of the plans in an as-much-as-possible decentralised process. A summary of key points of the water law and the water resources management policy is provided in Water for Growth Rwanda Technical Report (TR16) – Consistency Analysis.

Catchment planning is seen as an important instrument to contribute to the achievement of the objectives and goals of Vision 2020[4] and the second Economic Development and Poverty Reduction Strategy (EDPRS2)[5] of the Government of Rwanda, as well as for the implementation of the Green Growth and Climate Resilience Strategy of Rwanda (REMA, 2011), and other relevant sectorial policies, plans, and programmes.

An important aspect of the legal context for catchment planning is that according to Article 67 of Organic Law no. 4/2005, 'every project shall be subjected to an Environmental Impact Assessment (EIA), before obtaining authorization for its implementation.' Furthermore, the article mentions 'This applies to plans, programmes and policies that may affect the environment.' For plans, programmes, and policies the instrument of EIA is replaced by the instrument of the Strategic Environmental Assessment (SEA). In the guidelines for SEA (under development by REMA, the Rwanda Environmental Management Authority under MINIRENA) it is obligatory to implement an SEA process and to submit an SEA report to REMA for approval of any plan, programme, or policy. The integration of the SEA principles in the development of the current catchment plan development process is explained in detail in Section 1.3 below. More details on the legal and institutional context for SEA within Rwanda and for Rwanda in the international society, is provided in Section 1.3.4.

[3] There is a difference of about 20 km2 between the actual catchment area (1,568 km2) and the total of the district & catchment overlap for the three districts (1,547 km2). This due to the omission of 2 districts each with insufficient area in the catchment to merit to be considered in integrated catchment management (Burera and Rulindo).

[4] Republic of Rwanda, Ministry of Finance and Economic Planning, Vision 2020, 2000/2012

[5] Republic of Rwanda, Ministry of Finance and Economic Planning, Economic Development and Poverty Reduction Strategy II, 2013

1.3 Methodology and approach

1.3.1 IWRM process steps (incorporating SEA)

Both IWRM and SEA can be understood as participative processes to arrive at a well-developed plan with a broad support base. For the development of catchment plans in the framework of Water for Growth Rwanda, IWRM and SEA elements have been combined into an integrated IWRM-cum-SEA plan process. The process steps of IWRM, as followed within Water for Growth Rwanda, are presented in Figure 9. They are further listed side by side with the SEA process steps in Annex 1. An integrated (IWRM-cum-SEA) catchment planning process is presented in Section 1.3.2 below.

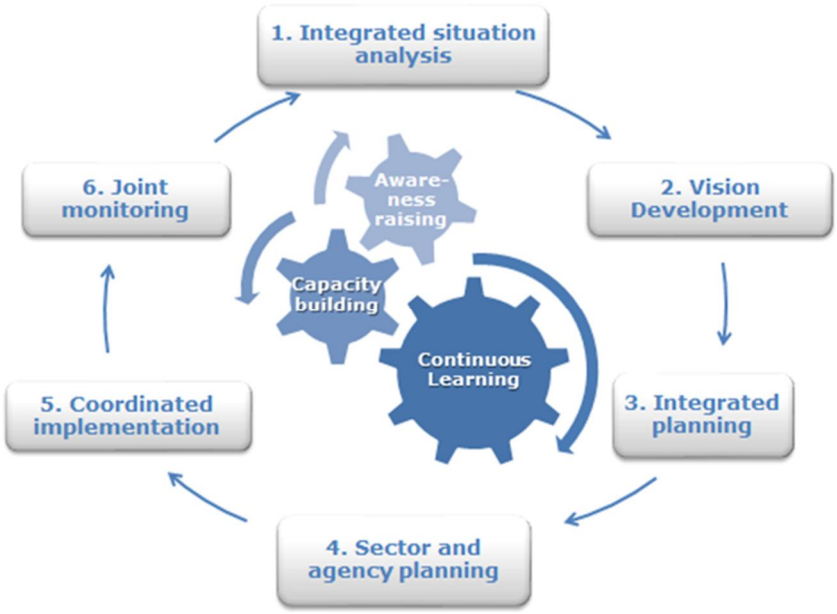


Figure 9: IWRM planning cycle, with integrated elements of capacity strengthening

1.3.2 The catchment planning process

Based on the integration of IWRM and SEA process steps as described above, a step by step integrated and participatory catchment planning process was developed. Up to end June 2016 steps 1 to 4 were completed for all four demonstration catchments. The consistency analysis (step 5) was completed in November 2016 (TR16 – Consistency Analysis). Steps 6 and 7 used a trifold approach. A multi-criteria assessment approach was developed and implemented for the main criteria of ecosystem services, economic development, social development, and water governance / institutional development. Catchment plan alternatives were assessed on these key criteria, by providing scores for each alternative of variation, using expert judgement, and by selecting weights to arrive at weighted final scores per alternative. A second, more quantitative approach, was the development of a series of water balance and allocation models. Results were again weighted to arrive at integrated assessments of each alternative or variation. Last but not least, a cost benefit analysis was developed to explore the costs and benefits of several key (physical) measures within the alternatives. Both steps were completed early February 2017. Step 8 consisted of consultation rounds with the Catchment Task Force (the last one of which was held on 2nd February in Gichumbi) and with the Water for Growth Rwanda Focal Points of sector ministries. This step will be completed during the Programme Steering Committee (PSC) meeting in March 2017. Regular implementation of the plan starts in formally in fiscal year 2018-2019, along with the regular oversight of

plan implementation and M&E of its positive and negative impacts. An Early Implementation Project has been proposed for implementation in Nyagatare District (Karama sector). Subsequent selection of urgent and no-regret Catchment Plan Implementation Projects by the PSC may further identify projects to be implemented ahead of the official implementation period, starting as early as in the current fiscal year 2016-2017.

Table 2: Detailed catchment planning process, integrating IWRM and SEA principles

Step	Details
1 Start plan process	§ Install Catchment Task Force and identify additional stakeholders at central and decentralised Government, NGOs, Civil Society Organisations, and private sector § Agree on roles, responsibilities and process structure
2 Situation analysis	§ Characterisation of the catchment, in terms of land & water systems (technical, social, economic, gender and sustainability aspects)
3 Stakeholder priorities	§ Identification of stakeholder issues and opportunities, and prioritisation of both
4 Vision development	§ Development of catchment vision(s) and overall and specific objectives, addressing priority issues & opportunities § Definition of alternative pathways to reach the plan objectives
5 Consistency analysis	§ SWOT analysis of existing Policies, Plans, and Programmes § What other policies have constraining or win-win consequences for the catchment? § Which feedback needs to be provided to existing PPPs, from a catchment plan point of view?
6 Terms of Reference	§ Set ToR for detailed assessment of alternatives, including assessment criteria, and for ultimate plan development
7 Planning & assessment	§ Definition of programmes of measures (physical projects and institutional developments) for each of the plan alternatives § Detailed studies for catchment planning, including a survey of water users and a study into water balance and water allocation under different alternatives and scenarios, incorporating remote sensing and modelling techniques § Assessment of social and environmental impacts; compare alternatives on their positive and negative impacts § q Iteration: design the alternative with maximum benefits and minimum negative impacts § Definition of mitigation/compensation measure for remaining negative impacts § Development of the catchment plan in accessible language (in English, with Kinyarwanda summary) with technical annexes
8 Decision making on version 1.0	§ Discuss with catchment task force and key additional stakeholders the alternatives and select the preferred alternative as starting point for the alignment process § Support decision making on the catchment plan version 1.0 by the Water for Growth Rwanda Programme Steering Committee (PSC) § Identify urgent and no-regret Catchment Plan Implementation Projects that can be supported using readily available funds, including the IWRM Investment Fund.
9 Review	§ Quality assurance of documentation (by REMA as competent authority, and preferably involving stakeholders)
10 Alignment process	§ Conduct sector dialogues to align the catchment plan and sectoral ministries' 5 year strategic plans § Conduct district dialogues to align the catchment plan and district 5 year strategic plans § Develop joint programmes of measures to be implemented in the 5 year period 2018-2023 § Develop joint performance contracts to guarantee implementation of the joint programmes of measures § Update the catchment plan version 1.0 with the results of this step, to arrive at version

Step	Details
	2.0
11 Formal decision making on version 2.0	§ Support formal decision making by the relevant authorities as per the (likely new) Water Law § Motivate the (political) decision in writing
12 Sector and agency planning	§ Assign tasks to implementing district administrations or sector agencies
13 Coordinated implementation	§ Implementation by competent authorities, within boundaries set by catchment plan § Regular meetings of catchment task force representatives and central and district level implementing authorities to oversee plan implementation
14 Joint monitoring	§ Monitoring and Evaluation of plan effectiveness, positive and negative impacts, by stakeholders in catchment and regular monitoring organisations § Formulation of lessons learnt (for continuous learning and development of knowledge base on catchment planning) and transfer of information into the next round of catchment planning

1.3.3 Explanation of embedding of SEA principles

SEAs are applied to policies, plans, and programmes with a broad and long-term strategic perspective (e.g. visionary or conceptual). The SEA is focused on better decision making pertaining to the policy, plan, or programme at hand, based on better quality information, from a broader information base including stakeholders affected by the policy, plan, or programme (PPP). A good SEA provides guidance for future decision making for any projects that may come out of the PPP.

For a catchment plan this implies first of all that an SEA is obligatory (hence the integration of SEA in the catchment planning process). Secondly, it implies that the programme of measures, a key element of the catchment plan, will be guided by decisions made at the planning level. Overall the integration of SEA in the catchment planning process will lead to a better catchment plan, with a broader support base, and local as well as central ownership, which will strongly enhance its implementation.

Having an SEA for the catchment *plan* does not release subsequent implementation *projects* from the requirements vis-à-vis Environmental Impact Assessments (EIA); an EIA is, according to Rwandan law, required for all specific and relatively short-term projects and their specifications. Whereas the SEA is focused on decision making, the EIA is geared toward obtaining the relevant permits for project implementation. An EIA rarely generates feedback to the considerations made in the PPP.

More than anything, by combining information, process, and procedures (Figure 10) SEA principles provide the catchment planning process with requirements for:

- participation – by strengthening the role of stakeholders;
- transparency – through an open and accountable process;
- information – on priorities, alternatives, and impacts;
- institutions – focusing on the plan implementation and enforcement capacity.

A catchment planning process incorporating SEA principles, such as the one followed here, will yield more attention to environmental impacts (positive of negative) of the plan; will provide better understanding of the cumulative impacts of the whole plan, rather than a list of individual impacts of a series of smaller projects that follow from the catchment plan; reduces the need for EIA discussions about strategic

choices (e.g. regarding locations selected, or technologies proposed); and will facilitate the implementation of downstream EIAs owing to the wealth of information collected in the plan development process.

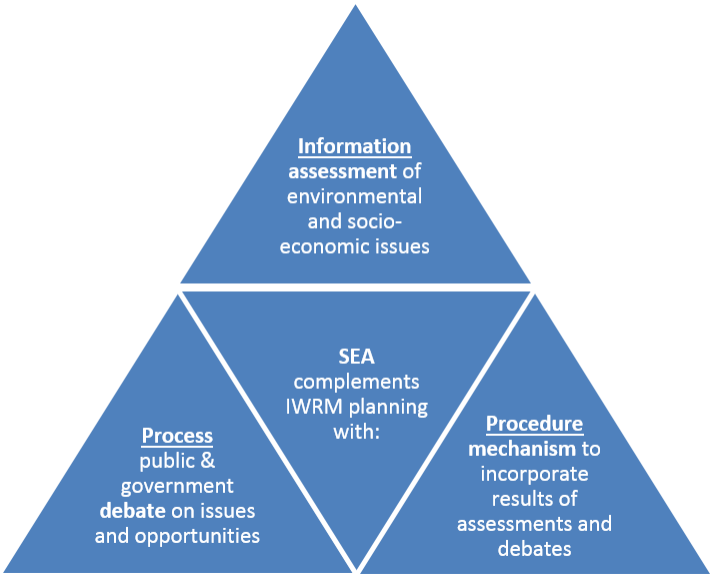


Figure 10: Added value of SEA to the catchment planning process, through information, process, and procedure (Source: NCEA[6])

1.3.4 Integration of gender aspects in the catchment plan

The Dublin principles on IWRM stress the importance of incorporation of gender aspects in water management. Traditionally, men are often more involved in decision making on IWRM, whereas women often are the most important water users at household level. The gender aspects and processes adhered to in the catchment planning process are laid down in the Gender Strategy developed under Water for Growth . In summary, the strategy explains that in the involvement of women and men differs between subsequent stages of catchment plan development.

In the initial stages (steps 1-6 in Table 4) first of all the composition of the Catchment Task Force and of different stakeholder groups included women and their representatives (i.e. of the National Women Council). Considering the functional composition of many stakeholder groups, limited influence could be exerted on the gender balance in each group, resulting in an under-representation of women in several fora and meetings. A recommendation related to this would be to enhance the percentage of women in key positions relating to water management in nearly all governmental entities. In the situational analysis data collection was as much as possible disaggregated for men and women. Women and men jointly developed the vision for the catchment, and influenced the approach (terms of reference) for catchment plan development.

The development of a high level programme of measures (the current Catchment Plan version 1.0) is guided by a combination of a technocratic and a socio-economic approach. The technocratic part focuses on a description of the physical environment, of issues, risks, and opportunities for improvement of the

[6] NCEA, the Netherlands Commission for Environmental Assessment, supported the Government of Rwanda and Water for Growth in the development of an integrated process for SEA and catchment plan development.

physical environment. The socio-economic part presents information in a gender-disaggregated manner where such data are available. In general though, considering the largely technical approach adhered to in this phase, integration of gender aspects was prominent in the definition of water governance orientated measures and the M&E plan, and less pronounced in the development of catchment plan alternative and the assessment thereof, which was gender neutral.

Full integration of gender aspects will take place in the development of detailed programmes of measures for version 2.0 of the catchment plan, and in the subsequent sector and agency planning, coordinated implementation, and joint monitoring and evaluation. The way forward is explained in Chapter 4; the roadmap for the year 2017 in included in Annex 7.

1.3.5 Integration of Climate Change in the catchment plan

Catchment planning needs to take into account the potential impacts of climate change, and is an outstanding example of incorporation of both mitigation and adaptation measures in response. In this catchment plan, climate change projections have been fully incorporated in the underlying water balance and allocation model that informed decision making between different plan alternatives. Moreover, climate change mitigation and adaptation measures have been incorporated in different ways in these plan alternatives as will be explained in Chapter 3. During the alignment phase, climate change considerations will be fully integrated at a more detailed level, resulting in a final programme of measures that will optimally support Rwanda in its ambitions for sustainable development while minimising adverse impacts of climate change.

1.3.6 Legal and institutional context for SEA

Rights to a healthy environment for the inhabitants of Rwanda as provided for in the Constitution of 2003 formed a basis for the Environmental Protection, Conservation, and Management Policy of 2004, which is given effect by the Organic Law No. 04/2005 of 8th April 2005, which determines the modalities for the protection, conservation, and promotion of environment in the country.

Organic Law No. 04/2005 and its regulations in the form of Ministerial Orders are implemented through Law No. 16/2006 of 3rd March 2006 that established the Rwanda Environmental Management Authority (REMA) as the regulating agency and determined its organization, functions, and responsibilities. Following its legal mandate, REMA has put in place environmental management tools and guidelines, including general and sector-specific guidelines for EIA.

Principle 1 of Article 7 in Organic Law 04/2005 stipulates precautionary measures that are informed by the results of both environmental assessments of policies, plans, projects, and development activities and assessment of social well-being. However, although the legal provision for the deployment of an SEA instrument appears to be present, only EIA is adequately treated in the law and in the general and sector-specific guidelines issued by REMA. REMA is currently in the process of finalising an official guideline for SEA in Rwanda[7] in order to establish SEA firmly in the Rwandan context. The SEA process as developed and implemented in Water for Growth Rwanda, with independent assistance from the Netherlands

[7] The majority of the text in this section is quoted literally from the 2011 'General Guidelines and Procedures for Strategic Environmental Assessment (SEA) developed by REMA in collaboration with United Nations Rwanda and UNDP.

Commission for Environmental Assessment (NCEA), complies with the guidance-under-development, and incorporates best international practice as well as local constraints and opportunities.

In the international legal and institutional context, SEA facilitates adherence to international legal conventions to which Rwanda is a party, including: UN Convention on Biological Diversity (UNCBD) 1992; UN Framework Convention on Climate Change (UNFCCC) 1992; UN Convention to Combat Desertification (UNCCD) 1994; Basel Convention 2005; Convention on International Trade in Endangered Species (CITES) 1973; Kyoto Protocol 1998; RAMSAR Convention on Wetlands of International Importance 1971; Rotterdam Convention 2004; Stockholm Convention 2001; Vienna Convention 1985 and four related protocols; and the Cartagena Protocol 2000. SEA contributes to the achievement of the Sustainable Development Goals (SDGs), which played a leading role in the development of visions for the catchment plans within Water for Growth Rwanda.

2. Current status of the catchment

2.1 Physical characteristics of the catchment

2.1.1 Lithology and soil charateristics

The lithology of the catchment is for its western part draining into Uganda through the Mulimdi River, characterized by alternating schist and quartzite layers with average groundwater potential mainly for local supply. The eastern part is dominated by granite as the dominant basement aquifer which, notwithstanding generally deep weathering, results in low storage capacity and conductivity. Unless located on a fault zone, boreholes will have low yields. Maps of the lithology and soil characteristics are provided in Figure 11.

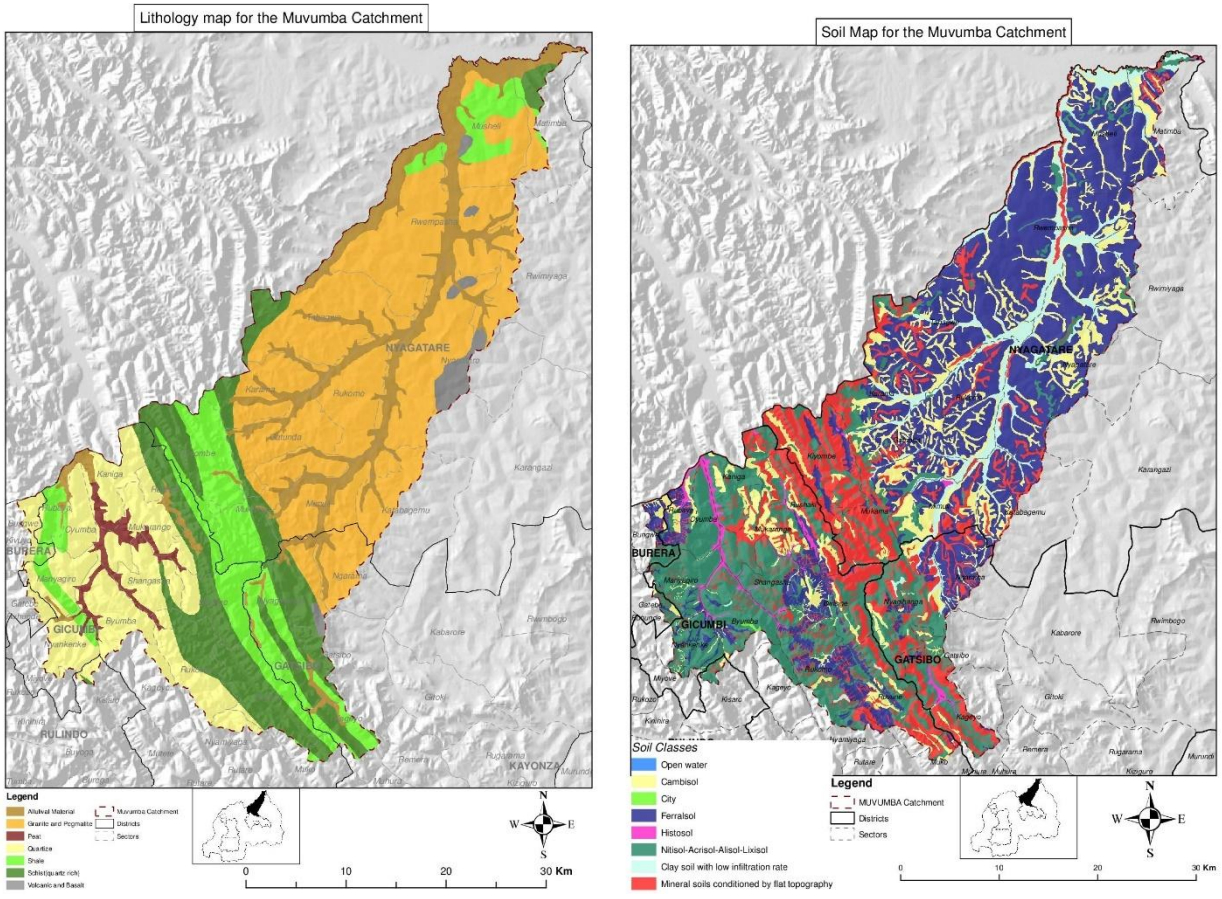


Figure 11: Lithology and soil map of the Muvumba Catchment

The most extensive soil types within the located within the low lying north eastern section of the catchment are Ferralsols. These are derived from deeply weathered siliceous rocks and thus are of low

fertility, acidic and increasingly with aluminum toxicity. They are generally deep, easy to work and less erodible than other deeply weathered soils. In the southwestern uplands on steep slopes are Cambisols and Alisols, which are moderately deep and more fertile than Ferralsols since they possess a higher Cation Exchange Capacity (CEC). Being located on steep slopes they are especially susceptible to erosion. Along valley bottoms and associated with swamps are the clay soils of moderate fertility and low infiltration capacity.

2.1.2 Ecology

There are three agro-ecological zones in the sub-catchment in Uganda, namely, the Kabale Rukungiri highlands, Kisoro – Kabale highlands, and the south-western medium high farmlands. The Kabale-Rukungiri highland zone is the most dominant, occupying about 85% of the Ugandan side of Maziba micro-catchment. Located at an altitude of 2,123 m ASL; this zone is characterized by a long-ridged hilly landscape. The slopes are steep to very steep in Kabale, but less steep in Rukungiri (outside the Maziba sub-catchment). The valleys are often wide and flat, occupied by huge wetland systems that receive runoff from the steep hill slopes. These valleys are intensively cultivated or grazed, and therefore have good agro-ecological potential if sustainably utilized.

The Southwestern Medium-High Farmlands of the sub-catchment in Uganda are located at an altitude of 1,428 meters ASL. They are characterized by low, broad and rounded hills which act as micro-catchments that drain their waters into narrow, flat, swampy valleys. Due to this nature of landscape, soil erodibility is low, and rainfall erosivity is low too moderate.

Standing at an altitude of 2169 m ASL, the Kabale-Kisoro highland zone is characterized by lava plains, with ridges, cones and alluvial fans in the south. Slopes are steep in the northern part of the zone. This agro-ecological zone has dark-brown acidic, low-base soils derived from the volcanic deposits. These are of moderate to high productivity. However, the productivity is threatened by the high erosion potential owing to the long steep slopes. One mitigating factor against soil loss to erosion is that the volcanic ash ash absorbs run-off, hence rainfall erosivity is moderate. About 75% of the land in this zone is under crop, alongside woodland. This is also one of the most important Irish potato production areas in Uganda. Other major crops are bananas and beans, followed by maize and finger millet.

Averaged climatic information (temperature, rainfall and altitude) have been used to divide Rwanda into 10 Agro-Climatic zones(ACZs). The ACZs can be used to classify the country according to agricultural suitability. Figure 12 below shows the Muvumba catchment on the map of the agro-climatological zones of Rwanda. The Muvumba catchment comprises command in the Buberuka Higlands, the Eastern Plateau and the Eastern Savanna. The Buberuka highlands are located at high altitudes, the Eastern plateau extends over highlands and hills of medium altitude while slopes are mild over the Eastern Savanna. The Eastern Savanna includes numerous lakes and wide areas covered by marshes extending along the Akagera River.

While ACZs are defined by temperature and rainfall, Agro-Ecological Zones (AEZs) are characterised according to pedological and climatic criteria. An Agro-ecological Zone is a land resource mapping unit, defined in terms of climate, landform and soils, and/or land cover, and having a specific range of potentials and constraints for land use. A more detailed agro-ecological zoning for Rwanda has been prepared by Rushemuka 2014 (RAB) as adapted from work by Schörry, 1991 and Verdoodt, 2003.

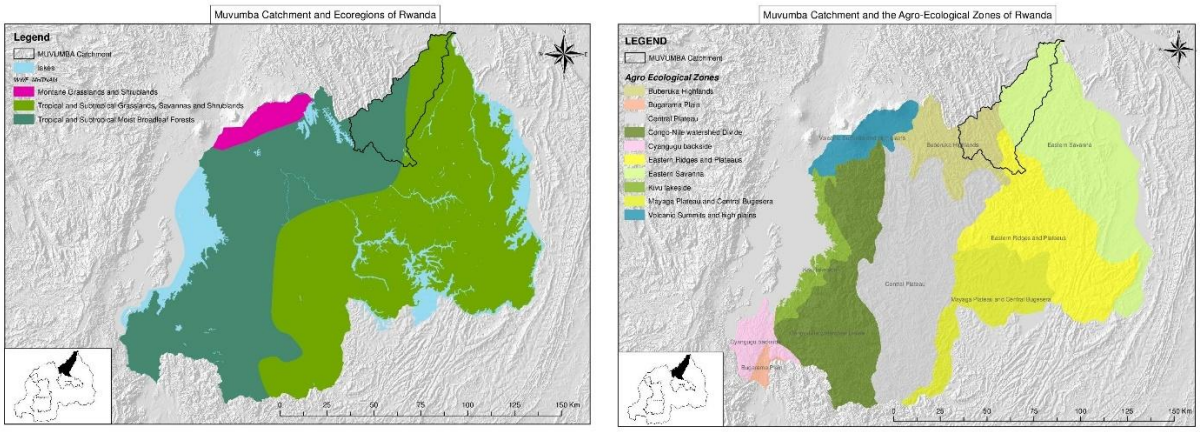


Figure 12: Catchment location within the ecoregions (WWF) and agro-ecological zones of Rwanda

2.1.3 Climate

Despite its location in the tropical belt, Rwanda experiences a temperate climate as a result of the high elevation. The average temperature for Rwanda is around 20°C and varies with the topology but relatively little throughout the year. The warmest annual average temperatures are found in the eastern part which includes the areas drained by the Muvumba catchment. Temperature observation data within the catchment indicates a maximum daily temperature of 21.9°C and minimum daily temperature of 13.2°C in the highlands at Byumba and a maximum daily temperature of 27.5°C and minimum daily temperature of 14.3°C at Nyagatare in the lowlands. The Muvumba catchment has experienced the highest annual temperatures in the Kagera basin based on data analysed for the period 1970 – 2000 (LTS, 2012.), with evidence of rising temperature over time. The rate of temperature increase in the Kagera basin has been quantified to be 0.04°C/year, which translates into 4°C per century. The year with the maximum temperature recorded in the Muvumba catchment and the Kagera basin was 1998, the same year as the maximum in the global record and associated with an El Niño event.

The rainfall pattern of the sub-catchments in Uganda and Rwanda is bi-modal. The mean annual precipitation received varies between 756 mm at Nyagatare to 1128 mm in the highlands at Byumba. The dry season runs from late May to early September, with the rainy period in October to early December, a slight dip around the month of January and a peak rainy season during the months of March up to early May. The dry season months are prolonged in the lower altitude areas and towards the East. The relationship between precipitation and potential evapotranspiration is significant in this catchment (Figure 13). Nyagatare has only 2 months when P/PET ≥ 1. These are in April when P/PET = 1.3 and November when P/PET = 1.0. It is therefore evident that severe precipitation-deficit regions occur for 1-3 consecutive months in this part of the catchment and shows that large tracts of the catchment experience frequent severe water shortage in the dry season.

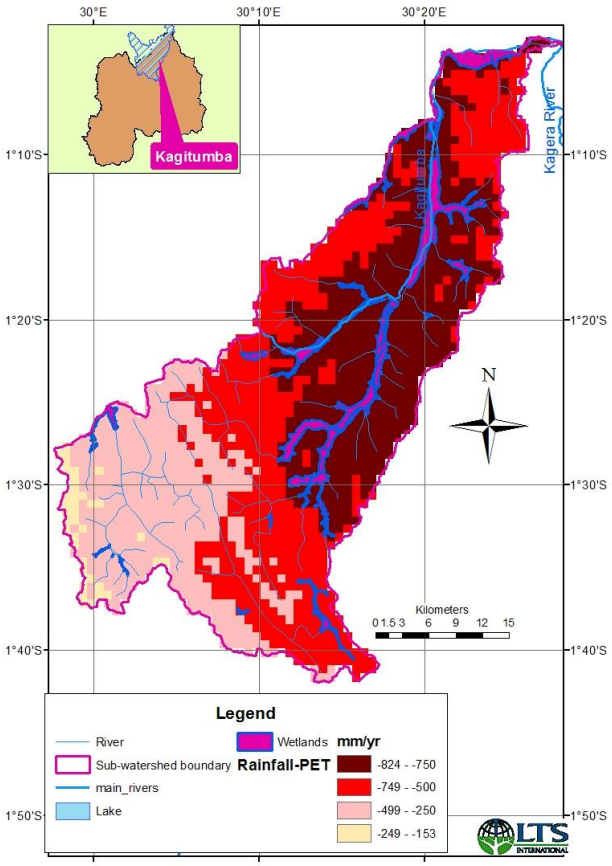


Figure 13: Muvumba - Mean annual rainfall minus Potential Evapo-transpiration (LTS,2012)

Recent climate change studies for Rwanda and the Kagera basin have been conducted under the auspices of the Smith School of Enterprise and the Environment of the University of Oxford (SSEE,2011) and the Feasibility Study for Kagera Integrated Watershed Programme (LTS, 2012).

SSEE (2011)[8], presents an analysis of observed meteorological data and an assessment of climate change projections for Rwanda. The data available indicate that mean temperatures have increased in Rwanda over the past 40 years (0.35°C per decade), with similar increases in minimum and maximum temperatures. Rainfall records, by comparison, show no significant trend between 1931-90 (there are not sufficient data to assess the most recent past). Projections of future climate for Rwanda indicate a trend towards a warmer, wetter climate. Increases in mean temperature are projected under all climate change models and all emissions scenarios, while the majority of models also indicate increases in annual rainfall totals.

The data collected and analysed (LTS, 2012) concurred with the analysis conducted by SSEE (2011) and confirmed that for precipitation, there is no significant trend of increasing or decreasing values. However, for temperature there is a clear increasing trend over time. LTS (2012) further analysed observed temperature for the Kagera basin from 1970 to 1999, and projected temperatures for two periods: 2020 to 2049; and 2070 to 2099. The projections suggest that during the period 2020 to 2049, temperatures will be 1.3°C higher than the period 1970 to 1999; and during the period 2070 to 2099, the temperatures will be higher than 1970-1999 by 2.7°C.

[8] Smith School of Enterprise and the Environment of the University of Oxford, 2011

2.1.4 Land use

The land scape of the catchment in Uganda and Rwanda is characterised by small fragmented holdings on mountainous terrain in the high altitude areas. Due to population land pressure, cultivation of the food crops has been extended from the uplands to the wetlands in the valleys. Large drainage channels are constructed to drain excess amounts of water from the wetlands, and open them up for cultivation. However, the wetland soils often contain high amounts of sulphur, and therefore quickly become acidified once drained. The main crops grown are bananas, beans, maize, sweet potatoes and sorghum. Alongside intensive crop farming, other land uses include woodland and grassland. Part of the land is also used for woodland and livestock rearing at small scale.

Land class data are often used in water evaluation and allocation models to simulate the hydrological relations between the soil, the atmosphere and runoff. For purposes of preparing data for such models, the recent land use cover data set for the year 2015 was obtained from RNRA and adopted with the following sub-classification:

- agroforestry with progressive terraces;
- agroforestry with radical terraces;
- agroforestry without terraces;
- forest;
- grassland;
- irrigated marshland;
- irrigated hillslope;
- progressive terraces without agroforestry;
- radical terraces without agroforestry;
- rainfed agriculture;
- river buffer zones;
- shrubs;
- urban;
- wetlands.

Land cover areas have been computed for each sub-catchment (Figure 14). As information on terraces and irrigation is lacking from this map, these are added separately. A Google Earth analysis has been performed to quantify the currently terraced areas. Terraces are distinguished in four categories; radical terraces and progressive terraces both either with or without agroforestry. Terraces and agroforestry are forms of soil, water and crop management and therefore will also influence the WEAP soil and water retention characteristics accordingly. The corresponding land cover distribution in each sub-catchment is presented as Figure 15. Natural wetlands cover 1,662ha (or just over 1 percent of the Sub-watershed. Cultivated wetland cover just over 4,000ha or 2.6 percent of the area. Thus some 71 percent of all wetlands have been converted to agriculture of various types. Irrigated and agricultural wetlands occupy a significant part of the catchment in the central and north eastern parts. In the southern part of the catchment, there are numerous spots of forests plantation. Natural open land is located in the central parts along the border with Uganda and in the north east. Built-up area is mostly dispersed with some concentration around Nyagatare and Gicumbi urban areas.

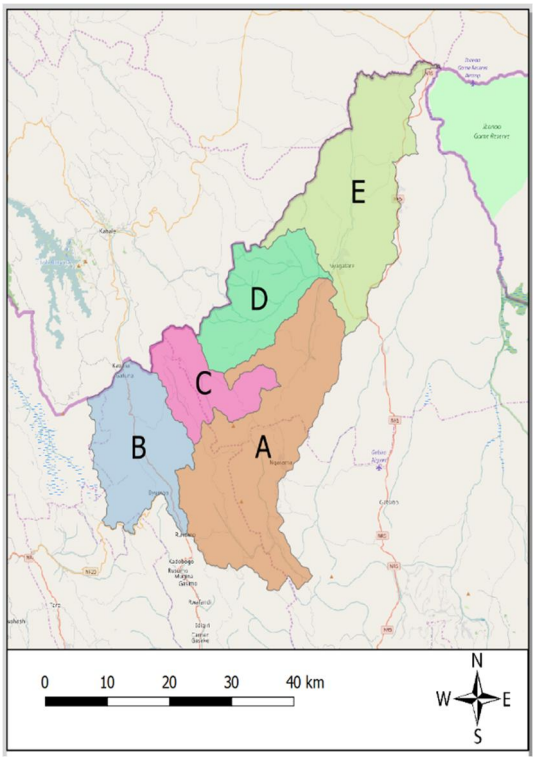


Figure 14: The sub-catchment delineation for water evaluation

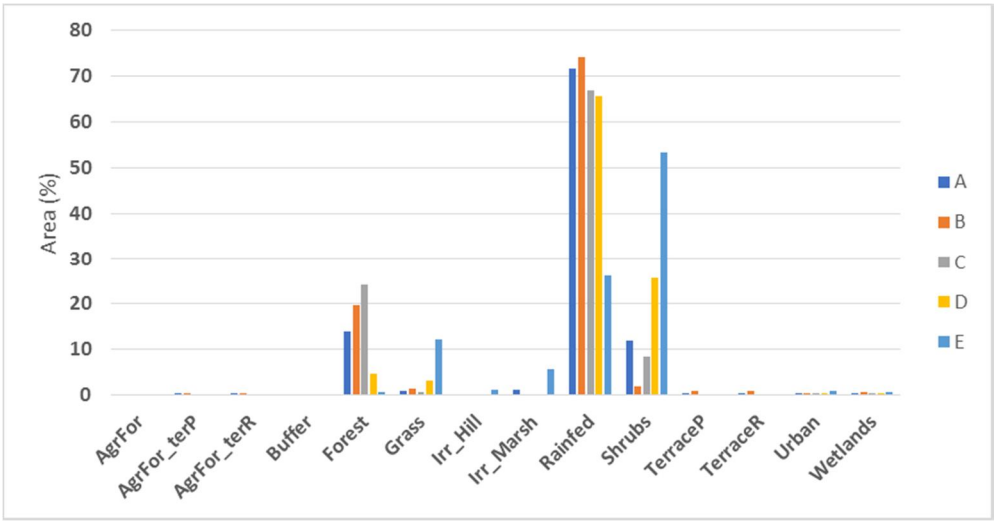


Figure 15: Land cover distribution in the sub-catchments

Given that the higher parts of the water shed are characterised by high and dissected relief with steep slopes, intensive rain fed cultivation and abundant rainfall, they are prone to erosion. The high run-off rates lead to a lot of soil loss which ends up as sediment in the rivers and streams. The loss of fertile soils leads to reduced soil fertility and poor agricultural productivity in the higher parts of the watershed. In addition to agriculture, over-grazing and collection of fuelwood have contributed to high rates of deforestation particularly in the upland watersheds. The removal of trees and vegetation compounds the effect of erosion on land degradation in Muvumba watershed. The sub-catchment area in Uganda in Kabaale district is reported to be very highly degraded (NELSAP, 2014), with loss of top soil being more pronounced in Uganda as compared to Rwanda. Land-use and land cover change analysis conducted

during the period 2000 – 2010 illustrated that all wetland areas had been lost by year 2002 has been conducted for the sub catchment in Uganda.

Similarly, a significant portion of wetlands in Muvumba sub-catchment in Rwanda has been degraded or converted to agricultural use (LTS, 2012). There are five types of wetland in Muvumba (Table 3) covering some 8,877ha. Intact grassland swamps cover 55 percent, followed by cultivated valley bottoms covering 36 percent. Cultivated rice covers some 6 percent, with intensive "industrial" cultivation and intact papyrus swamp both covering the remaining 2 percent each. Thus some 43 percent of all wetlands have been converted to agriculture of various types.

Table 3: Wetland utilization in Muvumba catchment

Type	State	Area (ha)	Area (%)
Cash crops	Cultivated	192	2%
Valley cultivation	Cultivated	3,152	29%
Papyrus	Intact	193	2%
Rice	Cultivated	2,345	22%
Grassland swamp	Intact	4,847	45%
	Total	10,729	100%

Wetlands provide important ecosystem services, but there is often a trade-off in these services; for example, converting them into cultivated land at the expense of degrading them to yield less natural ecosystem services such as flood attenuation, ground water recharge, nutrient absorption and water purification. The estimation of environmental flows required for the intact wetlands, such that their services can be conserved and used wisely should be an important consideration in the water allocation plan.

2.2 Socio-Economic Analysis

2.2.1 Population

The population and housing census conducted in Rwanda in 2012 indicated that the number of people who lived within the catchments was 596,980 with 7.7% living in urban areas and 92.3% living in rural areas. 48.3% of the population were female and 51.7% were female. 43% of the population is younger than 15 years and 54% of the population is below 20 years.

Figure 16 below illustrates the spatial variability of the population densities in each administrative area. The highest population density is Gichumbi district is in the sectors of Byumba, Rubaya, Cyumba, Munyangiro, Nyankenke. These sectors have more than 500 persons per square kilometre. The other district sectors having with a high population density of over 500 persons per square kilometre is Nyagatare. The sectors with the high figures are Rukomo and Mimuri sectors in Nyagatare district. Gatsibo sector in Gatsibo district also has similar population density. The high population densities exert a lot of pressure on water and land resources which manifests its self in the high rate of land and wetland degradation and pollution of water sources.

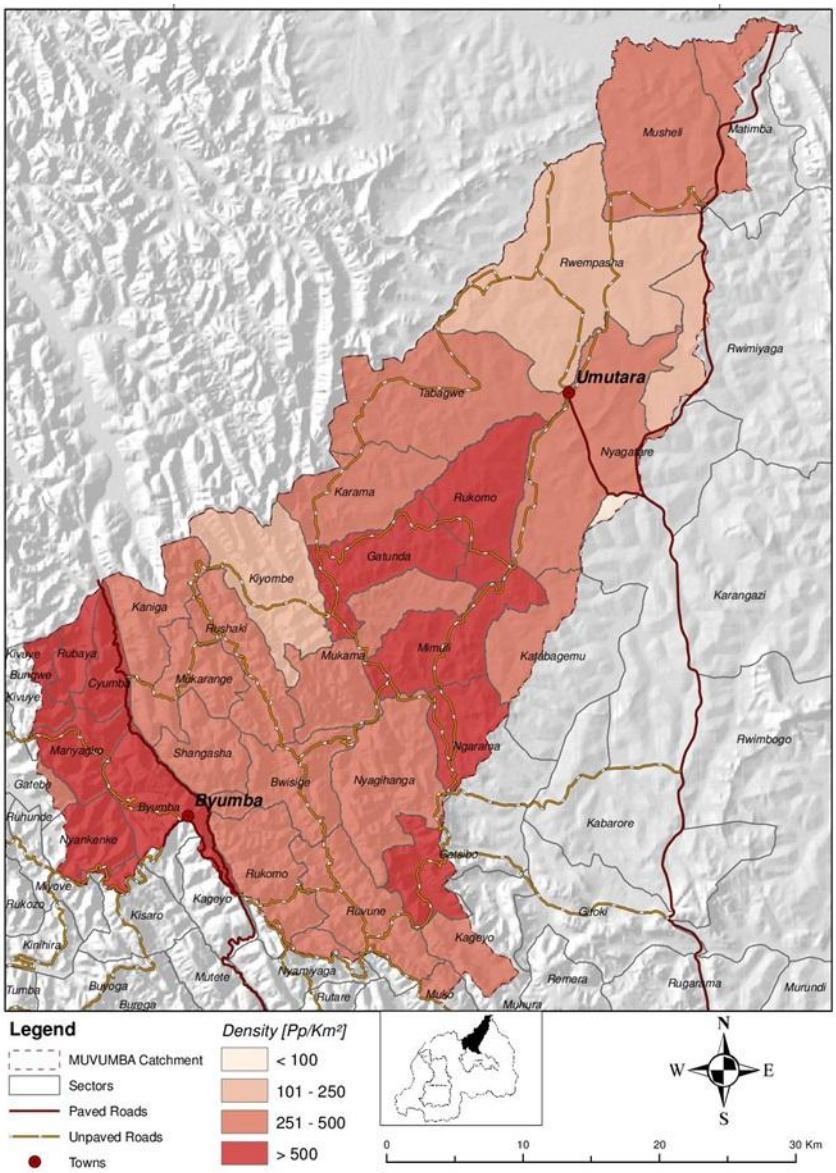


Figure 16: Population density map by sector for the Muvumba Catchment

2.2.2 Poverty and economic activities

Poverty rates within the catchment area are still very high with approximately 20% of the population still living below the poverty line. The cause of poverty has often been linked to high population growth and declining soil fertility in a largely agrarian based economy. The principle economic activity is agriculture i.e. crop production and livestock rearing. Levels of poverty in Household Living Surveys (EICV4) are defined on the basis of consumption figures. The 'poor' poverty classification is related to a consumption level of a basket of food and non-food items defined as 159,375 RWF per capita per year for the EICV4 survey (January 2014 prices). The 'extreme poor' poverty level classification is defined on the basis of consumption related to the cost of the basket of food items costed at 105,064 RWF per capita per year. Poverty level ranges between 44% to 53%. See Table 4 underneath.

Table 4: Population % identified as poor and extreme poor (EICV4 surveys)

District	District population	
	% poor[9]	% extreme poor
Nyagatare	59.95%	44.1
Gicumbi	29.03%	55.3
Gatsibo	9.72%	43.8

Land scarcity is a severe constraint to raising productivity. Only 52% of the land in Rwanda is arable. High population density on limited land resources has led to land fragmentation and reduction of farm sizes. The average size of land holding per house hold is approximately 0.7 ha., with most families cultivating small plots in a very intensive manner. Soil fertility has gradually decreased hence approximately 20% of the households within the catchment are affected by food insecurity. In the pastoral and agro-pastoral rangelands of the catchment in Nyagatare, population pressure is not as high but water shortages (for both humans and livestock), drought and overstocking are the main concerns. Overgrazing has been a big problem in the drier Umutara region, particularly soon after the genocide of 1994. Most returning refugees who settled in the region had large herds of cattle and overgrazing and accompanying soil erosion was a problem due to the limited carrying capacity of the dry region. The number of cattle in Umutara region in 1995 was estimated at about 800,000 head (REMA, 2009). These low lying areas along the river are largely used for irrigation but are affected by recurrent soil moisture deficits which cause low agricultural productivity and cause food insecurity. The farm practices in the small-scale irrigation farms are characterized by lack of modern irrigation technologies to enhance the productivity of rain-fed agriculture.

According to information from the Rwanda Development Board website, almost 80% of the population are dependent on rain-fed subsistence agriculture. Agriculture in Rwanda accounts for a third of Rwanda's GDP; constitutes the main economic activity for the rural households (especially women) and remains their main source of income. Today, the agricultural population is estimated to be a little less than 80% of the total population. The sector meets 90% of the national food needs and generates more than 70% of the country's export revenues. Other economic activities in Muvumba catchment include artisanal mining of wolfram, cassiterite and coltan and quarrying.

2.2.3 Access to basic services

In terms of electrical power supply, the Muvumba catchment remains significantly below the national average with access per household under 12.7 percent as against 17.5% for the national average. Dependence on forest resources for energy is very high with 82% percent of the households in this area utilizing firewood to for energy to cook their meals. This means that there is over dependence on wood as main source of energy. Alternative sources of energy like biogas, improved cooking stoves are still limited. Pit latrines are the most common form of sanitation facility and are used by 89.2% of the population. The most common type of waste disposal is by compost dumping and it is used by 67.7% of the population. There is no sewerage system in any of the large towns (Byumba and Nyagatare). 61.2% of the households within the catchment have access to improved sources of water.

[9] The percentage poor population comprises the percentage extreme poor population

Access to safe water is also low and varies between 40 – 50%. For example, the rural water coverage in Gatsibo is 49.2% and 52.8% in Nyagatare (WASAC, 2012). This means that majority of the population use dirty water from streams, dams, valleys or swamps. This shows that more than 50% of the populations in Gatsibo District do not have access to safe and reliable supplies of water for productive and domestic uses.

2.2.4 Water use

Adequate and quantified knowledge of current water resources utilization by sector is limited due to unregulated water use and lack of water use survey information. In November 2016, a Water Users' Survey[10] was carried out to get an overview of the water usage in each of the four studied catchments. The observed water users in this survey are: coffee washing stations, hydropower plants, water treatment plants, mineral extraction sites, dams, irrigation schemes, fishing farms, industries, and land parcels above 100 ha. A total of 18 water users was identified as having their water abstracted in Muvumba while 37 water used obtained their water from sources in the watershed divide between Nyabugogo and Muvumba.

The current known water demand locations within the catchment are presented below (Figure 17). The demand locations correspond to existing and proposed water related infrastructure e.g. irrigation schemes, hydropower dams, mining areas and urban centres.

[10] GCC Rwanda (2016). Water User Survey Report

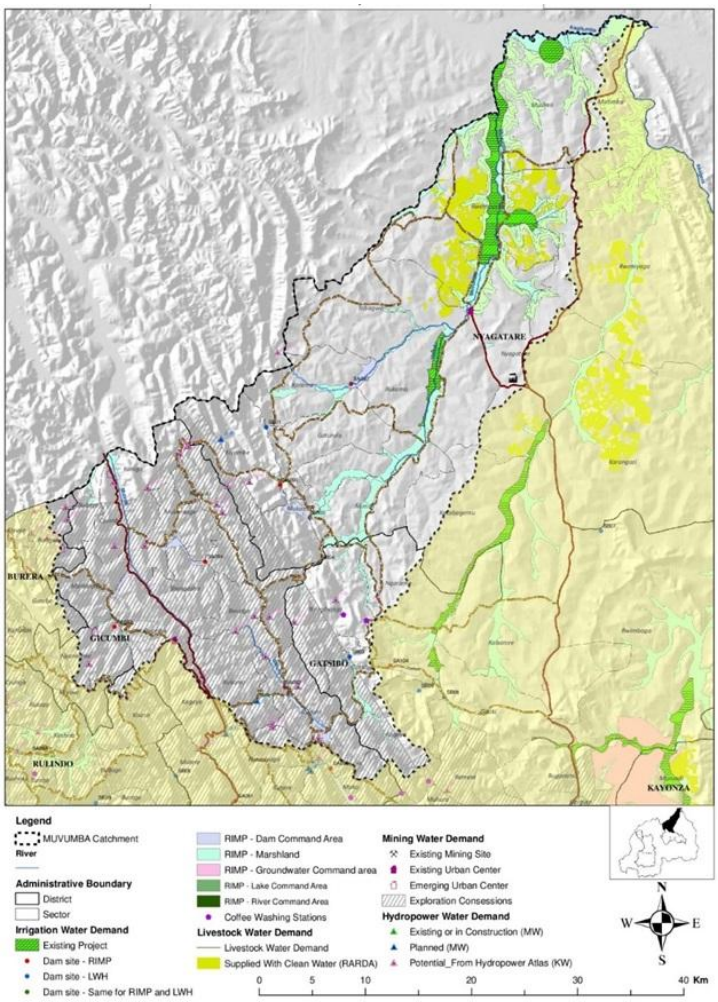


Figure 17: Demand locations map for the Muvumba catchment

Based on the results of the water user's survey and other supplementary sources, the following water consumption figures have been used:

- rural water demand, 80 litres/cap/day;
- urban water demand, 100 litres/cap/day;
- mining, 125 litres/cap/day;
- coffee washing stations, 75l litres/cap/day;
- tea factories, 35 litres/cap/day;
- other, 35 litres/cap/day;
- marshland irrigation, 1 455mm – 2 749mm/ha/year; (estimation based on MINAGRI data)
- hillside irrigation, 810mm – 1 251mm/ha/year; (estimation based on MINAGRI irrigation data)
- livestock, for each 5 people one animal (excluding chicken) is present. Water consumption was taken as 125 l/head/day;
- environmental flow requirements, 30% of the surplus or available water resources.

2.3 Water resources analysis

2.3.1 Hydrology

Long term river flow observations are available at the confluence of River Muvumba with River Kagera at Kagitumba. Figure 18 shows the monthly variation of flow indicating an annual average flow of 14 m3/s. In the Figure 18, Q_{95} refers to average monthly flow exceeding 95% of monthly flow events in m³/sec; (similar for Q_{65} exceeding 65% of events, etc.).

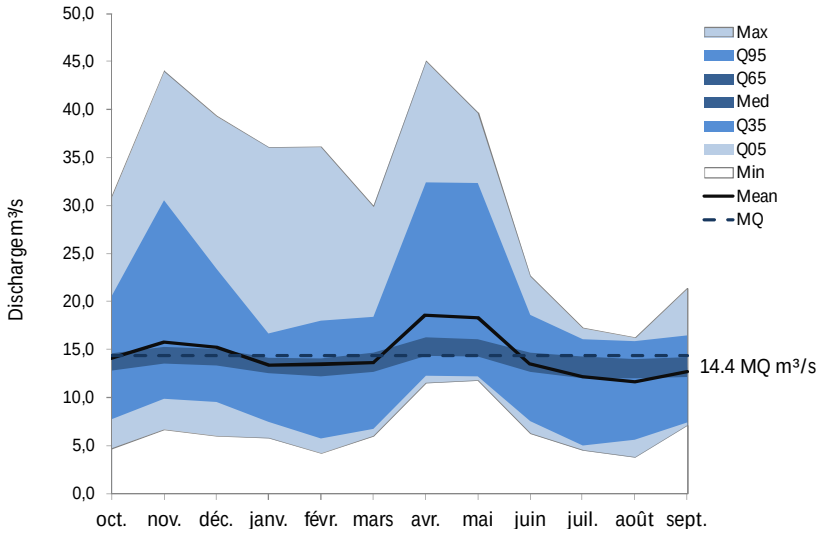


Figure 18: Monthly water regime curves for station 70001 (Kagitumba-Muvumba)

2.3.2 Water quantification

Previous quantification of water resources in the catchment were undertaken under the auspices of the National Water Resources Masterplan (NWRMP) Based on a thorough analysis of all available hydrological and meteorological data up too early 2013, the NWRMP established the total renewable water resources to be 193 MCM. The ratio of total water use compared to the available resources was established to be only 5.5%.

In this study, a varied approach to establishing the baseline water estimates for the period 2006 to 2015 was adopted. Meteorological data, more especially observed flows and rainfall data are essential for purposes of deriving runoff estimates. Some historical data are available for Rwanda, however the time series data is extremely fragmented and not continuous. Recent data is also difficult to obtain, and with limited spatial coverage. Extensive data quality checks and quality control has to be performed. On the other hand, global initiatives of various research group around the world have resulted in compilation of consistent data sets of precipitation, based on using remote sensing, observations and advanced data assimilation techniques. These can readily be utilized as they are accepted as high quality. One such example is the so-called CHIRPS[11] precipitation data set. Data are delivered for the entire continent at a daily based. Using QGIS and python scripting these data were aggregated to monthly values for each sub-catchment.

Additional climate data are required to estimate the potential evapotranspiration. Average monthly values of temperature and humidity at Kigali (elevation 1567 MASL) have been utilized within a Water Evaluation and Planning (WEAP) system model[12] to derive water balance estimates for each of the

[11] CHRIPS is the Climate Hazards Group InfraRed Precipitation with Station data and is a 30+ year quasi-global rainfall dataset. Spanning 50°S-50°N (and all longitudes), starting in 1981 to near-present, CHIRPS incorporates 0.05° resolution satellite imagery with in-situ station data to create gridded rainfall time series for trend analysis and seasonal drought monitoring. The creation of CHIRPS has supported drought monitoring efforts by the USAID Famine Early Warning Systems Network (FEWS NET). The CHIRPS data can be downloaded free of charge from http://chg.geog.ucsb.edu/data/chirps/.

[12] Future Water and eLeaf (2017). Water Balance and Allocation Modelling in Rwanda

demonstration catchments for a baseline period of 10 years from 2006 to 2015. Calibration and assessment of the model performance based on flow records at Kagitumba, is illustrated in Figure 19 below.

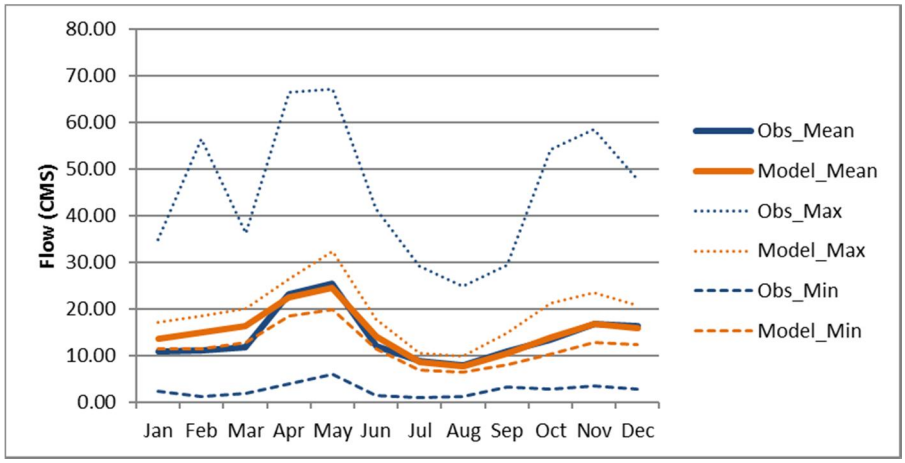


Figure 19: Observed and simulated mean, min and max flow for station Kagitumba

Based on the simulated flows and demand figures obtained from the water user's survey, the National Water Resources Masterplan and other sources Table 5 and Table 6 below show the summarised water balances for the baseline 10-year period.

Table 5: Summarized water balance for the entire basin for the baseline as 10-year average

In	(MCM/y)	Out	(MCM/y)
Precipitation	1,543	Evapotranspiration	995
Return flows	13	Withdrawals	30
Storage change	1	Outflow	526
Inflow	198	Groundwater recharge	203
Total	1 755	Total	1 755

Table 6: Summarized water balance for the manageable water components (Blue Water) as 10-year average

In	(MCM/y)	Out	(MCM/y)
Runoff	39	Domestic	2
Baseflow	303	Industry	9
Groundwater	3	Irrigation	18
Return flows	13	Livestock	1
Inflow	198	Outflow	526
Total	*556*	Total	*556*

From these Tables it is clear that most of the precipitation is lost to evapotranspiration by vegetation. Outflow from the catchment and groundwater recharge are other important components in the catchment which provide water to sustain environmental flow requirement. It is interesting is that the so-called manageable water (sometimes referred to as Blue Water) is about 30% of total water resources. Only a small fraction is currently withdrawn for domestic, industry, irrigation and livestock.

The scope for the development (regulation) of surface water resources is significant. The development of large scale reservoirs allows for the harnessing of surface water resources generated in Uganda. For this

reason, it is considered important to put in place frameworks for transboundary coordination on the development of dams at site SA97 (Muvumba dam) and at site SB3 (Warufu). Feasibility studies are available for the SA97 site (Muvumba dam) and for SB3 site (Warufu dam). Both dam sites have been considered in the NWRMP report which has recommended their construction (from 2020 onwards) along with 2 other sites (SB2 and SB4) which will provide a significant regulation potential for irrigation development in the marshlands of Muvumba and Warufu rivers. It was in particular mentioned to consider their combined development and operation for optimum development of the available (marshland) irrigation potential. A combined hydrological study of these 4 dam sites is not yet available.

2.3.3 Water quality

Systematic monitoring of water quality data in Rwanda has only been taken up recently by the RNRA-IWRM department at a limited number of locations throughout the country. Currently, water quality is monitored at Nyagatare and Kagitumba monitoring stations.

During district surveys pollution arising from application of fertilizers and pesticides from irrigation schemes e.g. Mulindi tea factory in Kaniga sector of Gichumbi district was cited as a major cause of poor water quality in River Cyondo and River Muvumba. Other areas from which pollution emanates are the emerging urban centers of Byumba, Gatuna, Yaramba, Miyove and Rukomo. The Karenda-Mukaka river has been cited to as being polluted by the sediment load from mining activities located in Mubuga cell (Miyove sector). Other alleged point sources of pollution are those attributed to EAGI (Granite production) and Inyange (SAVANA, milk production) industries located in Rutaraka and Nyagatare cells (Nyagatare sector).

Results from the established sampling points at Nyagatare and Kagitumba show high contamination. The exceeded parameters were E coli and Faecal Coliform. Along with high levels of turbidity, the concentration of Lead (Pb), Manganese (Mn), Iron (Fe) and Copper (Cu) exceeded the threshold values. Elevated levels of BoD and CoD have also been reported. Recent water quality surveys have been undertaken by the IWRMD[13] from sampling sites along River Muvumba and Warufu. Turbidity levels and Total Suspended Solids (TSS) were found to be elevated i.e. above the prescribed World Health Organization (WHO) and Rwanda Standards Board (RSB).

2.4 Stakeholder analysis

The process followed to identify and analyze stakeholder interests and their roles and responsibilities, contributes to a catchment management plan with broad ownership, enhancing the subsequent joint implementation by all stakeholders. Effective engagement of these stakeholders ensures sustainability of the plan's proposed interventions. During the consultative meetings, stakeholder analysis processes were undertaken to determine who the key stakeholders are, what are their interests, what benefits do they derive from the catchment, and what roles and responsibilities they currently have and can play in the future management of the catchment.

See Annex 3 for the stakeholders list which comprises:

[13] RNRA-IWRMD (2017). Semi-annual water quality report 2016/2017

- National Government, in the form of line ministries and their authorities/agencies, including the significant projects and programmes carried out under their auspices;
- Semi-Governmental utilities, such as water supply and electricity utilities;
- Districts;
- NGOs and iNGOs active in the districts;
- Private sector stakeholders.

Stakeholders within the catchment can be classified in three broad categories according to the role they are expected to play, the level of influence they are expected to exert within the framework for design and implementation of the catchment plan, and their role in the stakeholder engagement strategy.

1. Primary stakeholders - include the local communities and community groups (the majority of whom are poor men and women), farmers, herders, and fishermen etc. who derive their livelihoods from the water resources of the catchment, or whose activities directly rely on or impact the water resources of the catchments. These would also include water users, water user associations and business entities directly affected by the catchment plan. A long list of these primary stakeholders is included in the various district survey reports. This group of stakeholders should be kept informed, and engaged through participatory implementation so as to guarantee ownership of the project interventions.

2. Secondary stakeholders - are those individuals, institutions or organisations that are intermediaries who have an interest in the catchment plan implementation projects or outcome, although it is less significant and directly related than that of the primary stakeholders. We can say that these secondary stakeholders are "indirectly affected" by outcomes. In the Muvumba catchment these would be the local government or constituent districts, NGOs, WASAC, RURA, EWSA, electricity companies e.g. REG, and other transboundary projects in the basin such as Kagera Integrated Water Management & Development project under NELSAP, TAMP, LVEMP II. The recently constituted task force committees and hydrographic basin committees are the focal point persons for this category. Whereas these stakeholders are indirectly affected by the outcomes, they are powerful and highly interested in the catchment planning process. They should constantly be engaged and consulted during the planning process and should therefore be satisfied by the investment plan.

3. Tertiary stakeholders - can also be referred to as external and usually play an advisory, approval or advocacy role to the Project. These include the National Governments, the Embassy of the Kingdom of the Netherlands in Rwanda, potential donors, and technical ministries that formulate the policies, plans and programs relevant for the design of the catchment plan (e.g. MINIRENA, MINAGRI, MINALOC, MININFRA). The apex bodies for water management such as the Water Inter Ministerial Committee and National Water Consultative Committee are also included in this category and play a critical role in approval of the catchment plan.

   For each category of stakeholders, it is important to feel that they are part and parcel of the proposed projects in the catchment plan. Regular communication on outcomes and decisions being made is essential. It is recommended that a dedicated communication strategy for all levels of stakeholders is to be designed at the beginning of the implementation phase.

2.4.1 Stakeholder engagement plan

The stakeholder engagement plan for the implementation phase of the catchment plans is outlined on the next pages:

Table 7: Stakeholder engagement during catchment plan implementation

Type of stakeholder	Timing of involvement	Type of participation required	Tools for participation and communication	Outcome of involvement	Comments
Communities, Water user associations, Farmers, Herders, Rwanda Miners Association	Implementation and M&E	Interactive participation, participation for material incentives. active role in management of watershed.	Community meetings, focus group discussions.	Resource mobilization and development of community structures for catchment plan implementation and M&E phases, enhanced ownership of sub-projects	Integration of gender, vulnerable segments of the community, conflict, HIV/AIDs and other cross cutting themes will need to be factored into project design and implementation.
Private Sector Associations including water utility companies and parastatals (REG, WASAC, RURA, EWSA)	Consultative biannual or annual meetings	Participation by information giving, by consultation	Formal meetings and representation in Focal Group, national and multi-stakeholder meetings, email, social networking.	Exchange of best practice across sub projects e.g. water source protection, water efficiency promotion. Fulfilment of private sector objectives in economic development in the various projects they support or implement	The water allocation plan should be discussed in depth as it affects the operations of this group of stakeholders
Local Governments, District Hydrographic committees, Catchment Task Force	Quarterly meetings	Interactive participation	Advisory committees, formal meetings, project monitoring visits.	Enhanced ownership and sustainability of sub- project outcomes. Contribution towards attainment of catchment plans in imihigos	Interventions in the catchment plans can be streamlined into joint imihigo
Technical Ministries, REMA, RWFA	Biannual	Advisory and consensus building	Formal meetings e.g. Focal Groups PSC, water sector meetings, exchange visits to the other riparian countries for lesson learning and exchange of best practice	Contribution towards the attainment of sector plans in IWRM due to sub project activities.	It is envisaged that the sub-projects will be part of the sectoral plans
Regional projects	Biannual	Information exchange of best practices and lessons	Formal meetings lesson learning workshops	Commitment to collaboration on similar projects or activities in the	It is envisaged that the IWRM Catchment

Type of stakeholder	Timing of involvement	Type of participation required	Tools for participation and communication	Outcome of involvement	Comments
		learnt		Nile Basin. Contribution towards regional environment and economic development goals	Investment Plan will be in harmony with other investment plans for the region.
Regional bodies (EAC, NBI)	Annual	Information exchange of best practices and lessons learnt	Formal meetings and lesson learning workshops	Commitment to harmonization of similar activities and donor coordination in the Nile Basin. Contribution towards regional environment and economic development goals	It is envisaged that the IWRM Catchment Investment Plan will be contributing to the goals of regional bodies.
Donors of Water for Growth Programme, EKN and other development partners	Biannual	Information exchange and updates of sub projects	Formal meetings	Commitment to continuation of funding for sub projects within the four demonstration catchments and/or additional catchments.	Donor funding for the IWRM activities in the catchments is factored into national budget.

2.5 Consistency analysis of existing policies, plans and programs

2.5.1 Introduction

The purpose of a 'consistency analysis of existing Policies, Plans and Programs (PPPs)' is to check the consistency of the catchment plan under development with existing policies, plans and programmes, by means of interagency co-operation. The analysis requires an inventory of National, local and sector plans that may have influence on, or that may be influenced by, the catchment plan, to ensure that the four catchment plans are compatible.

During the stakeholder, consultative meetings (with National stakeholders and the Catchment Task Force), a first analysis of existing policies, plans and programs was undertaken to develop an overview of relevant PPPs that have consequences for the catchment plan of the Muvumba catchment, see Catchment Plan interim report TR17 – Catchment Characterisation and Vision for the results. The analysis shows the key PPPs that might generate opportunities for the catchment plan; set environmental and socio-economic conditions (criteria), and those that have the potential to conflict with the plans and how these conflicts can be resolved.

The Water for Growth Program commissioned a study to investigate the policy, plans, programs and legislation frameworks in terms of their relevance and alignment to Integrated Water Resources Management (IWRM). The purpose of consistency analysis of policy instruments was to check the extent to which policies are consistent and supportive of each other or policy instruments presenting conflicting objectives. The analysis was conducted by preparing an inventory of relevant policy instruments that may have influence on IWRM. The goals of each policy instrument evaluated to assess the level of consistency so that specific goals and policies contained in one policy are not in conflict with those contained in another. Thereafter, SWOT Analysis framework (Strengths, Weaknesses, Opportunities and Threats) was applied to unearth inconsistencies and alignment issues. The findings reveal that there are strengths and challenges in the performance of existing policy instruments and legal texts. The sections below provide key findings from the consistency analysis. The full report is available as Water for Growth Rwanda TR16 – Consistency Analysis (November 2016).

2.5.2 Key strengths of existing policy instruments

The first key strength is that that Rwanda subscribes to the principles of IWRM in the management of her water resources this manifest itself in the availability of key policy and legislative frameworks related to IWRM. To be specific, the principles of IWRM are integrated in an explicit manner in several policy instruments (e.g. national policy for water resources management, environmental policy, green growth and climate resilience strategy, national water resources master plan, etc.). For example, law N°62/2008 enacted in 2008, lays out the general framework for the principles of integrated water resources management, including the prevention of pollution, and the principle of "user pays" and "polluter pays," as well as the principle of users' associations for the administrative management of water. It also calls for better integrating the management, development, utilization and protection of land and water resources at the catchment level.

Similarly, Organic law n° 04/2005 of 08/04/2005 determining the modalities of protection, conservation and promotion of environment in Rwanda is also very relevant for IWRM and catchment plans. An important aspect of the legal context for catchment plans is that according to article 67 of organic law no. 4/2005, 'every project shall be subjected to an Environmental Impact Assessment (EIA), before obtaining authorization for its implementation.' The article further mentions that 'this applies to programs and policies that may likely affect the environment.

The principles of IWRM are also implicitly captured in law n° 08/2005 of 14/07/2005 determining the use and management of land in Rwanda. This was repealed and replaced in 2013 in order to strengthen the law's scope on gender equality, property right protection and environmental conservation and protection. Some other most relevant pieces of legislation related to natural resources include No. 58/2008 of 10/09/2008 determining the organization and management of aquaculture and fisheries in Rwanda, law N° 30/2012 of 01/08/23012, law on governing of agrochemics, law N°10/2012 of 02/05/2012 governing urban planning and building in Rwanda and law N°55/2011 of 14/12/2011 governing roads in Rwanda.

There is also an acknowledgement of pressure on water resources and an incorporation of key normative dimensions of IWRM (water as a social and economic good, stakeholder participation, promotion of catchment relevant scale, e.g. basin) (e.g. national policy for water resources management, revised vision 2020, EDPRSS 2, seven year government program, decentralization policy, community development policy, disaster management policy, environmental policy, national strategy for community development and local economic development, etc.).

In similar fashion, national rice policy calls for the development and management of water through a participatory approach, involving users, planners and policy makers at all levels. Likewise, thee gender policy sets out the key objectives for ensuring the empowerment of women in various sectors including environment protection and land use management. In terms of management of water resources at a watershed level, key regulations are organic laws nº 04/2005 and 62/2008. Decentralized entities are given responsibility for "efficient management of rivers, lakes, sources of water and underground water", as well as for the 'efficient management and effective use of swamps'.

Hence it is clear from the cited examples that many policy instruments are consistent and supportive of each other with regards to IWRM. Thus, for example, policies on agriculture, environment, land, water resources management and infrastructure emphasize aspects of soil erosion protection and water conservation. Other points of convergence are found in areas such as the promotion of agro-forestry (e.g. five-year strategic plan for the environment and natural resources Sub-Sector, national climate change and low carbon development strategy, SPTA 3, etc.).

In addition, some policy documents (e.g. National fertilizer Policy, irrigation policy, strategic plan for the transformation of agriculture in Rwanda, Rwanda irrigation master plan , master plan for development of fisheries and aquaculture in Rwanda, public policy and strategy for Rwanda, law No. 58/2008 of 10/09/2008 determining the organization and management of aquaculture and fisheries in Rwanda, law n° 30/2012 of 01/08/23012 law on governing of agrochemics, law N°10/2012 of 02/05/2012 governing urban planning and building in Rwanda, law N°55/2011 of 14/12/2011 governing roads in Rwanda)

establish objectives and indicators directly relevant to environment and natural resources. Above all, the national decentralization policy, community development policy and national strategy for community development and local economic development deserve to be highlighted, as they establish responsibility for implementation of actions in environment, natural resources, agriculture, infrastructure for example at the local level. These policy instruments show similar points of convergence with the revised vision 2020, EDPRS 2 and Seven Year Government Program.

2.5.3 Key weaknesses of existing policy instruments

There are specific challenges which might hinder the implementation of IWRM. The first challenge is that some policy instruments lack provisions for IWRM. For example, the environmental policy is less specific in terms of the purpose of conserving wetlands. Instead, the policy acknowledges that traditional wetland use has been poorly conceived and lacks organization or objective. It calls for elaboration of a formal wetlands policy and master plan, and a national wetlands inventory that distinguishes between protected and unprotected wetlands acceptable for human use. There are also limited capacities at decentralized level to promote watershed management, address soil erosion control, agro-forestry and other soil and water conservation measures. Many committees in various sectors e.g. environmental committees, agricultural water user committees, forestry management committees, Disaster Management Committees etc. often with similar or overlapping roles and responsibilities for natural resources management.

Rwanda's constitution of 2003 amended in 2015 states a right to a clean environment in article 22: "Everyone has the right to live in a clean and healthy environment". However, the legislation does not explicitly expound on the principles of adopting IWRM as a means to secure universal water rights. It is anticipated that the new water law will make such express provisions. With regard to land management, under the ministerial order No 14/11.30 of 21/12/2010, the land consolidation is designed to enable farmers to consolidate multiple parcels under one crop management program and optimize agricultural productivity as well as strengthen connection between buyers and farmers. However, there is no single clause on managing land, water and other terrestrial land and marine resources in integrated way. Furthermore, the order does not provide for the active participation of local people in land management and consolidation.

Although women play a pivotal role as providers and users of water and guardians of the living environment, it is also surprising to note that in most pieces of policy instruments, there are no guidelines for the role of women in the provision, management and safeguarding of water resources in most policy instruments (e.g., national water resources master plan, five year strategic plan for the environment and natural resources sector, national agriculture policy, strategic plan for the transformation of agriculture in Rwanda phase III. Furthermore, integration and coordination between various policies and human activities (in particular the development of different economic sectors) are not clearly highlighted in most policy instruments.

The other weakness of the existing policy and legal framework that were underscored is the existence of some conflicting objectives in the programs for transformation of agriculture (e.g. objectives related to intensification in use of pesticides and fertilizers which conflict with objectives on improving water quality; as well, objectives for marshland reclamation which are potentially in conflict with objectives on

wetlands protection) These soil intensive mechanisation measures are prioritised in agricultural mechanization strategies for Rwanda and in the national agriculture policy at the expense of the protection environment and natural resources management. Similarly, the national climate change and low carbon development strategy seeks to aggressively promote protection of environment which may be at odds with agriculture transformation and economic development. These potential conflicts have to be carefully examined at local sub-catchment level.

2.5.4 Implications of findings of consistency analysis for catchment planning

Given this complex context of various policy instruments, the key requirement for effective implementation of catchment plans is to first integrate policies, programs, plans and laws. This will ensure inclusive and accountable decision making and sustainable water resource management. Such integration should be reflected in the local plans. This will give districts the necessary capacity to effectively implement these policies at the local level.

In order apply the principles of IWRM in catchment planning it is necessary to have cross-sectoral cooperation, at catchment scale including both bottom-up and top-down participation in planning, with emphasis on coordination across multiple scales. Cultivation of a network of partnerships is essential to ensure inclusion of diverse stakeholder perspectives within a framework of collective decision-making on water and land resources management. It is increasingly recognized that central governments agencies cannot do everything and that some components of water and land management are better handled by other actors. The emergence of networks involves the redefinition of centralised planning to an alternative catchment boundary planning approach which is much more open thereby allowing for diversity and experimentation between many different stakeholders. This will allow major stakeholders to have common vision and shared understanding of water management issues.

Therefore, it is imperative to revise policy documents that have inconsistencies or weaknesses to ensure they are aligned with the principles of IWRM as opposed to promulgating various fragmented policy and legal texts. Central government agencies such as MINIRENA, MINAGRI, REMA, should coordinate better with local governments to integrate the activities of a comprehensive catchment plan various constituent district development programs for effective implementation at district level.

2.6 Analysis of issues and opportunities

The scoping workshop for the catchment plan of Muvumba, held in June 2016, resulted in a prioritised list of issues and opportunities in the catchment. With thanks to the participation of all members of the Catchment Task Force, as well as the key representatives of the National Government (MINIRENA and partner Ministries) in the scoping workshop, the results in Table 8 provide a solid basis for the catchment plan.

Table 8: Priority issues and opportunities in Muvumba catchment as scored by the districts representatives in the Catchment Task Force

Issues	Score	Opportunities	Score
Soil erosion	23	Irrigation	22
Pollution (from Agriculture)	19	Potential for hydropower	14
Deforestation	15	Mechanization of agriculture	12
Lack of water storage (Water scarcity)	13	Land use planning	8
Drought	11	Bilateral cooperation	7
Domestic water shortage	8	Fish culture	6
Unprotected river banks	7	Land for agriculture	5
Inefficient water management	6	Tea plantation	5
Conflicts over water use (agriculture/livestock)	5	Land husbandry	4
No coordination with Uganda	4	Employment opportunities	3
Illegal mining	2	(Eco)Tourism (Rugezi wetland)	3
Dam siltation	1	Water resources	2
Non-Productive forest	1	Marshland	2
		High rainfall (water resources)	2
		Water storage potential (Resources)	2

The consultation in the scoping workshop and further analysis of the water resources leads to the following top priority issues: erosion and flooding, poor water quality mainly caused by high sediment load, population pressure, and insufficient drinking water supply and sanitation. These key problems together with the underlying causes and opportunities are discussed in detail below.

2.6.1 Erosion and flooding

The land scape of the catchment in Uganda and Rwanda is characterised by small fragmented holdings on mountainous terrain in the high altitude areas. Given that the higher parts of the water shed are characterised by high and dissected relief with steep slopes, intensive rain fed cultivation and abundant rainfall, they are prone to erosion. The high run-off rates lead to a lot of soil loss which ends up as sediment in the rivers and streams. The loss of fertile soils leads to reduced soil fertility and poor agricultural productivity in the higher parts of the watershed. In addition to agriculture, over-grazing and collection of fuelwood have contributed to high rates of deforestation particularly in the upland watersheds. The sub-catchment area in Uganda in Kabale[14] district is reported to be very highly degraded, with loss of top soil being more pronounced in Uganda as compared to Rwanda. Projections of future climate for Rwanda indicate a trend towards a warmer and wetter climate. Intense rains on steep slopes will lead to increased erosion.

2.6.2 Poor water quality

Due to population land pressure, cultivation of the food crops has been extended from the uplands to the wetlands in the valleys. Large drainage channels are constructed to drain excess amounts of water from the wetlands, and open them up for cultivation. Thus some 71 percent of all wetlands have been converted to agriculture of various types as means to secure food security. However irrigated systems are often poorly developed and characterized by inefficient water use. Pollution arising from application of fertilizers and pesticides from these irrigation schemes is a major cause poor water quality.

[14] Nile Equatorial Lakes Subsidiary Action Plan (NELSAP), 2014. Maziba sub-catchment management plan, Kabale district, Uganda.

2.6.3 Population pressure

The Muvumba is a densely-populated catchment with a population of over 596,980 inhabitants mainly living in emerging urban areas of Gatsibo, Byumba and Nyagatare. The population is expected to triple by the year 2020. Population densities are as high as 500 inhabitants/km2 in urban centres. The emerging urban centres towns such as Byumba Gatuna, Yaramba, Miyove, Rukomo and Nyagatare, lack solid waste, storm water, and sewerage facilities. Most of the waste finds its way into the rudimentary drainage system and ends up polluting the water courses. Other sources of pollution are those attributed to industries, mining activities and some informal settlements in Gichumbi.

2.6.4 Poverty reduction

Poverty rates in some parts of the catchment area are still very high with approximately 60% of the population in Nyagatare classified as poor. The cause of poverty has often been linked to high population growth and declining soil fertility, and recurring droughts in a largely agrarian based economy.

Opportunities do exist for poverty reduction through adoption of green growth strategies to ensure that environment and natural resources are utilized and managed productively in support of equitable and sustained national development. There is significant potential to enhance agricultural productivity through more productive utilization of water resources, increase of storage to decrease water shortage, empowering youth and women while increasing resilience to drought induced by a changing climate. There is also a unique opportunity to influence the other sectors, ministries and districts in the catchment in the implementation of measures to address these issues in a coordinated manner within the framework of a catchment plan. There is potential to expand the current acreage under irrigated agriculture in marshlands from 3,302 ha to 8,868 ha through intensive utilization of water resources.

2.7 Ongoing catchment management initiatives at National and local level

On-going key projects linked to catchment management in Muvumba catchment include among others: Transboundary Agro-Ecosystem Management Programme, Land Husbandry, Water Harvesting and Hillside Irrigation (LWH) Project, and Decentralisation and Environment Management Project (DEMP) Phase II. On-going Government projects related to water management currently implemented in the catchment Muvumba are listed in Table 9.

Table 9: On-going implementation of National Government projects related to the catchment plan

S/N	Name of the project	Implementing institution	Number of Districts
1	Transboundary Agro-Ecosystem Management Programme	FAO and MINAGRI	3
2	Project d'Appui à la Reforestation au Rwanda (PAREF Phase 2)	MINIRENA	
3	Land Husbandry, Water Harvesting and Hillside Irrigation (LWH) Project	MINAGRI	2
4	Third Rural Sector Support Program (RSSP)	MINAGRI	2
5	Lake Victoria Environmental Management Project (LVEMP) II – APL2:P118316	WASAC	1
6	Decentralisation and Environment Management Project (DEMP) Phase II	REMA	3
7	Early Implementation Projects EIPs under the Water for Growth Programme	MINIRENA	1

A description of all the national and local current projects related to the catchment plan, including Early Implementation Projects are provided in the subsequent sub-sections. These can be grouped under the following broad categories

- initiatives to reverse land degradation through sustainable use of land resources and agroforestry systems;
- initiatives to manage solid waste and sewerage facilities;
- initiatives to increase coverage of safe water and sanitation facilities;
- initiatives to enhance agricultural productivity through increased water use for irrigation.

2.7.1 Transboundary Agro-Ecosystem Management Programme

The Transboundary Agro-Ecosystem Management Programme (TAMP) for the Kagera Basin was designed to reverse land degradation through sustainable use of land resources and agroforestry systems. Project start-up was March 2010 and implementation was envisaged over 4.5 years. The project was completed in June 2015. It's source of funding was the Global Environment Facility (GEF) and the Governments of the Kagera Basin partner states in Rwanda, Burundi, Uganda and Tanzania. The programme was managed through the UN Food and Agricultural (FAO) Land and Water Division with support from national agriculture and environment sector agencies.

Within the area, drained by Muvumba catchment, the project area covered the districts of Nyagatare, Kabale and Ntungamo. Country level coordination was through Ministry of Agriculture and Animal Resources (MINAGRI) in Rwanda and Ministry of Agriculture, Animal Industries and Fisheries (MAAIF) in Uganda. Implementation was centred around demonstration of best practices to Farmer Field Schools (FFS) and production of land degradation maps. Standard sustainable land management practices were promoted on 745 hectares within catchments in Rwanda by June 2013. Establishment of soil erosion control structures (bench terraces, water retention ditches, runoff ponds) stabilized with grass was undertaken in most parts of the project sites. Other SLM interventions included establishment of buffer strips along rivers and tree planting.

The demonstrations are considered a good approach of community level engagement of groups to promote sustainable agriculture and soil conservation measures. The Mid-term review assessment[15] for the project particularly noted the inadequate integration of the potential of rainwater harvesting into programme activities. These were only limited to infiltration ditches. A significant amount of effort was expended to develop capacities of individuals such as farmers in terms of transfer of knowledge and skill but with relatively less attention on improving the capacity of relevant organizations and developing an adequate enabling environment for the basin including the necessary policy, legislation and governance frameworks.

The last phase of the project focussed on the scaling-up of innovative and cost-effective Sustainable Land Management (SLM) practices and investments that reduce land degradation and deforestation issues, enhance the productivity and the resilience of agricultural systems and generate socio-economic/livelihood benefits for local land users as well as global environmental benefits.

[15] Midterm Evaluation of the Kagera Tamp Project – Final Report. FA0, August 2013.

The Forest and Landscape Restoration Mechanism (FLRM) is the successor project to TAMP. It is currently being implemented by FAO and coordinated at national level with pilot activities in Rulindo. These activities are designed too upscale the successful practices implemented during the last phase of TAMP.

2.7.2 Project d'Appui à la Reforestation au Rwanda (PAREF Phase 2)

PAREF Phase 2 is designed to focus on supporting the Forestry Sector to implement the National Forestry Policy in Rwanda so as to reverse both quantitative and qualitative degradation of forest resources and restore Rwanda's forestry cover to a target of 30% forest cover by 2018. PAREF covers all the districts of the Eastern, Western and Northern Provinces. PAREF is funded by the Belgian Development Agency (BTC) and the Netherlands government and implemented by RNRA. The phase 2 of the program commenced in the year 2009 and will end in December 2016. Project interventions include afforestation, agroforestry and forestry management. Through PAREF, a list of suitable species for each intervention area was developed. Planting interventions of PAREF have predominantly used exotic species, as it is more cost effective than indigenous species. However, some native species have been used and acknowledged by the RNRA for their medicinal products and role in conserving biodiversity. The interventions of PAREF (Be) within the catchment are located in Gichumbi district were 884.3 ha of forest plantation were completed in the year 2014.

2.7.3 Land Husbandry, Water Harvesting and Hillside Irrigation (LWH) Project and GFI Project

Government of Rwanda designed the Land Husbandry, Water harvesting and Hillside irrigation (LWH) project to increase productivity and promote commercial farming on the hillsides of Rwanda. The project is introducing sustainable land husbandry measures for hillside agriculture on selected sites in Rwanda, as well as developing hillside irrigation for sub-sections of each site. Within Muvumba, the selected sites are in Nyagatare, where 900 hectares have been developed by the GFI Project (Table 10). Appropriate techniques and technologies in construction and management of land have been demonstrated and appropriate land husbandry practices developed for both rain-fed and irrigated agriculture to enhance productivity of annual and perennial crops. Land husbandry practices on hillsides depends on slope categories i.e. soil bunds on 6-16% slope, terraces on 16-40%, narrow-bench terraces on 40-60%, more than 60% slope afforestation.

The project uses community participation approach where community members are employed in different land husbandry activities. This has contributed to increased rural income. These activities can be up-scaled in other areas.

2.7.4 Third Rural Sector Support Program (RSSP)

The Rural Sector Support Program (RSSP) is an ongoing project that is implemented by the Ministry of Agriculture and Animal Resources (MINAGRI). Its objective is to ensure reduced poverty in rural areas through increased agricultural production and income. The first phase of the project begun in the year 2011. Current funding arrangements are in place since then for 15 years. The potential irrigable area for Marshland in Muvumba catchment is 25,998 ha (NWRMP) and currently, 2 435 , hectares have been developed under marshlands within the framework of the RSSP 2 in Nyagatare (Table 10).

Table 10: Irrigation projects in Muvumba catchment

Name of scheme	District	Type	Water source	Command area	Project

				(ha)	
Muvumba P-5	Nyagatare	Marshland	Dam	145	RSSP 2
Muvumba P-8	Nyagatare	Marshland	Dam diversion	1750	RSSP 2
Muvumba P-2+3	Nyagatare	Marshland	Stream diversion	310	RSSP 2
Muvumba P-4	Nyagatare	Marshland	Stream diversion	230	RSSP 2
Matimba & Kagitumba	Nyagatare	Hillside	Pumping	900	GFI

At Muvumba P-8 irrigation scheme, the project has as of now rehabilitated 1750 ha of marshland along River Muvumba to enable farmers that were growing subsistence low value crops such as maize and rearing cattle in these marshes to start growing high value crops such as rice throughout the year. This has been attained through construction of Umuvumba water retaining dams and irrigation canals that facilitated irrigation in the dry season and control floods in the rainy season. Farmers in these marshlands have doubled their rice yields form 3t/ha to more than 6t/ha after rehabilitation. Over 4,850 people that use these marshlands have tripled their income completely changed their lives. In addition, 24,500 ha of surrounding hillsides were sustainably protected against soil erosion to prevent siltation to the marshland and increased economic value of the land.

At Muvumba P4 and P-5 irrigation schemes in Nyagatare district, marshland of about 140 ha in each case have been developed by constructing a retaining dam along River Muvumba. Soil erosion control measures on adjacent hillsides of marshland have also been developed to protect the dam against siltation. Rice yields increased from 3T/ha to 5T/ha.

2.7.5 Lake Victoria Environmental Management Project (LVEMP) II – APL2:P118316

LVEMP II APL-2 (which covers the two riparian countries – Burundi and Rwanda) began at the start of 2012 and runs until the end of FY 2017. The interventions in Muvumba catchment under this project are the provision of water supply and sanitation to Nyagatare town.

In August 2015, with funds secured from Lake Victoria Water and Sanitation (LVWATSAN) Project Phase II, WASAC is implementing improved water supply services to the population living in the Nyagatare District through improved water infrastructure. The project will increase access to safe water from a currently coverage of only 56 per cent of dwellers in Nyagatare to 64 per cent of the residents. The project components are a water supply system, drainage system, land fill and faecal sludge treatment facility for Nyagatare town.

2.7.6 Decentralisation and Environment Management Project (DEMP) Phase II

DEMP Phase II is a UNDP supported initiative in Rwanda to be implemented between July 2008 – July 2018. Its activities in the catchment are mainly geared to focus on capacity development of Ministry of Natural Resources (MINIRENA) / Rwanda Environment Management Authority (REMA) to undertake environmental policy coordination and monitoring and the Districts to be able to integrate environment with development through the district planning, budgeting process and project implementation. DEMP has contributed to improving productivity and sustainability of key sectors including land, water resources management and agriculture within the catchment in 6 Districts in Eastern Province.

2.7.7 Early Implementation Projects EIPs under the Water for Growth Programme

An Early Implementation Project (EIP) for landscape rehabilitation is to be implemented from the start of the year 2017 in order to address urgent needs of the sector, ahead of the official development and endorsement of the Catchment Plan. The targeted area is located upstream of Muvumba Multi-purpose dam in Nyagatare District, between Gatunda, Karama and Tabagwe sectors. The EIPs are designed to reduce soil erosion by protection the land through interventions such as promotion of Agroforestry, construction of progressive, bench and narrow cut terraces, re-afforestation, river and reservoir buffer zone protection and gully rehabilitation. The total area to be covered by all interventions is equivalent to 2,324 ha. The location and details of the interventions are illustrated in Figure 20 below.

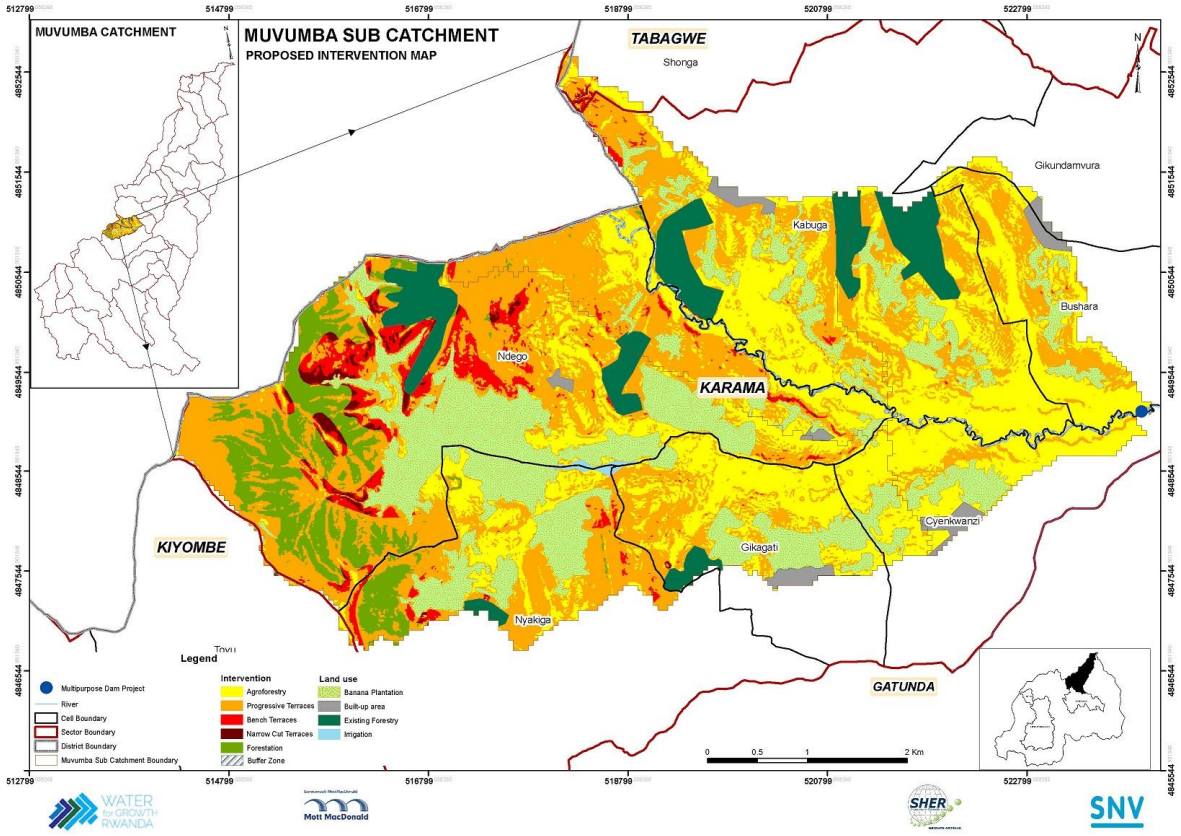


Figure 20: Land management measures of the Early Implementation Project

3. The catchment management plan

3.1 Introduction

The current document constitutes the Catchment Plan – version 1.0 – for Muvumba. In this plan, a detailed report is given of the methodology and process. Moreover, a preferred alternative is selected, based on a multi criteria analysis in which objective quantitative assessments are combined with expert judgement on criteria that are of a more qualitative nature. Version 1.0 of the catchment plan serves as the starting point for a year of intensive sector dialogues and district dialogues, geared towards the alignment between the numerous strategic plans that are being developed this year (5 year strategic plans of ministries and districts, 7-year Government Plan, EDPRS3, Vision 2050, and last but not least, this catchment plan). By the end of this year, all plans should be aligned properly, so as to arrive at a shared development agenda and joint performance contracts. The results of this alignment phase will be laid down in, among others, the Catchment Plan version 2.0.

This chapter presents the vision, objectives, and alternatives for the catchment plan, along with the report on and results of the decision making process, to arrive at a preferred alternative for the catchment plan. Where the definition of the programmes of measures under the alternatives at current is still sometimes abstract, this will be made more specific and detailed in version 2.0.

3.2 Vision, objectives and alternatives

3.2.1 Guiding values and principles

The catchment planning process is guided by the content of the policy statements vis-à-vis water resources conservation, water allocation, policy legal and institutional frameworks, water resources, climate change resilience, capacity building, and other crosscutting issues[16]. Hence the following guiding principles are taken into account in the process of formulating the catchment plan:

1. Equity - This principle requires that economic, social and environmental benefits accruing from management and development of the catchment water and land resources are shared in a fair and equitable manner amongst different groups. Equity considerations may be appropriate between different districts, between upstream and downstream communities, between different livelihood groups, and between water use sectors, as well as protecting and promoting the interests of vulnerable and socially marginalized groups.

[16] National Policy on Water Resources Management, 2011

2. Environmental protection or sustainability - This principle relates to managing water and land resources to maintain ecological integrity while meeting the needs for social and economic development.

3. Economic efficiency - Efficiency is one of the pillars in the Global Water Partnership's definition of integrated water resources management. Economic efficiency entails achieving the greatest benefit to the largest possible number of beneficiaries within the available financial and water resources.

4. Balanced development - This principle requires catchment planning to balance, in a fair and transparent manner, competing needs and interests from the diverse community of water users (such as between agricultural irrigation and hydropower generation, and between livestock grazing and forest conservation).

5. Cooperation and participation - Cooperation and coordinated actions are the hallmarks of integrated planning. This principle recognizes the need for fostering goodwill and promoting alignment and joint actions among institutions and groups with overlapping roles and mandates as a way of achieving sustainable results. The related principle of participation requires that the stakeholders of the Catchment, who stand to benefit or lose from the planned interventions of the plan, be given an opportunity to influence its construct and outcomes.

3.2.2 Vision statement

Having a common vision for the future is an important first step in developing a catchment plan. It should define the "destination" that is desired. The "vision-oriented" approach starts by clearly defining the vision: "where we want to go". A catchment vision statement is the long-term, aspiration of what the Catchment might look like in the future, or a description of the desired state of affairs. Visioning involves the prioritisation of water resources management issues through the lens of water for growth, development and sustainability, leading to the formulation of a Catchment Vision. Achieving the catchment vision is the ultimate goal of the Catchment Plan. The vision statement has been formulated so as to ensure that it is broad to allow for wider interpretation and buy-in from various stakeholders. A generality has also been incorporated to give it a long lifespan and allow its constituent medium term plans to remain relevant to the long-term goal and objectives of the plan.

At a scoping workshop held on 29 August 2006, a broad range of catchment stakeholders reached a common vision and understanding of the water and land resources issues and opportunities and put forward what should be addressed and achieved in the future for the Muvumba catchment. A core group of ISU and IWRMD technical staff discussed and synthesized the workshop messages and outcomes in a series of work sessions, then formulated an agreed vision as follows:

A catchment that is managed in an environmentally friendly manner to addresses the socio-economic needs of communities taking into consideration the transboundary nature of the catchment.

3.2.3 Objectives

The overall objective for development of the catchment is as follows:

Secure sufficient water for sustainable socio-economic development in the catchment.

Specific objectives were also defined for the catchment, as listed below.

Specific objectives

1. reverse degradation in fragile ecosystems and adapt to climate change and its impacts;
2. promote water storage through large and small scale water infrastructure for various uses;
3. promote efficient water use to improve agriculture and livestock productivity;
4. ensure equitable water allocation among various competing users according to set priorities;
5. strengthen institutional framework and capacity building and transboundary cooperation.

3.2.4 Alternatives

The catchment vision is intentionally aspirational and while it implies trade-offs, it does not indicate the desired state for which these catchments should be managed. In order to clarify possible interpretations of the vision statement, two distinct alternatives were formulated, reflecting different water resources management assumptions and principles.

Planning by Administrative and Sectoral Boundaries (PASB)

The first main alternative is basically a continuation of the current planning practice, which is largely sectoral defined and implemented at district level. Under PASB, all policies, plans, and programmes, as well as prevailing regulations, are implemented unchanged, without a clear IWRM approach. There is, as currently, limited enforcement of environmental legislation.

Planning by Catchment Boundaries (PCB)

In this alternative, the only boundary that truly counts, is that of the catchment. Resources are managed in an integrated manner, largely within the confinement of the catchment. Walls between sector ministries or between districts are less relevant – these need to be overcome by joint planning and joint performance contracts, in order to arrive at win-win situations. This alternative concentrates on environmental protection and sustainable ecosystem services, improvement of livelihoods with diversified investments, and maximized exploitation of local potential socio economic opportunities. This alternative is supported by an improved, efficient water governance, comprising the institutional Governmental frameworks at local and national level, as well as the private sector and informal constituents of water governance. PCB supports an integrated approach on agriculture, water, health, economic development (mining), rural electrification, forestry and land management.

Sub-alternatives or variations of PCB

In the assessment of alternatives for the catchment plan, several extra analyses were done to explore optimisation opportunities for a number of aspects (climate change adaptation, urban development, industrial development, irrigation development, landscape rehabilitation, water productivity and efficiency, and combinations thereof). The most promising combinations were included in the final multi-criteria assessment of alternatives.

3.3 Strategic framework for the development of programmes of measures

The vision statement and subsidiary objectives by themselves cannot bring about the desired change. Multiple and wide ranging actions are required to be taken by numerous actors over many years to deliver the envisioned state. To move from vision to actions, it is necessary to prioritize a limited number (typically three to ten) of core concerns around which to formulate actions. These concerns, which are variously referred to as strategic objectives, strategic areas, or key result areas, represent distinct but intricately interrelated facets of water resources management. In this plan, we refer to these core concerns as strategic areas. The strategic areas make it easier to set objectives for IWRM and develop strategies and specific projects to achieve the catchment plan objectives. The strategic areas group and categorise the issues being faced for water resource management and possible solutions.

By carefully re-examining all study assessments and reviewing the types of issues that arose under each, we can conclude that all catchment issues could be conveniently grouped into five broad areas. These are subsequently adopted as the strategic areas of the catchment plan for integrated management of land, water, and related resources.

The five Strategic Areas or pillars for the catchment plan are:

1. Environmental conservation and protection - This primarily focuses the management of streamflow, water quality, habitat and riparian zones related too riverine, wetland and land resources, to maintain important ecosystem services and biodiversity.

   Activities for the protection of environment (with an impact on water management, but also on water-dependent infrastructure like hydropower plants) such as rivers, lakes, wetlands, forests and other natural ecosystems are included in this key strategic area. The investments required to protect critical watersheds from erosion (terraces, grass strips, gulley rehabilitation) are envisaged as well. These include investments for rehabilitation of already degraded environments (aquatic and terrestrial).

   Other infrastructure necessary for handling water related waste e.g. storm-water conveyance systems, sewers, and solid waste disposal facilities for existing and emerging urban areas are also envisaged in this strategic area.

2. Water resources development and management for social and economic growth - This primarily focuses on activities related to exploitation of water sources (surface and ground water) – that is increasing water to authorized users and how the infrastructure developed in the process is operated and maintained. This can entail providing operational rules for the effective operation of the proposed dams at Nyagare and Warufu. Other activities are promotion of efficient and effective utilization of water in irrigation systems (canals, water supply distribution systems, water harvesting) to provide water for productive and social purposes.

3. Water sharing for equity and development – This area is particularly important in a water stressed catchment like Muvumba. It covers the process of establishing and protecting water rights and allocating water among competing uses and users, as well as setting priorities for water entitlement

during times of shortage. Such allocations will be among sectors (e.g. irrigation, urban water supply, hydropower) or geographically (upstream versus downstream sub catchments). Gender equity is a key aspect of this strategic area. Last but not least, inter-generational equity requires attention, in order to safeguard water rights of future generations of catchment inhabitants.

4. Water governance – This primarily focuses on the management of institutional aspects to enable and facilitate the protection and sharing of water, including the more cooperative stakeholder framework. It also includes the alignment of legislation, policies, plans, and protocols that define the relationships among these organisations. Accordingly, the following activities may be envisaged: facilitating the catchment tasks force, capacity building, and operationalizing water user committees, land use management committees and institutions for participatory irrigation management, water user identification and facilitation to licence or acquire water rights as well as compliance to water permit conditions.

5. Disaster risk management – Within the context of Muvumba catchment, the disasters identified are those related to occurrence of landslides and drought. While drought must also be classified as a water-related disaster, the strategic response to drought mitigation is through increasing water availability, which is included above under the water resource development key area. Other drought mitigation measures can also be envisaged such as improve dissemination of early warning to facilitate preparedness.

The vision needs to be supported by appropriate interventions in each of the key areas if integrated water resource management is to be implemented and the vision realised. The vision and strategic framework imply a balance between environmental protection and agricultural and urban development with a focus on the needs and aspirations of the catchment's residents. They highlight the need for adaptation and the possibilities of diversifying the economy through innovative energy and improved mining technologies.

3.4 Programmes of measures under the alternatives and variations

3.4.1 Programmes of Measures for PASB and PCB

The two main alternatives (PASB and PCB) comprise two different programmes of measures, which are presented in Table 11 and Table 12 respectively. Measures of PASB have been introduced in detail already in Section 2.7, as ongoing initiatives in the catchment. Measures of PCB are organised along the strategic areas, introduced in Section 3.3.

Table 11: Programme of Measures of alternative 'Planning by Administrative and Sectoral Boundaries' (PASB)

Measure	Location	Size / magnitude
Terracing, afforestation and agroforestry	Gicumbi & Gatsibo district	-
River buffer zone protection	Muvumba, Warufu, Mulindi, Ngoma and their tributaries	-
Irrigation system development	Nayagatare & Gatsibo	3,302 ha.
Collaboration mechanism between Uganda and Rwanda under auspices of the NBI	Transboundary context	Memorandum of understanding in place
Promotion and dissemination of improved cooking stoves	Entire catchment	-
Development of the Green Growth and Climate Change resilience strategy (2011)	Entire country	Not yet implemented

Table 12: Programme of Measures of alternative 'Planning by Catchment Boundaries' (PCB)

Measure	Location	Quantity
Agroforestry, combined with terraces, grass strips, cut-off drains, horizontal trenches, and gully treatment as needed. River buffer zone protection/rehabilitation by using either biological or physical protection as appropriate. Enforcement of the law related to river buffer zone protection	Entire catchment	93,431 ha agroforestry 12,087 ha afforestation 1,124 ha buffer zones
Development of a series of 9 reservoirs or dams. Expanding livestock water development programmes (valley dams, watering throughs)	The interface between the Gicumbi highland catchment area feeding into the downstream Muvumba, Mulindi and Warufu rivers	9 dams
Establish the legal basis for water use rights and tenure rights for irrigation system and allocate water to competing uses in equitably manner	Entire catchment	N/a
Put in place a transboundary taskforce (coordination); agree on how to share water upstream/downstream	Entire catchment	N/a
Strengthen WUA (on field training). Training on water infrastructure maintenance and operation; Introduction of efficient water use technologies and practices	Large scale water users	N/a
Early warning capability for drought and food shortage in Nyagatare; flood early warning system in Mulindi Gicumbi district	Entire catachment	N/a
Promote alternative source of energy (hydropower, gas, etc.).	Gichumbi	2 micro-hydropower plants

3.4.2 Incorporation of alternatives and variations in water balance and allocation model

The following alternatives have been analysed in WEAP, the Water Evaluation and Planning model package used to simulate the water balance under different projections and alternatives. Results are presented and discussed for each demonstration Catchment. For a full description of the model, its inputs, and outputs, Water for Growth's technical report TR29 – Water Balance and Allocation Modelling can be consulted.

PASB: Planning by Administrative and Sectoral Boundaries

Continuation of planning and implementation as usual – no integrated water resources management or catchment planning and coordinated implementation. All sector ministries, agencies, and districts, as well as private sector and NGOs implement existing plans in relative isolation. Measures planned run into circa 2020 at maximum. Limited implementation and less coordinated alternatives are implemented. No specific catchment rehabilitation.

In WEAP implemented by: (i) no specific catchment rehabilitation will take place (slopes, infiltration capacity, soil water capacity unchanged), (ii) some minor water savings in irrigation (93% of baseline), (iii) some minor implementation of drought resistance crops (Kc 93% of baseline), (iv) minor savings in industry and domestic water demand (95% of baseline), (v) minor overall improvement of water productivity (5%), (vi) implementation of irrigation master plan by 50% in 2023, 100% in 2030 and even 50% more in 2050.

PCB: Planning by Catchment Boundaries

The catchment plans are developed in a participative and vertically and horizontally integrated manner, resulting in a coherent program of measures for each sub-catchment. Implementation is coordinated between implementing agencies, with support of the Catchment Coordination Office and overseen by RWFA and Catchment Task Forces. Potential maps are used to assess economic development potential.

In WEAP implemented by: (i) catchment rehabilitation will take place (more pronounced terraces, infiltration capacity and soil water capacity higher), (ii) water savings in irrigation (85% of baseline), (iii) implementation of drought resistance crops (Kc 85% of baseline), (iv) savings in industry and domestic water demand (85% of baseline), (v) overall improvement of water productivity (10%), (vi) additional water storage, (vii) implementation of irrigation master plan by 50% in 2023, 100% in 2030 and even 50% more in 2050.

PCB+: Variation of PCB, with elevated levels of water storage and water saving interventions

Further enhanced implementation of PCB, with a strong focus on innovations in water use leading to higher water efficiency and productivity in all sectors, leading to higher water availability for all sector. This aims in particular to meet the high water demands of a fully implemented irrigation master plan, but also to serve the water needs of e.g. industries.

In WEAP implemented by using elevated levels of parameters compared to the regular PCB, e.g. by more pronounced terraces, higher infiltration capacity and higher soil water capacity.

PCB-: Variation of PCB, with reduced irrigation development

Same as the normal PCB but here with limited implementation of the irrigation master plan (50%), to reduce the water demand from irrigation and the ramifications (water shortages) that a strong increase in irrigated area would have on future water availability for other users, as well as for irrigated areas.

In WEAP implemented by using same parameters as PCB, but with irrigation development of only 50% of the irrigation master plan (25% by 2023, 50% by 2050, and no further increase up to 2050).

Additional variations

In order to better understand the relative impact of the PCB Alternatives, additional analyses have been undertaken where only one component is considered and at a more pronounced implementation level:

- PCB_agr: PCB explored by focus on Climate Smart Agriculture only. Only the climate smart agriculture component of PCB is considered to be implemented and in a more intensive way;
- PCB_store: PCB explored by focus on additional water storage only, and in a more intensive way;

- PCB_irr: PCB explored by focus on water savings in irrigation only;
- PCB_ind: PCB explored by focus on water savings in the industrial sector only;
- PCB_cities: PCB explored by focus on water savings in the domestic sector only;
- PCB_wp: PCB explored by focus on increasing water productivity only.

3.5 Multi-Criteria Assessment and prioritization of the proposed alternatives

A multi-criteria assessment was devised to analyse and rank the results of different alternatives. The results of the WEAP simulations of the water balance were assessed along a number of objective, quantitative criteria, as calculated by the software. Weights were given to each criterion in a meeting with the catchment task force[17]. In addition, the alternatives were scored along four key criteria (ecosystem services, economic development, social development, and water governance / institutional development) using expert judgement. These criteria also received weights from the members of the catchment task force. Weighted average scores per alternative were compared in three groups, both for the water balance criteria and the additional key criteria, and a preferred alternative was selected. The three groups arrived at the same conclusion regarding the preferred alternative. In other words, there was consensus among the members of the catchment task force, and a preferred alternative was selected unanimously. The sections below provide a more detailed description of the assessment. The detailed results of one of the groups is included in 0.

Results from the technical process of undertaking a water balance – that is, weighing up the available water resources against the water requirements, for a range of scenarios including the current and likely future situations are presented in this Chapter. The findings are interpreted and applied to Multi-Criteria Analysis (MCA) and expert judgement or stakeholder input to rank the preferred alternative for formulation of the catchment plan as explained in the subsequent sub-sections.

3.5.1 Reconciling water demands against water availability at different planning horizons

Three different types of projections were analysed: climate change, population growth, and macro-economic development. For each of these three Projections a three time-horizons were considered (2023, 2030, 2050). A “Future Medium” water stress scenario has been selected to interpret the findings since it is more likely to occur in the future. This scenario corresponds to medium changes in magnitude with respect to climate change, population growth and macro-economic development. The impacts of this scenario in terms of % change against the baseline are presented for three criteria. The evaluation criteria are water demand, water shortages (unmet water demand), number of water short months per year, peak flows and low flows are summarised in Table 13. The baseline is taken to be the withdrawals for the period 2009 to 2015.

Table 13: Impact on water resources for the “Future Medium” water stress scenario

Planning horizon (Year)	Water demand increase MCM	Water shortage (MCM/year)	Number of water short months per year (No.)	Peak Flow	Low flow
Baseline (2009 – 2015)	40	10	5	86	19
2023	196	60	6	68	5

[17] CTF meeting in Gichumbi, 7th February 2017)

2030	286	99	7	64	5
2050	464	180	9	66	5

Table 13 illustrates that Water demand is expected to increase substantially in the future: from currently 40 MCM/y to 464 MCM/y in 2050. Hence water demand by 2030 will be 6 to 8 times higher. Water shortage (unmet demand) is expected to increase substantially. Without proper actions taken it is expected that 35% of the demand by 2030 cannot be delivered. (Figure 21).

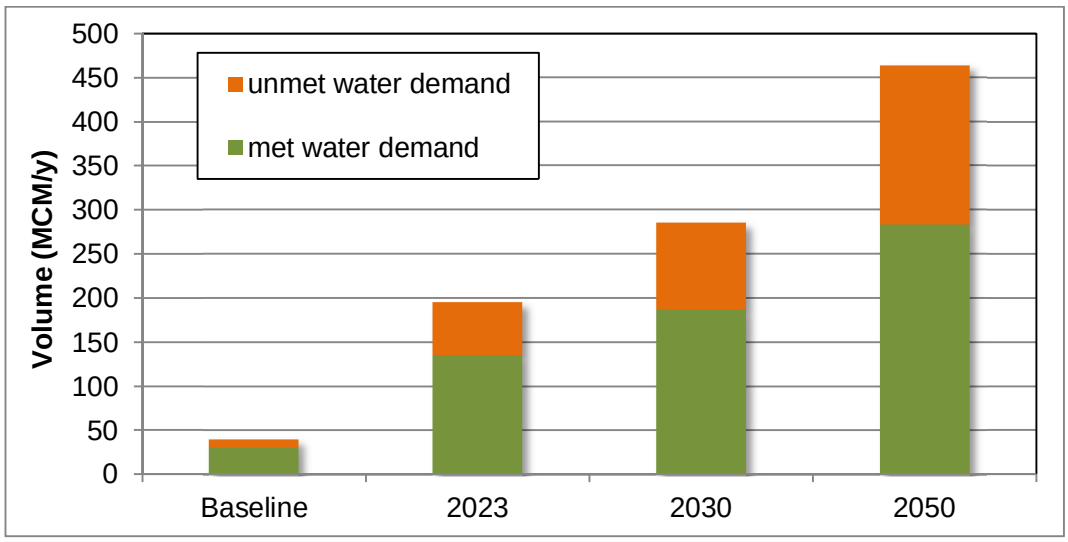


Figure 21: Met and unmet water demands in the three target years, compared to the baseline (2015), based on the future medium projection

Peak flows will become lower due to the effects of climate change. At the same time will low flows are likely to be lower 70% lower compared to today, leading to severe water shortages. Streamflow flowing out of the catchment is projected to decrease substantially in the future to average flows of 70% compared to today.

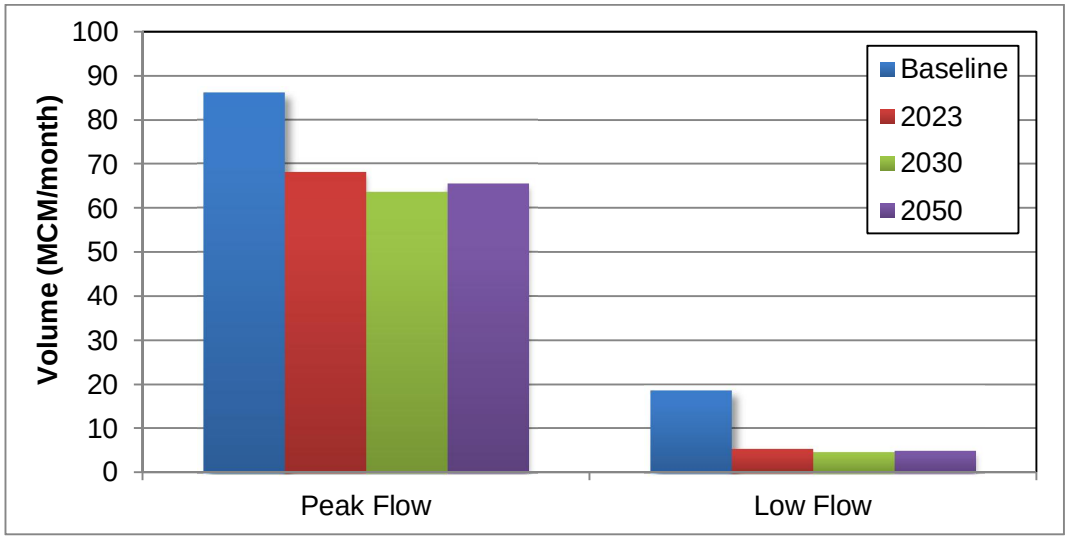


Figure 22: Simulated expected peak flows and low flows by 2050, based on the future medium projection

Two main planning alternatives (with pre-defined packages of measures) designed to address key issues and opportunities were analysed against the projections in Table 13. The first of these two is a continuation of Planning by Administrative and Sectoral Boundaries (PASB), often also referred to as business as usual. The second one is referred to as Planning by Catchment Boundaries (PCB). The PCB approach is further subdivided into selected sub-alternatives or variations (such as PCB+ and PCB-) to evaluate the effects of maximising certain interventions within this integrated package. Consideration of variations is intended inform decision making on the definition of a final 'preferred alternative'. The definition of the selected main alternatives and variations is provided in Section 3.4.2.

The effectiveness of selected alternatives in terms of mitigation or alleviation of the "Future Medium" water stress is summarised in Table 14 and illustrated in Figure 23, Figure 24, and Figure 25.

Table 14: Impact on "Future Medium" water stress scenario by selected alternative

Planning horizon (Year)	Alternative	Water demand (MCM)	Water shortage (MCM/year)	Mean outflow	peak flows	low flows
Future medium 2050		464	180	324	66	5
2050	PASB	412	136	336	67	8
	PCB	362	106	353	69	11
	PCB+	272	77	354	61	12
	PCB-	267	65	419	77	12

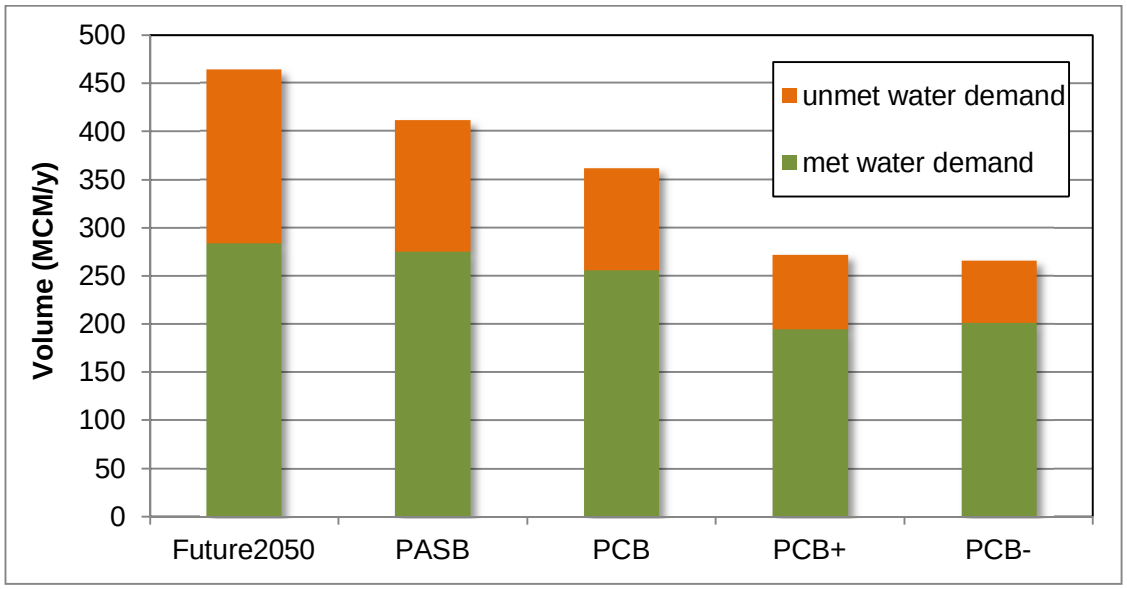


Figure 23: Effects of implementation of various alternatives on met and unmet water demand based on the 2050 future medium projection

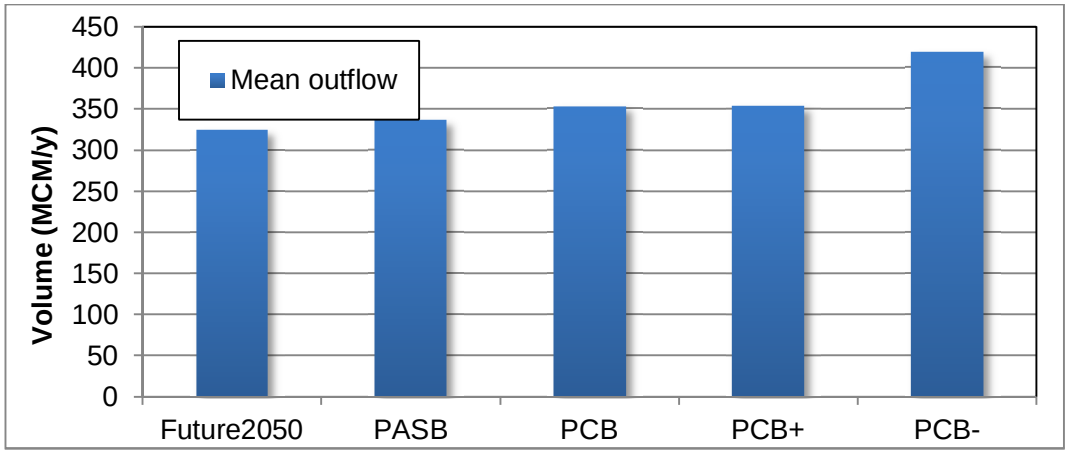


Figure 24: Impacts of implementation of various alternatives on mean outflows based on the 2050 future medium projection

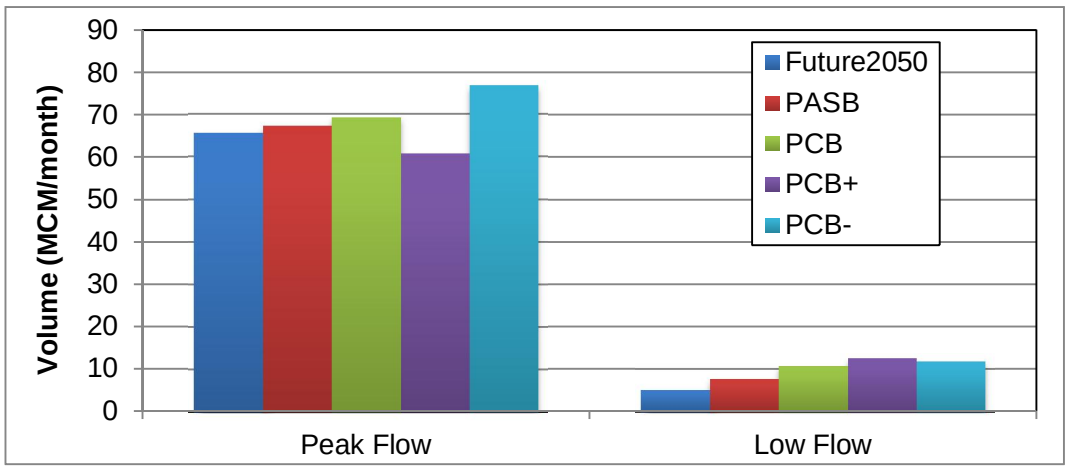


Figure 25: Impacts of implementation of various alternatives on peak flows and low flows based on the 2050 future medium projection

Alternative impacts:

- Most alternatives have a positive impact on the water demand, water shortage, streamflow, and catchment hydrology;
- The alternative of Planning by Administrative and Sectoral Boundaries (PASB) is less effective compared to other alternatives, especially in the context of alleviation of water shortages and low flows;
- The alternative Planning by Catchment Boundaries (PCB), and its subs PCB+ and PCB- are the preferred alternatives. PCB- looks the most effective one, but is should be kept in mind that for this irrigation development is quite reduced, having impact on food security;
- PCB+ and PCB- are able to reduce projected water shortages by 50% to 60%.

3.6 The consensus catchment plan

The multi-criteria assessment resulted in the selection of the PCB+ alternative as preferred alternative in the long term. The programme of measures of this alternative incorporated a large set of integrated measures, of which narratives are provided in the following sections.

It needs to be mentioned again here that the preferred alternative in this Catchment Plan version 1.0 serves as the starting point for detailed alignment between all stakeholders in 2017. The final programme

of measures of version 2.0 will be the result of negotiations between stakeholders, and will therefore be more explicitly quantified and more precise in locations of measures.

3.6.1 Landscape rehabilitation, re-afforestation and land husbandry

The core intervention of this catchment plan will be the intensification and diversification of agroforestry techniques; this will involve extending the diversity and intensity of agroforestry trees already used to stabilize the slopes of terraces and improve soil fertility, promotion of perennials and tree-crops (including tea, shade coffee, fruit trees, etc), intercropping or planting of in-field trees, and shelter-belts / live-fences. This will particularly promote the use of local species, such as *Podocarpus, Polyscias fulva, Entantophrama, Croton megalocarpus, Markhamia lutea, Vernonia Amydalina Mytragyna*, and S*ygygium*, in addition to exotics like *Alnus acuminata, Acacia Agustima* and Acacia *melanoxylon*.

Farmlands will be protected by construction of progressive and radical terraces, whereas wetlands and rivers will be protected by buffer zones constructed using vegetative bamboo and natural tree species. Many studies have demonstrated the effectiveness of vegetative buffers in reducing the concentration of nitrates, phosphorous, and pesticides from water running off cultivated fields. Concentrations of nitrogen trapped and assimilated by buffers or wetlands can be reduced by up to 94 percent before entering a stream. Phosphorus runoff can be reduced by 25–95 percent. The ability of buffers to retain pesticides is variable because each pesticide has unique mobility and soil-binding properties, but they can be especially effective when pesticides are tightly bound to the soil. Figure 26 below illustrates the range of measures and scope over the spatial extent of the catchment.

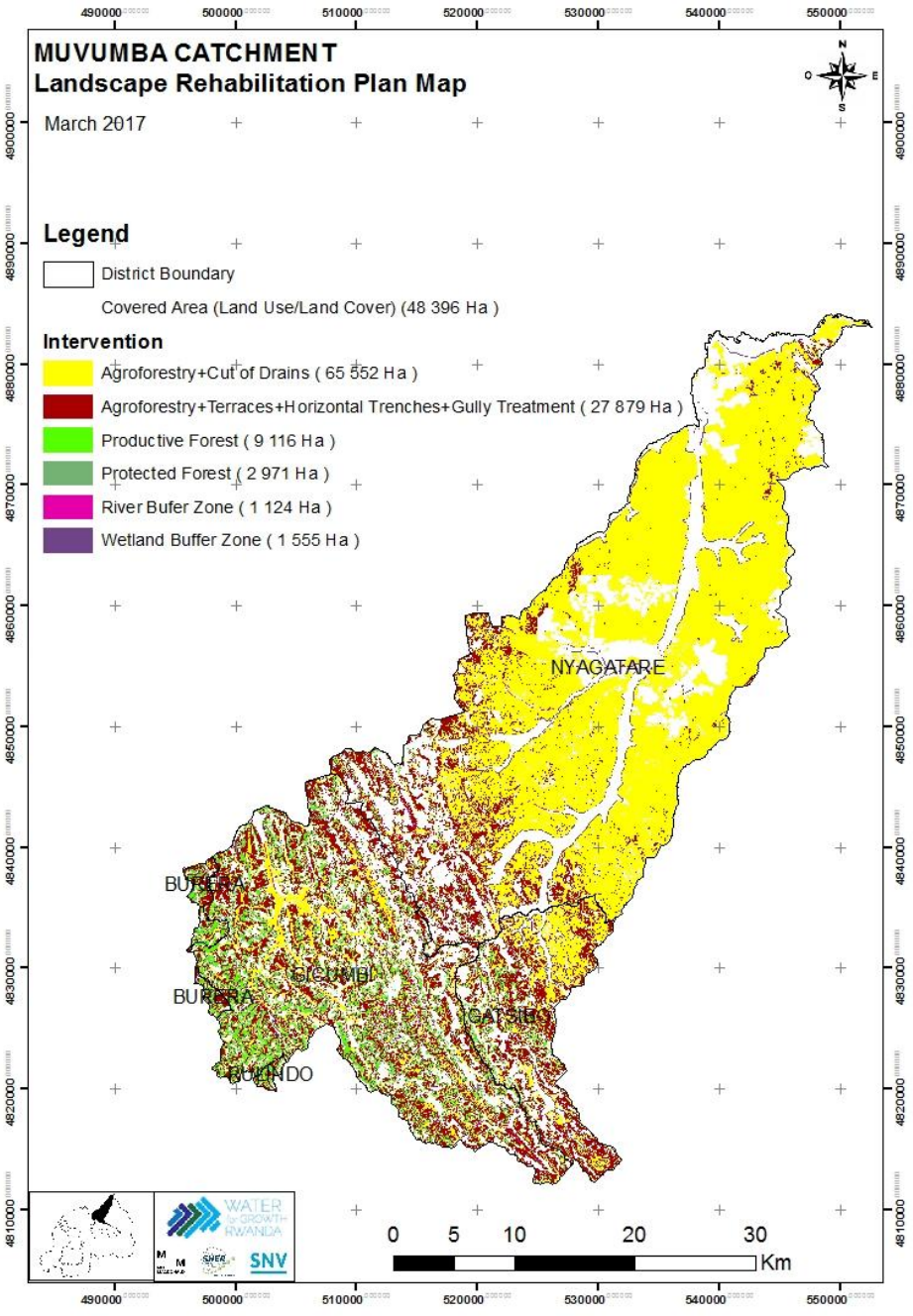


Figure 26: Landscape rehabilitation plan of Muvumba catchment

3.6.2 Climate smart agriculture

Rwanda's climate change vulnerability originates in the mountainous character of the country with an inherent susceptibility to soil erosion, combined with a strong reliance on rain-fed agriculture. This sector represents 34% of Rwanda's GDP (2014) and employs 90% of its inhabitants (both directly and indirectly), leaving the country in a challenging position with regard to climate change adaptation. As the temperature increases, Rwanda's historically predictable rainy seasons are becoming increasingly unreliable and short, resulting in more frequent droughts and higher intensity rains with the potential of causing progressively significant economic damage to crop yields and infrastructure.

Climate smart agriculture approaches are mainly covered under the term 'conservation agriculture' (CA). This approach to agricultural management is based on three principles: Minimum soil disturbance, ranging from zero tillage to a maximum of 20 to 25%; retention of crop residues or other surface cover; and use of crop rotations to reduce the build-up of weeds, pests and diseases. The first two principles require a drastic adaptation of the current, traditional farming methods. For the third principle, as farmers in Rwanda often do not have enough land to rotate crops, intercropping is an option.

The benefits of this approach are with regards to climate resilience are:

- stable yields: Increased average yields in the long term due to the water and soil conserving effects of CA, which help to stabilize the crops against weather extremes;
- drought buffering: The approach increases soil water content through increased infiltration and a reduction of runoff and evaporation. Increased infiltration improves water use efficiency and buffers crops against drought;
- reduced field preparation costs: CA allows for timelier planting that supports successful harvest due to the reduction in effort associated with tillage;
- reduced soil erosion: Reducing tillage and maintaining soil cover with crop residues can reduce erosion by up to 80%. CA also generally increases soil organic matter in the top soil, along with an increase in soil biological activity and biodiversity;
- climate change mitigation: Under certain conditions, CA may contribute to climate change mitigation through carbon sequestration and reduced GHG emissions.

An additional approach that supplements conservation agriculture is the 'Push-pull-strategy', promoted in Rwanda's National Programmes of Action. This strategy is a sustainable pest management technique that introduces certain species of plants to the cropping systems, to control plant parasites and pathogens such as stem borers and *Striga* weed. For Rwanda the plant species for this technique are *Napier* grass (push) and Desmodium (pull) to manage pests in e.g. fields of maize, sorghum, millets and raid-fed rice. The technique works by planting the desired crop alongside a 'push' plant (Napier) that repels pests, and planting a 'pull' crop (*Desmodium*) around the perimeter to draw insects out of the plot. The *Napier* grass and *Desmodium* can additionally provide a continuous supply of cattle fodder. Both Napier grass and Desmodium have low water and nutrient requirements, making its implementation accessible even on uncultivated lands.

3.6.3 Alternative sources of energy to reduce dependence on biomass fuels

Biomass energy is predominantly used by at least 86% of households in the demonstration catchments. In the short-term, biomass energy will remain dominant for cooking and other household uses and in this regard it is imperative that forests and woodlots be more productively managed and charcoal more efficiently produced. Table 15 below indicates the opportunities for enhanced management of forest plantations.

Table 15: Opportunities for improved management of forest plantations

Measure	Area (ha)
Improve management of existing eucalyptus woodlots.	19,989
Improve management of existing Pine timber plantations	176
Total	20,165

Other elements of Rwanda's Sustainable Energy for All Strategy interventions focus on efficient stoves and biogas digesters. The most widely used type of biogas digester in Rwanda is the fixed dome variety which comes in two sizes, 6 m^3 and 8 m^3 and costs around Rwf 800,000 and Rwf 900,000 respectively (US$ 1260 and US$ 1410). These systems require two cows to operate and provide 5 hours of cooking gas. The Government of Rwanda already offers a Rwf 300,000 (US$ 450) subsidy to encourage the uptake of biogas technology as well as subsidies for solar water heating systems. In addition to this, the intervention under the catchment plan will be to offer concessional loans to enable households to finance biogas digesters (existing loans are available at 13% interest from Bank Populaire) - low cost loans as well as a subsidy are already available for solar water heating systems. Local SACCOs will host the loan accounts.

Development of hydropower as an alternative clean energy sources to reduce dependence on fuel wood is a key element of the strategy to reverse deforestation. Sites for development of micro-hydropower projects have been identified under the Hydropower development master plan. There are 2 sites within the catchment are presented under Table 16, with sites identified being rated between 50 kW and 100 kW.

Table 16: Planned micro-hydropower development sites

Name	Code site	Potential (MW)
Ruhondwa	ENY-01	0.05
Murusumo	NG-15	0.10

Development of these sites will support efforts to reach the set targets of 70% access to electricity by 2017/2018 and 100% by year 2020[18]. Technical and financial feasibility studies will be conducted and thereafter the sites can be tendered out to private developers. Initiatives elsewhere by SNV[19] to strengthen the capacity of local entrepreneurs to run or install such hydroelectric plants with a capacity of less than 50 kW will be replicated and up-scaled.

Specific activities of the initiative include:

- trainings of local entrepreneurs in turbine manufacture and plants operations and maintenance;
- training on the dimensioning of turbines;
- support to obtain subsidies for pico-hydro equipment, e.g. from the IIF basket fund;
- assist entrepreneurs or village cooperatives to develop financial skills and business development plans.

The total cost of a typical pico-hydropower system and installation in Rwanda is estimated to be approximately $4,500[20]. The potential commercial market for off-grid hydropower plants in Rwanda with a generation capacity of 50 kW or less is promising, owing to strong demand for electricity services by sector offices, schools, health centres, local businesses, cottage industries and of course village communities. In these areas, the demand for different electrification alternatives remains high, with pico-

[18] Rural Electrification Strategy, Republic of Rwanda, Ministry of Infrastructure, June 2016

[19] Rwanda Pico Hydropower Development (DPHER), The Netherlands Development Agency (SNV), 2016.

[20] Scott Gladstone *et al.* (2014). Implementing pico-hydropower sites in rural Rwanda. Procedia Engineering 78 (2014) 279 – 286.

hydropower being the least-cost solution for electrification with around US$ 1.1/kWh compared to diesel generator sets or solar PV systems (US$ 6 and US$ 1.2 per kWh respectively)[21]. Due to the topography found in most of the catchment, characterised by deep valleys and steep hills, a low-head pico-propeller turbine, is not an option for Rwanda. The topography is more suitable for medium to high head pico- and micro-hydro run-of-river schemes. The turbine types used for such schemes are mainly turgo, pelton and cross-flow. In contrast to the off-the-shelf propeller turbines, these types need to be designed and installed by skilled and experienced people and made to the specifications of the site. Figure 27 below illustrates system components for a suitable hydropower package (2kW) from Vietnam. The system components shown are a turbine, generator, load controller, ballast load and installation materials.

Figure 27: System components of the Power Pal T5 Hydropower package Vietnam (Meir and Fisher, 2011)

3.6.4 Resilience to climate change by establishing early warning and disaster preparedness systems for droughts

Current response mechanisms to drought are implemented through inter-ministerial task force directed short-term mitigation measures. These include promotion of agriculture/livestock insurance (e.g. involve Bank Populaire, SACCOs) and emergency food relief, are mainly short term interventions. A long-term and holistic approach is required which involves implementation of the Green Growth and Climate Resilience Strategy (2011). This entails a shift from short-term mitigation measures to integration of long term mitigation programs. Specific elements and activities under this intervention are outlined below:

- development of an early warning capability for drought and food shortage for Nyagatare. Increased capacity to detect climate change patterns. disseminate information necessary to prepare for foreseen extreme events and manage them better. Develop forecasting models, improved meteorological services, and improved hydro-related information management. Incorporate climate change risk into district development planning. Active engagement with existing regional early-warning systems (FAO implemented Famine Early Warning Systems Network (FEWSNET) and IGAD-ICPAC);
- develop an integrated storage and water harvesting system by constructing 9 multi-purpose reservoirs;
- introduce efficient irrigation, and other water demand management measures for existing irrigation and water infrastructure. Prepare and issue guidelines on water demand management and increased water use efficiency in all user sectors. Training of private and operators of irrigation schemes and WASAC private operators in maintaining and operating the infrastructure for effective water use. Demonstrate application of appropriate irrigation scheduling techniques. Effective operation of

[21] Meir and Fisher (2011). Assessment of the Pico and Micro-Hydropower Market in Rwanda.

irrigation infrastructure to prevent water loss. Various measures can be promoted to reduce water loss in distribution pipes and canals, irrigation application methods and their use during times of the day and night when evaporation is reduced. Effective maintenance of irrigation equipment to reduce wear and maintain efficiency;

- § set up emergency water supplies such as groundwater harvesting along dry riverbeds and marshlands through use of sand dams and shallow wells. Drill 500 new boreholes. Provision of emergency water supply by means of water tankers to communities. Repair existing WASAC water infrastructure;
- § design and implement an expanded livestock water development program e.g. water point development for livestock watering.

3.6.5 Increase and sustain 100% access to safe water and sanitation facilities

An investment plan to support achievement 100% of water supply coverage by 2017 and to ensure 100% sustainable water supply up to 2032 has been elaborated by Water and Sanitation Corporation. The study recommended the option of multi-purpose development which encompasses both water supply and irrigation. The selected sites relevant to the catchment for large scale water abstraction is at Ngoma River, located in the northern part of Nyagatare District. Source water would be abstracted from a dam 40 m high to guarantee sufficient water supply to the year 2032 for Nyagatare district and a part of Gatsibo for domestic water without compromising other water users. Capacity of the WTP was designed to be 29,275 m^3/day. Investment requirements for the water supply infrastructure (intake, dam, storage, pumps and distribution works) were estimated to be USD 58, 788, 674. No funds have of now been allocated for the project.

3.6.6 Rational implementation of the irrigation masterplan to boost agricultural production

The Irrigation masterplan elaborates irrigation plans for each district within the catchment. Figure 28 below illustrates the spatial extent of potential irrigable areas. The potential irrigable areas are consolidated and outlined below (Table 17). The total irrigation potential has been estimated to be 19,407 ha. However, as confirmed by the members of the catchment task force, the implementation degree of the Irrigation Master Plan is preferably contained to about 50% initially but embraced fully (100%) by the year 2050. In version 2.0 of the catchment plan, the exact locations and sizes of irrigation schemes to be developed, need to be specified.

Table 17: Muvumba maximum catchment irrigation development opportunities

Potential command areas linked to water sources	Area (ha)
Marshland development command area	8,868
Dam/multi-purpose reservoir command area	1,223
Groundwater command area	-
River command area	9,319
Lake command area	-
Total	19,407

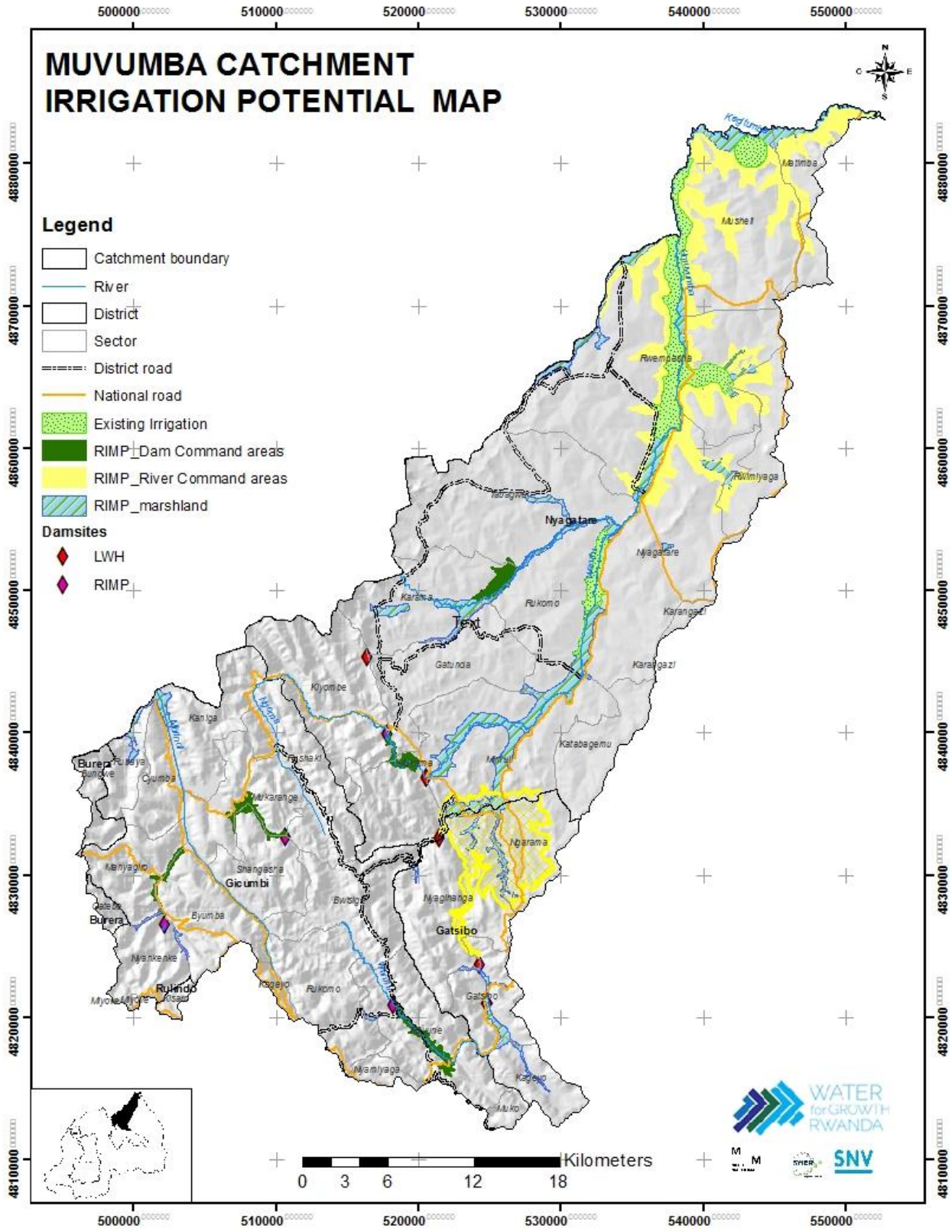


Figure 28: Potential irrigable areas in Muvumba catchment

Expansion of irrigated areas is associated with development of 11 multi-purpose reservoirs. Table 18 below indicates the small dams that have to be constructed to increase irrigable areas. The dams require detailed feasibility studies to determine the total cost implications and their impacts on increasing access of water to livestock and utilization for aquaculture. Detailed designs for Muvumba and Warufu are available.

Table 18: Potential irrigation development from small multi-purpose reservoirs in Muvumba catchment

ID	X coordinate	Y coordinate	Catchment area	Command area (Ha)
SA 76	495948.00	9799124.00	2372	168
SA 082	518232.00	9821071.00	6261	313
SA 083	502109.00	9827234.00	1323	149
SA 084	510646.00	9832803.00	1143	254
SA 090	517727.00	9840018.00	10459	192
SA 097 – Muvumba	523828.93	9849419.00	942.7 km2	8 000
SB 01	561141.26	9797275.30	1757	321
SB 02	565503.15	9782976.25	11543	177
SB 03 – Warufu	555920.51	9775366.14	160 km2	2 500
SB 04	571798.89	9777766.54	3986	234
SB 08	531682.88	9782733.13	3233	394

Source: National irrigation Master Plan, 2010 & Muvumba & Wrufu multipurpose dams, feasibility study

The Project Cost for the Muvumba (SA 097) Multipurpose Dam Construction was estimated as 93,724,578 103 RWF (approx 124,966,104 USD). The project cost would increase to 129,194,812 103 RWF (approx. 172,259,750 USD) an additional cost for canals construction and compensation costs were to be included. Similarly, the total cost for Warufu Dam (SB 03) has been established to be RWF 6,809, 175,000.

3.6.7 Diversification of rural incomes to alleviate poverty

Rwanda's Vision 2020 is to achieve a GDP per capita of $900 by 2020. This requires a real growth rate averaging 8.1 per cent per year comprising annual industrial sector growth of 12 per cent, services sector growth of 8 per cent and agricultural sector growth of 6 per cent. These projections assumed at the time that population growth would remain at a modest 2.78%.[22] Actual growth figures should be analysed to reflect on achieved growth figures. These inputs are expected to lead to the key outputs of diversification of livelihoods through promotion of industry such as mining, textiles, pharmaceutical industry, hides and skin processing, dairy products, beekeeping, horticulture and fresh fruit production to reduce dependence on traditional rain-fed agriculture, create more jobs and reduce poverty. Development of these sectors entails the implementation of activities of the mining strategic plan, processed fruit and vegetables strategic plan and the bee keeping strategic plan.

Bee keeping

Productivity and production of bees have sharply increased and consequently improved rural incomes in areas with marginal land for agriculture. Bee keeping activities have been modernised following the development of a strategic plan[23] document and issuance of guidelines[24] to support utilization of modern

[22] Rwanda Industrial Master Plan 2009 -2020

[23] National Beekeeping Strategic Plan Document, MINAGRI, 2007-2012.

[24] National Beekeeping Guidelines, MINAGRI, August 2009,

equipment and infrastructure for production and processing. The strategic plan aims to contribute to the mechanisms of increased production, sustainable linkages with markets, partnerships with support institutions, well managed beekeeping infrastructures and a well-established domestic and export market for beekeeping in Rwanda. Key elements of the strategy involve mobilizing women and youth, to start beekeeping businesses (modern bee farming techniques, wax processing techniques). The establishment of at least 1 demonstration apiary in each of the demonstration catchments for use as decentralized training facilities is a viable intervention measure. Each of the demonstration apiaries will have at least 20 modern hives (10 Langstroth and 10 Kenya Top Bar) and 10 traditional hives. These apiaries will be used for decentralized training and knowledge development for rural beekeepers by master beekeepers in the districts. Accompanying accessories to include smokers, hive tools, bee-suits with veils will also be supplied to serve these demonstration centres. To enable bulking of bee products by producers in the selected areas, collection centres with adequate facilities for primary processing of bee products will be established by cooperatives.

Fisheries and fish farming

Aquaculture presents a significant opportunity to increase water and land productivity in Rwanda and enhance incomes of rural communities where reservoirs, dams or rivers with sufficient quantity exist to support fish production systems. However, increased depletion and degradation of the fisheries resources as well as highly polluted rivers due to high sediment loads have resulted in diminished fish capture and supply in Rwanda[25]. The Master plan for Fisheries and Fish Farming outlines an action plan to develop the best aquaculture production systems for the various ecological regions in Rwanda.

Opportunities for tank based aquaculture production (Figure 29), where fish is reared in tanks supplied with clean water have been identified along several rivers flowing from the hills in Gichumbi. Since this area is characterized by high altitude, cold tolerant fish species such as trout are recommended. Useful guidelines on how to farm trout, design of structures for water management and economic calculations of investment and production have been issued by the FAO[26].

Figure 29: Rainbow trout farming in water tanks (FAO, 2011)

[25] Masterplan for Fisheries and Fish Farming in Rwanda. MINAGRI, Inland Lakes Integrated Development and Management Project (PAIGELAC), 2011.

[26] Small-scale rainbow trout farming. FAO, 2011.

Good examples of such sites are to be found at Cyabayaga dam (01º 41'08.9" S, E 30 º.28'50.6"E, elevation 1357 m) in Nyagatare district, near the rice scheme. This site is suitable for development of a catfish hatchery.

Another option is to promote the development of Aquaculture Parks within the demonstration catchments. Aquaculture parks are concentrations of fish production units in suitable watersheds that are well supplied with water; with appropriate environmental conditions for culture of the target species in terms of temperature, soil types, and terrain/topography. Aquaculture parks are planned akin to the industrial parks concept.

3.6.8 Enhanced regulation of the mining industry

Mining and quarrying activities within the catchment are generally characterized by widespread reliance on traditional mining methods involving use of simple manual tools with devastating environmental consequences. In response to these challenges, the Department of Geology and Mines introduced the model mine concept which has a stringent criterion at acceptance level above 60% on:

1. compliance with the legal framework and contract obligation;
2. developing a safety, health and environment policy;
3. developing a mining plan based on sound mineral resources estimation;
4. developing a safe and secure mine with proper extraction methods;
5. optimizing mineral recovery by using the appropriate equipment;
6. develop a solid waste and water management approach, including water conservation, water harvesting, no silting of surface water and no hill erosion;
7. an approved Environmental Management Plan with a post closure rehabilitation plan.

However, there are significant shortfalls in technical capacity which constrain the departments of IWRMD and Geology and Mines within MINIRENA to control pollution from various sources within the catchments, and enforce compliance with environmental regulations and standards. There is also an acute shortage of skills and personnel to effectively engage with the private mining companies. In addition, there is a need to clarify the roles and responsibilities of the districts in the regulatory framework. The critical areas for intervention include:

- drafting, negotiating, and enforcement of mining contracts;
- setting regulatory standards and enforcing them;
- ensuring environment sustainability in mining;
- recruit and train more mine inspectors and develop RWFA and Mining Authority capacity to train artisanal miners to upgrade existing practices in line with international standards;
- rehabilitate degraded landscapes and ecosystems modified by mining and quarrying activities in accordance with pre-established rehabilitation plans;
- treat and safely dispose of all top soil, sludge, waste water and tailings generated from mining sites;
- ensure that all mines design and construct tailings disposal facilities;
- strengthen the monitoring and regulation of mining companies, including the introduction of an information management system;
- strengthen the capacity of REMA and RWFA -Geology and Mines Department and district environmental officers to ensure compliance of mining companies to environmental regulations, decommissioning and mine closure procedures;

§ ensure that all mines have qualified environmental managers.

3.6.9 Waste water discharge management, pollution control and cleaner production

Inventory of sources of pollution

To identify the need for pollution control measures, and to assist pollution control regulators i.e. REMA and RWFA in targeting the most significant problems, and propose suitable pollution control measures, a knowledge of the source and type of pollutant is necessary. The sources of point source pollution in the catchment have been mapped and illustrated as Figure 30.

Cleaner production

Given that a reliable inventory of point pollution sources is available, the most logical approach is to prevent the production of wastes that require treatment. Thus, approaches to cleaner production from industry that focus on wastewater minimisation, in-plant refinement of raw materials and production processes, recycling of waste products, should be promoted and adopted. For example, whereas in a conventional tanning process for tanneries 20-40 per cent of the used chrome is lost in the wastewater, in a waste minimisation process 95-98 percent of the waste chromium can be recycled. Examples of waste recycling methods in Rwanda include the making of briquettes from bio-waste.

Similarly, Sulphur dyes are a preferred range of dyes in the textile industry, but cause a significant wastewater problem hence necessitating end-of-pipe treatment technology. To avoid capital expenditure for wastewater treatment, alternative methods are available where hydrol, a by-product of the maize starch industry is utilized with minor adaptations in the textile dyeing process[27]. The introduction of hydrol does not involve any capital expenditure and has been demonstrated to reduce sulphide levels in the mill's wastewater from 30 ppm to less than 2 ppm.

The Pilot Project on Cleaner Production that was implemented by Rwanda Environment Management Authority (REMA) in partnership with UNEP in 2005 demonstrated that there is a significant potential for efficiency improvement within existing industries. Lessons learnt from the Pilot Project need to be taken stock of and activities up-scaled in the four demonstration catchments. Such activities can include the introduction of an environmental reporting requirement for industries and businesses covering basic data on the volume of resources consumed and waste generated and discharged including air emissions. Another key intervention that is applicable is to expand and extend the series of industrial training that led to the development and implementation of cleaner production programmes to known sources of point source pollution in the catchment (Figure 30).

[27] WHO, 1997. Water Pollution Control - A Guide to the Use of Water Quality Management Principles.

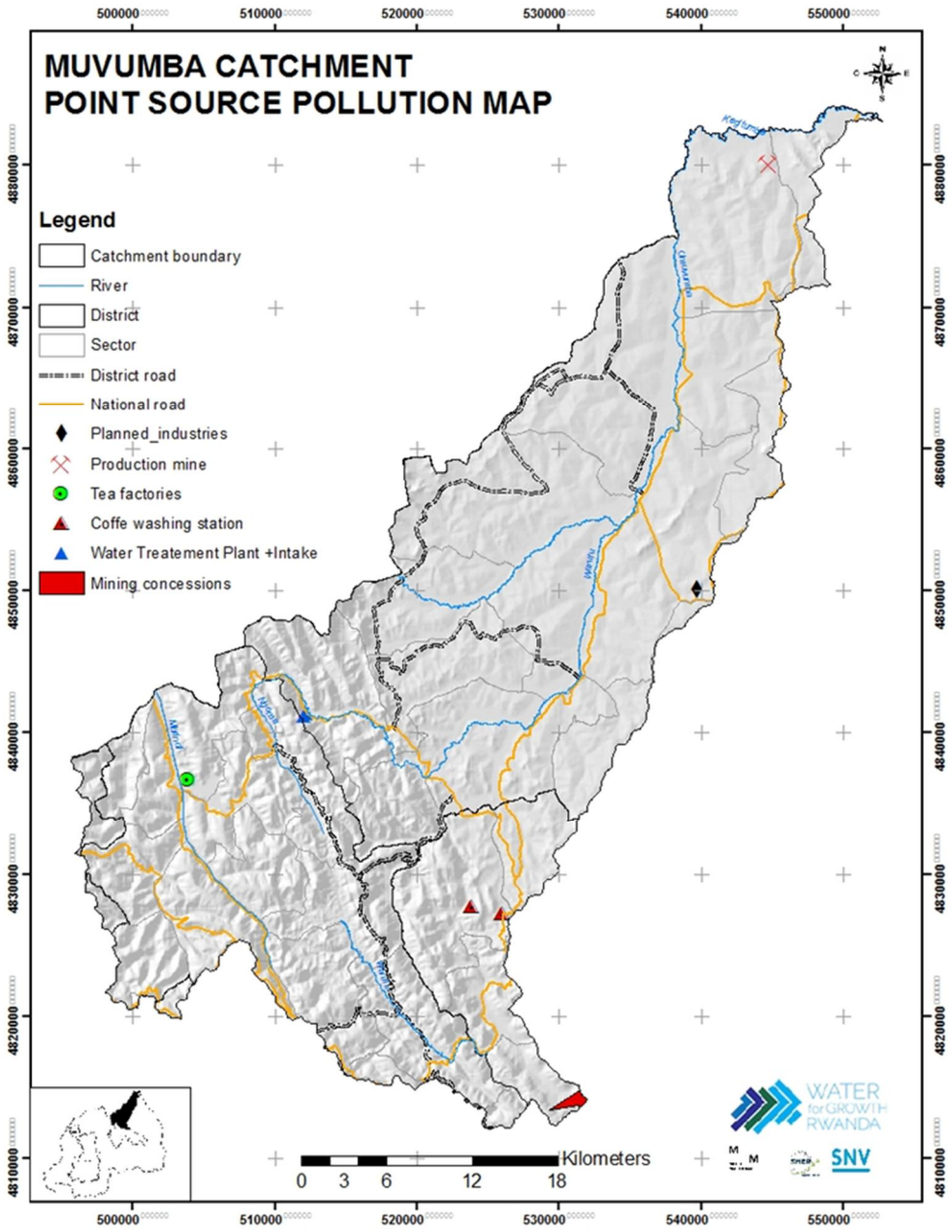


Figure 30: Point source pollution sources of the Muvumba catchment

Effective regulation

Realistic standards and regulations for waste water discharge should be enacted. A waste water permit system, and systematic monitoring of water quality in rivers should be introduced. Codes of good agricultural practice that address the causes of water pollution from agriculture, such as type, amount and time of application of fertilisers, manure and pesticides, can give guidance to farmers on how to prevent or reduce pollution of water bodies. These pollution control measures should be promoted at the lowest appropriate level i.e. districts and catchment offices. Attempts to implement the polluter pays principle should include financial charges for industrial wastewater discharges and special taxes on pesticides. The regulatory framework should be strengthened by improved collaboration between REMA and RWFA. A key issue in respect of point source discharge control is the ability of REMA & RWFA to take enforcement action against the discharger when the conditions of the wastewater discharge permits are

breached. Legal provisions vary but these should include issuance of violation notices or a prohibition notice requiring the polluting activity to stop, and finally legal action. On the other hand, REMA and RWFA can consider to provide incentives to those industries which are reducing their pollution and environmental pressure through efficient utilization of resources. This capacity needs to be developed.

Many countries have established water quality management schemes for catchment management of surface waters based on classification schemes. The classification systems are typically established on the basis of the water quality requirements for a particular use. For example, industries are routinely not permitted to discharge any effluent in stretches of rivers classified in "Class A" - waters for use as drinking water source, without conventional treatment and/or disinfection. Similar regulatory frameworks could be established in Rwanda.

3.6.10 Water allocation

Water permits

Current and potential water users will need to apply for a permit to use water, for which they will be charged. Each application will be evaluated against this allocation plan. Successful applicants will be issued water permits and Watershed Management Officers will check that permit holders are using the correct quantity of water for the correct purposes in agreed upon ways.

Water conservation and demand management

Uncertain water availability and a climate characterised by recurring droughts and high intensity rains causing flash floods, provides strong motivation for the irrigation sector in Rwanda to strive for continuous improvement in water management. To help ensure the long term viability of irrigated agriculture, increased insight into the performance of the various water management and irrigation systems is needed, together with the development and adoption of strategies, tools and guidelines to improve performance. However, adoption of best management practices depends to a large degree on incentives, especially at the individual or farmer level. If reasonable incentives are not in place, adoption of even the best tools and guidelines will likely be limited. Therefore, an integrated Water Conservation and Demand Management (WCDM) strategy is needed which addresses both tools and guidelines for field level irrigation water management, and also policy and institutional arrangements which provide positive incentives for the adoption of best management practices.

Tools and methods for field scale irrigation management

One way to determine how good irrigation hardware is performing is to have the system evaluated by a Mobile Irrigation performance evaluation Laboratory (MIL). The data and information acquired using a MIL can be used to calculate 'Irrigation Engineering Performance Indices' (IEPIs). One such IEPI is the Distribution Uniformity, or DU, which is a performance index that describes how uniformly or non-uniformly water is applied. The DU of applied water can have significant effects on irrigation performance because even if the timing and average magnitude of water applications is well matched to crop water demand and soil water storage capacity, non-uniformity results in some areas receiving relatively higher water applications and other areas receiving relatively lower water applications. Excessive runoff and deep percolation losses are likely on the areas receiving the relatively higher water applications and reductions in crop yield can be expected on the areas receiving the relatively lower water applications.

Depending on how well an area is drained, reductions in crop yields can also occur on the areas receiving excess water.

MILs also check numerous other aspects of a system hardware, from the suction arrangements of a pump through to the performance of emitters in the field. Measurements including: operating pressures, nozzle wear, emitter flowrates and power consumption, are all aimed at ensuring that the system hardware is performing according to design specifications and accepted standards[28] (Koegelenberg and Breedt, 2002). Whilst such measurements are valuable in their own right, use of a systems simulation model to translate MIL data/information into associated impacts on crop yields and water use and then relative profit margins, increases the value of a MIL evaluation considerably. The role of a MIL in a more complete systems evaluation which uses a systems simulation model[29] to translate MIL information and data into predicted impacts on crop yields, water use and thereby profitability, is illustrated diagrammatically in Figure 31.

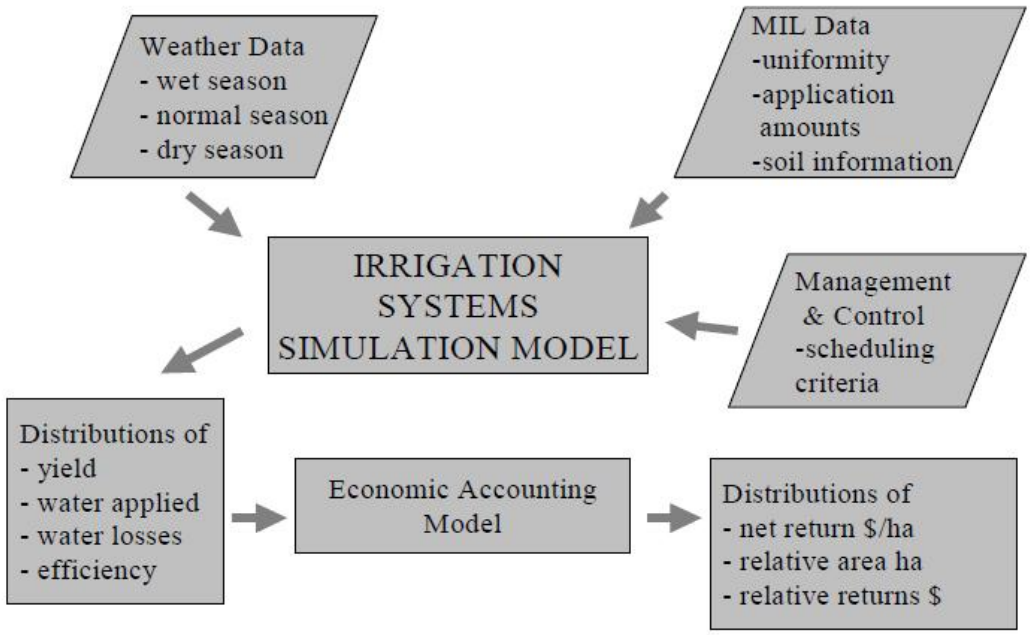


Figure 31: Proposed methodology for evaluation of existing irrigation and water management systems (Lecler, 2003)

Such methodologies are capable of revealing many areas in which the design, maintenance and operation of the system hardware could be improved, resulting in higher land and water productivity.

Institutional arrangements for water allocation and management

Since the irrigated agricultural sector uses a major portion of the available blue water resources, facilitating gains in efficiency in this sector is a vital strategic issue. Water allocations can be instituted by volume per time unit, issued at an estimated level of assurance. To prevent conflicts where upstream users may, on occasion, pump a river dry in low flow periods even although the amount pumped may be

[28] Koegelenberg, FH, and Breedt, HT. (2003). Manual for the Evaluation of Irrigation Systems. Agricultural Research Council – Institute for Agricultural Engineering, Pretoria, South Africa

[29] Lecler, NL. (2003). A model for the evaluation of irrigation and water management systems in the Lowveld of Zimbabwe I: model development and verification Proc. S. Afr Sug Technol Ass, 77 pp 322-367.

less than their license entitlements, incentives for individual water use sectors to implement effective water conservation and demand need to be put in place. Detailed water allocation management will be required in dry seasons.

3.6.11 Strengthening of water governance

Catchment Coordination Offices

To ensure closer working relations with the Districts and the Catchment Taskforces (which under the new water law will become Catchment Committees), as well as to offer more access to information to the public, it was proposed under the institutional strengthening component of Water for Growth Rwanda, to establish sub offices or coordination organs of the IWRMD in the field, each dealing with a single catchment. The catchment coordination office will be instituted at the most suitable district headquarters in the catchments, and staffed by the watershed management officers (IWRMD), program officers (ISU) and a few additional staff. The office would then engage in activities such as secretarial support and strengthening of CTFs, District authorities and eventually the District Hydrographic Committee. De-concentration of some IWRM related activities from the centre (RWFA) to a level closer to the districts can also be facilitated in the long-term. These can be envisaged as improved communication, assistance with filling out and completing permit application forms, continuous update of databases for water use and closer interaction and participation in current district planning procedures.

Water User Associations

Water User Associations (WUA) have an important part to play in the process of management, decision-making and administration. The users directly participate in, and are responsible for, water supply and distribution in their own farming area. WUAs need to be supported at formation stage and nurtured through gradual building of capacity to undertake the following activities during implementation of the catchment plan:

- registration of WUAs;
- management, operation, and maintenance of water supply and irrigation schemes;
- water source protection;
- gender responsive design of WUA;
- assist in resolving conflicts over water use in consultations with the Catchment Coordination Offices and/or decentralised MINAGRI staff;
- identify and adopt appropriate Benchmarks for irrigation water use and water management in the WUA area. The primary benchmarks for irrigation water use are firstly the crop water requirement of a specific crop (ETcrop) in a specific area at a specific time of year. The ETcrop benchmark can be used to calculate the irrigation water requirements for a specific crop in a specific area and at a specific time of year by adjusting the crop water requirement for appropriate irrigation efficiency factors such as leaching requirements, irrigation application efficiency, effective rainfall and reasonable transmission losses (mainly evaporation). This Benchmark is a management tool for decision-making within a WUA to calculate the expected irrigation water requirements and irrigation scheduling for the WUA as a whole;
- develop a Water Account of the WUA's water resources and uses for auditing purposes. The Water Account is essentially a record of data for water abstracted and supplied by the WUA. Automatic registering flow control valves, pump records, parshall flumes or weirs can be used to support measurements;

§ develop access to subsidies and grants.

3.6.12 Summary of program of measure under the preferred alternative (PCB+)

The summary of interventions under each objective is summarized under Table 19.

Table 19: Programme of measures under preferred alternative (PCB+)

Project Objectives	Components	Activities	Key partners
Reverse degradation in fragile ecosystems and adapt to climate change and its impacts Promote water storage through construction of large and small water storage infrastructure for various uses	1. Water source protection	Support registration of Water User Committees and District Water Boards build their capacity to improve operational efficiency and reduce water losses (unaccounted for water). Finance preparation of water safety plans. Prepare water resource protection plans for the proposed large scale water supply projects at Nyagatare. Protection plans should address storm water management, private and community sanitation systems, erosion and waste water discharge, solid waste management and disposal.	WASAC, RURA,CTF WASAC, REMA, Districts
	2. Regulation	Put in place effective regulatory (licensing) mechanisms in place for waste water discharge. Support the department of mines to setup regulatory standards for mines and enforce them. Implement model mining concept at Quarries and two existing mining sites. Rehabilitate sites for abandoned mines in accordance to existing environmental rules. Enforce existing rules and regulations governing quarries and mines exploitation by the Districts.	RWFA, MINIRENA, REMA Mining Department, Districts
	3. Soil conservation and erosion control and increase agriculture productivity	Scaling-up of innovative and cost-effective Sustainable Land Management (SLM) practices and investments that reduce land degradation and deforestation. Soil and water conservation measures will include terraces, grass strips and where required radical terraces over an estimated 16,769 ha in Gichumbi district (sub-catchments D&E). Create 20m buffers along Rivers Muvumba and Mulindi with native bamboos and native tree species (1,124 ha.) A total of 93,441 ha would be treated with soil fertility enhancement interventions. With an average land holding of 0.95ha it is estimated that some 41,200 households in Muvumba catchment will benefit from increased crop yields and farm incomes from both SLM and soil fertility interventions, and a further 24,300 households from soil fertility enhancement interventions only. There will be secondary positive impacts on reducing food insecurity. The primary approach in fertility enhancement will involve short-rotation nitrogen fixing or phosphorus mobilizing shrubs and herbs, to develop a large biomass during a short period (6-12 months). Organic matter and soil nutrients will be enhanced, while soil pH will also improve from lime application. The plant species to be used include *Tephrosia vogelii, Mucuna pruriensis, Sesbania sesban, Calliandra callothyrsus, Leucaena* species, and *Tithonia diversifolia*. The bigger shrubs (*Calliandra* and *Leucaena* species) will also be used to stabilize terrace risers. The germplasm of these plants will be procured from the Rwanda Agricultural Board. Herbaceous plants (e.g. *Mucuna pruriensis*) and small shrubs (e.g. *Sesbania sesban* and *Tephrosia vogelii*) will be planted as temporary cover, while bigger shrubs will be	MINIRENA/RWFA, MINAGRI/RAB, Communities, Districts

Project Objectives	Components	Activities	Key partners
		planted as hedges on terrace risers.	
		Implement a scheme for Payment for Ecosystem Services by structuring payments to farmer cooperatives for effective management of land, water and forestry resources (e.g selling carbon credits, labour, grants from tea factories, WASAC, etc.) The PES scheme is an incentive for farmers to engage in land scape rehabilitation activities.	REMA, WFA, Districts
	4. Promotion of alternative sources of energy to reduce dependence on biomass fuels	Promote diversification of alternative sources of energy by preparing feasibility studies for two micro hydropower plants. Lease feasible micro-power plants to private sector developers.	REG, RURA, NGOs
		Support Households to acquire and install improved cook stoves and biogas digesters	
		Improve management 20,165 ha. of Pine &Eucalyptus forests and woodlots to reduce dependence on natural forests as sources of wood fuel.	
	5. Poverty alleviation	Support farmer cooperatives, women and youth to acquire modern equipment for apiculture. Establish one demonstration apiary.	MINAGRI, RWFA
		Increase the water productivity stored in the dams by setting- up tank based aquaculture production units at Cyabayaga dam and 3 dams at Muvumba (P-8) in Nyagatare district.	MINAGRI/RAB
		Support farmers (individuals/cooperatives) to acquire and install mobile small scale irrigation equipment (pumps, pipes, rain guns, etc.) to develop horticulture and vegetables	
	6. Water resources infrastructure development and management	Increase resilience to climate change and manage recurrent droughts by increasing water storage through development of 18 small multipurpose dams with potential to expand small scale irrigation.	MINIRENA/RWFA MINAGRI/RAB MININFRA/WASAC Districts
		Conduct feasibility and detailed designs for construction of 7 dams in Muvumba catchment	
		Finance the construction of 9 multipurpose dams	
		Investment in soil conservation measures to manage and conserve water sources in upland and around the future multipurpose dams to reduce sedimentation of reservoirs and improve water quality. These interventions should be articulated in the catchment plan based on feasibility studies and detailed designs.	
Promote efficient water use to improve agriculture and livestock productivity	7. Increasing of efficient water use	Develop guidelines on water demand management and increased water use efficiency in all use sectors. Training of private and operators of irrigation schemes and WASAC private operators in maintaining and operating the infrastructure for effective water use. Demonstrate application of appropriate irrigation scheduling techniques. Effective operation of irrigation infrastructure to prevent water loss. Various measures can be promoted	MINIRENA, MINAGRI & RAB

Project Objectives	Components	Activities	Key partners
		to reduce water loss in distribution pipes and canals, irrigation application methods and their use during times of the day and night when evaporation is reduced. Effective maintenance of irrigation equipment to reduce wear and maintain efficiency.Water supply designs for various sector users will be made considering improvement of efficient water use technologies and new crops with high economic-value and less water intensive will be introduced	
		Train farmers in infrastructure operation and in water management, O&M, (infrastructure maintenance & irrigation scheduling). Quip farmers with skills for water management and use such as water saving irrigation, equitable water distribution, on time and on demand irrigation, repairing facilities, etc.	MINAGRI MININFRA/WASAC
		Water to be used in irrigation, domestic use and in livestock will be regularly monitored on order to set up a data base on water use which is an important water management tool.	
Ensure equitable water allocation among various competing users according to set priorities	8. Water allocation	Various water users will be sensitized and advised to comply with the water permit system so as to avoid water use conflicts among them.	MINIRENA/RWFA
Strengthen institutional framework and capacity building and transboundary cooperation	9. Setting up and operationalize the Catchment Office (CO)	Strengthen the water governance framework by having clearly defined responsibilities and working partnerships with other stakeholders for the catchment.	MINIRENA,
		Institute a catchment co-ordination office to provide all stakeholders with opportunity and forums to participate meaningfully in the planning and management of the water resources of the catchment. The CO will assist to allocate water and resolve all conflicts over utilisation of the water resources of the catchment quickly and satisfactorily	RWFA, MINIRENA, CTF
		Involvement of all stakeholders in policy and strategy formulation; integrated gender responsive planning; joint monitoring of water resources usage	
	10. Set a transboundary framework cooperation with Uganda	Organize official contacts and meetings with Ugandan Muvumba catchment part to elaborate the guidelines (catchment collaboration framework) on how to collaborate in Catchment plan management.	MINIRENA/RWFA/REMA MINAFET Districts CTF
		Organize and conduct continuous contacts and study tours/field visits for information and experience exchanges (updating) on what it is being implemented or what should be done in both Muvumba catchment parties (Rwanda & Uganda).	

3.7 Budget estimates and available financing options

3.7.1 Cost-Benefit Analysis of main alternatives

An initial overview of investment costs and benefits (expressed as Financial Internal Rate of Return (FIRR) and Net Present Value (NPV) was developed for the agricultural and industrial measures in the main alternatives PABS and PCB, and for variation PCB-. The draft results are provided in Table 20. Within these sub-programmes of measures, the highest FIRR rates are calculated for hillside (pumped) irrigation, using high value crops, and for forest plantations.

Table 20: Cost-Benefit Analysis of main alternatives

Parameter	PABS	PCB-	PCB
Agricultural Areas & Industrial (Q)	Tbd	Tbd	Tbd
Investment Costs 2017-2023 (RWF Billion)	Tbd	Tbd	Tbd
FIRR for Catchment Measures (%)	Tbd	Tbd	Tbd
NPV (RWF Billion)	Tbd	Tbd	Tbd

3.7.2 Financing options and prioritization

Finances for the catchment plans are to be sources from an IWRM Investment Fund (IIF), which can function as a Basket Fund to be fed by different sources e.g. GoR, donors, international climate funds and others as part of its bilateral development cooperation on IWRM. The GoN is willing to contribute to this and has reserved an amount of EUR 18 million for the period from 2016 to 2019, to be used for investments in 4 Demonstration Catchment Areas (DCAs) in Rwanda. The IIF will be established and managed by the GoR under MINECOFIN. The responsibility will be delegated to the Director General of the Rwanda Water and Forestry Authority (DG RWFA).

3.7.3 Time frame and phasing of activities or program of measures

Implementation of the programme of will commence as soon as possible with the Early Implementation Project for Landscape Rehabilitation in Nyagatare. Detailed designs and feasibility studies will be conducted for the micro-hydropower, small multi-purpose reservoirs and proposed aquaculture systems in the period 2017-2018. A detailed road map of activities to be undertaken during the year 2017-2018 is provided as annex 7.

3.8 Proposed institutional arrangements for the catchment

3.8.1 Institutional roles and responsibilities

A Catchment Coordination Office will be instituted as an extended arm of the IWRM-department to support the alignment process in 2017, and to support the implementation of the catchment plan. The office will support the districts to integrate the catchment plans into the district's 5 year strategic plans, provide additional technical support (water resources monitoring and licensing) where needed and become an office that will be more accessible to the various stakeholders in the catchment (Districts, water user associations, Private sector, NGOs, utilities, etc.).

For the time being, the staff of the IWRM department is all based in Kigali and travels with various

frequencies to the field. The current proposal is based on the new scenario, to have a permanent presence in each catchment. In the institutional assessment report of Water for Growth Rwanda[30], an assessment was made of the various institutions and organs that play a role in IWRM processes. As can be derived from the matrix below (Figure 32), the CO intervenes at two levels, the Catchment level, and the district level. While this role is of a coordinating nature at the level of the catchment, there is a more technical support role to focus on in collaborating with the district level actors. The CO will support translating catchment plans into district plans and guide interventions from the various sectors in combining efforts to move from curbing catchment degradation into sustainable management of the resources. The CO must also become an information hub for the various interested stakeholders and the public at large.

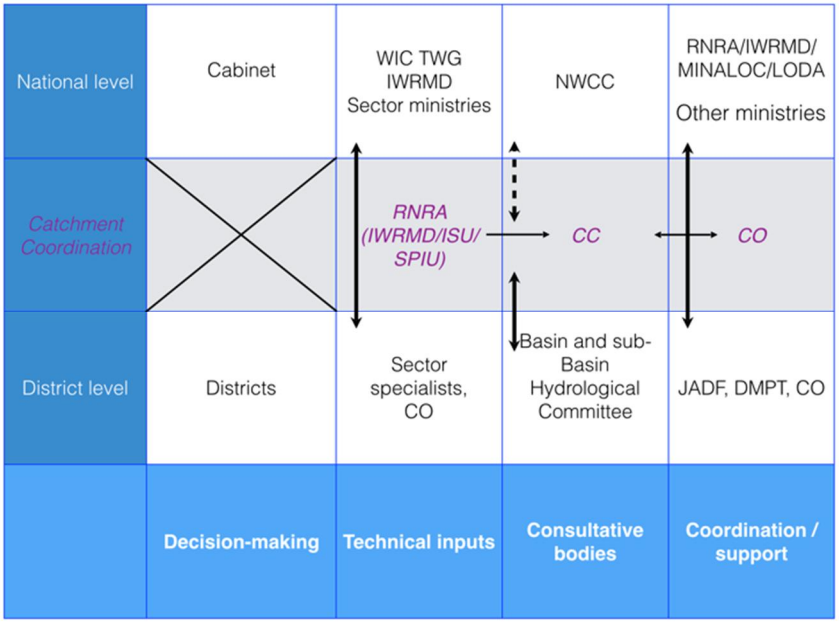


Figure 32: Matrix presenting coordination, consultation, technical input and decision-making at various levels[31]

Being a coordination office and a technical support entity, it is expected that the CO will:

- be involved in a continuous process of further improvement of the catchment plans;
- integrate new thinking and disseminating successful practices for replication in the same catchment or in neighbouring pilot catchment;
- be a linking pin between sector ministries and local partners, especially in promoting best practices and disseminate learnings;
- support the districts in translating the Catchment plan into district implementation plans and translate the district measures for the larger public;
- support the Districts in monitoring the effects of the Districts' implementation plans in relation to the overall catchment implementation plan;
- provide technical inputs to the Catchment Committee and the District Committees for Hydrographic Basins, including capacity building support;

[30] Water for Growth Rwanda technical report TR03 – Institutional Frameworks (January 2017)

[31] CC stands for Catchment Committee, the successor of the Catchment Task Force under the new Water Law under development

- support the districts in organizing stakeholder events;
- assist in meetings organized by the Districts to provide technical inputs and advice;
- develop into a resource and information centre for the districts and the public;
- be an extended arm of the IWRMD and the Water and Forest Authority (RWFA, the applicable successor of RNRA);
- support the (decentralized) activities of the IWRMD (water permits and water resources monitoring).

Location of the CO

Given the tasks of the CO, such a role can only be correctly performed if the CO ensures a local presence in the selected catchments. Catchment boundaries are not identical to administrative boundaries, and consequently, multiple districts can be physically represented in the same catchment, either in full or partly. The CO will be hosted in the catchment area and will liaise with all stakeholders that rely on the same catchment. From a pragmatic point of view, it is proposed to locate the office in Gicumbi.

The most suitable options to set-up the new CO

The ideas around the local presence have further matured and can be as well linked to the likely new structure of agencies in MINIRENA. The proposed structure includes a new Water and Forest management Authority, dealing with the Departments of IWRM and of Forestry Management, managed by a Director General. Given this closer link to the forestry department, merging the CO office with the District Forestry office seems to be an ideal construction. Although the CO will deal with more than one single districts in the catchment, using the forestry office will pave the way to establish an easy stronghold in the catchment. This option will also allow linking catchment interventions to forestry, agroforestry, and environment.

Given that the new water law is not yet endorsed by the Cabinet it is proposed that the ISU will be the catalyst behind the initiative and provide the financial resources to start as soon as possible the CO office. Having this local presence is opportune since the implementation phase of the catchment plans is to start soon. Monitoring the performance and functioning is important and additional guidance, and capacity strengthening might be required. The POs and the IWRM-watershed managers should provide coaching roles to these new staffs as well. However, it will not be sustainable for the CO if their funding for staff and operational costs will continue to be provided by the IWRM Programme funds. Being recognized in the law, staff and their costs need to be budgeted for by the IWRM Department and the WFA, and a transfer of costs can be proposed in a gradual manner. Concerning the operational costs, the different districts in the catchment can contribute to the operational costs, most likely based on the activities that are implemented for a specific district. Otherwise, based on the percentage of each district within the catchment area, a distribution of running cost can be based on these percentages.

Composition of the CO

The size and composition of the CCO are not static since it will depend as well on the development stage of the basin plan in the respective basins, or specific needs during the implementation of the plan. In general, it would be good to have at least two full-time staff, possibly reinforced with interns for specific tasks. Also, as mentioned, the POs and the watershed managers are to spend around 50% of their time in the CCO office. Possible profiles which can further elaborated could include:

- a water resources planner/ water economist 1 FTu;

- climate-smart agricultural expert, 0.5 FTu;
- agroforestry expert, 0.2 FTu;
- communication/stakeholder engagement expert 1 FTu.

The staffing of the CO can evolve over time and collaboration will be sought with the sector experts in place. This will require discussions at various levels, how sectors can be more and better implicated in the IWRM agenda.

3.8.2 Memoranda of understanding and service contracts

Through Memoranda of Understanding (MoUs), the implementation of some of the technical activities of catchment plan implementation will be the responsibility of partner agencies and institutions working in collaboration with MINIRENA.

1. landscape rehabilitation activities, irrigation development, water supply infrastructure, model mining, green villages, water quality regulatory framework, micro hydropower development and other initiatives to alleviate poverty will be implemented through cooperation of a number of agencies according to their mandates. Hydrological models for drought forecasting will be developed between Meteo Rwanda and the Integrated Water Resources Management Department of RWFA. Local disaster preparedness planning will be carried out by Ministry of Disaster Management and Refugee Affairs (MIDIMAR). Irrigation development will be implemented by RAB and MINAGRI while WASAC will implement the proposals for improvement of water supply and sanitation infrastructure.
2. research activities will be carried out through partnerships with key research institutions, which are expected to include the University of Rwanda;
3. depending on the scope of activities, to be determined under the landscape rehabilitation component, the RWFA & Nature Conservation and Geology & Mines Authority may also directly implement activities under MoUs related to enrichment of plantation forests with native species and environmental management of mining activities. Otherwise, these will be implemented through district-level joint project teams, involving RWFA-staff;
4. components of the catchment plans relating to poverty alleviation, fish farming, beekeeping, horticulture, agroforestry, strengthening community participation etc. will be implemented through the District level under MoUs, in accordance with national decentralization policies;
5. capacity-building and joint micro-watershed / silvo-pastoral and livelihoods planning activities with communities and cooperatives will be overseen by District and Catchment Coordination Office Staff but due to the significant time required for these interactions, they will be supported by local teams of service providers / NGOs depending on the local circumstances;
6. the output of participatory planning processes may involve contracts signed between the Water for Growth program and communities / cooperatives committing support for specified livelihood and landscape restoration activities, ecosystem service provision, carbon sequestration in return for the beneficiaries' active involvement in implementing various elements of the catchment plan. This support will be bolstered where necessary with additional specific technical Government experts, and consultants. Implementation on the ground will also be supported by peer learning structures involving demonstration plots and local knowledge exchanges.

3.8.3 Incentives – Payment for Ecosystem Services

Ecosystems produce valuable goods and services for society like clean water, air, nature. However, ecosystem services are usually for free and not valued in the conventional accounting systems. Natural resources and ecosystems are under pressure and so are the services they deliver. Payment for Ecosystem Services (PES) is a market based mechanism where the consumers of the good or service pay for the preservation of the ecosystem that is providing the good or service. An opportunity for such a market-based mechanism can be piloted in Gicumbi with involvement of WASAC. Possibilities to set up contractual arrangements between WASAC and land users to reduce the erosion will be explored.

It is expected that as economic development in Rwanda advances, consumers will have more financial resources and willingness to pay for the conservation of the natural ecosystems and its environmental services.

3.9 Monitoring and Evaluation mechanisms

A Monitoring and evaluation (M&E) framework was developed to keep track of implementation progress and of the achievement of intended and unintended outcomes and impacts. M&E is a way of tracking and reporting on the accountability of various stakeholders during the plan implementation.
Monitoring: Regular tracking of progress should be conducted by the W4GR and SPIU team and should compile monthly and quarterly reports on the physical implementation on ground.

A logframe matrix has been developed, providing a list of key performance indicators (impacts, outcomes and outputs) to be used in the progress reports. Data collected regularly should be analysed to enrich and update the Water MIS of the IWRMD as well as the production of regular reports to the PSC, MINECOFIN and relevant Stakeholders.

Evaluation: During the monitoring process, lessons and best practices will be documented as basis for implementation improvement and catchment plan review.

A midterm review is to be conducted in 2020, around mid-term of the plan implementation period. The four standardized criteria for evaluation namely relevance, effectiveness, efficiency and sustainability should be applied in order to convince the beneficiaries and decision makers on the achievement of catchment plan objectives and to guide eventual adaptation of the catchment plan if needed.

The M&E framework / log frame for the implementation phase of the catchment plan is provide in Table 21 overleaf.

Table 21: Preliminary Catchment Plan M&E framework

Hierarchy of results	Key Performance Indicator	Baseline 2015/2016	Target 2022/2023	Means of verification	Assumptions
General objective: Secure sufficient water for sustainable socio-economic development in the catchment					
Impact 1 All water demands for socio-economic development in terms of quantity and quality are met	Unmet demand for key economic sectors (Domestic, Agriculture, industry)	10 MCM/Yr	0	Annual WEAP Model simulations	National and District Land use plans respected for all investments in the catchment
	% of water bodies meeting water quality standards in the catchment	TBA	75%	IWRM Annual survey reports	
	Water demand per capita (CM/capita/Y)	TBD	TBD	IWRMD Annual survey reports/WEAP	
Impact 2 Water and land productivity increased	Yield per ha of main crops in the catchment	TBA	TBD	Districts Imihigo Reports	
	Water productivity (RWF/m^3)	TBA	TBD	IWRMD Annual survey reports	
Specific objective 1: Reverse degradation in fragile ecosystems and adapt to climate change and its impacts					
Outcome 1.1 Critical sub catchments are restored and protected to reduce soil erosion	Area of degraded catchment rehabilitated (ha and %)	TBD	TBD	W4GR/IWRMD Reports	The districts, Ministries and agencies have mainstreamed erosion control in their DDPs, sectoral and annual action plans
Output 1.1.1 Areas prone to erosion are protected with terraces and agroforestry	Areas of developed terraces (bench, radical and progressives) in combination with agroforestry (ha) %			Districts & MINIRENA Quarterly reports	All stakeholders in the Districts committed to mainstream erosion measures
Output 1.1.2 Forest plantations increased in public and private lands in line with DFMP	Area of forestry plantations cover (ha) %?	7395		Forest Department Quarterly reports	District to have updated their District Forest Master plans with the support of RWFA.
Output 1.1.3 Gullies and degraded old mines rehabilitated	Area and % of gullies and old mines rehabilitated (ha)	TBD	TBD	IWRMD Quarterly reports	Gullies and old mines rehabilitation mainstreamed in the new DDPs.

Output 1.1.4 Mining companies adopt the application of sustainable mining practices	Number and % of mining companies applying sustainable mining practices	0	100%	IWRMD Quarterly reports	Mining companies are willing to comply with mining low and their mining licenses
Output 1.1.5 Agricultural practices driving soil erosion in the catchment are decreased and replaced with climate smart agriculture	Area (ha) and % of farmlands with improved (climate resilient) farming methods using Farmer Field Schools (FFS).	TBA	100%	MINAGRI Quarterly reports	The Ministry of agriculture cooperates to adopt improved farming methods protecting land in Farmers Field Schools
Outcome 1.2 Floods and drought hazards reduced.	Area of high risk zones protected against flooding (ha)	TBA	TBA	IWRMD Quarterly reports	Feasibility studies conducted
	Command area for marshlands and hillside irrigation from various sources of water (Dam, reservoirs, Groundwater, and rivers)			MINAGRI Quarterly reports	
Specific objective 2: Promote water storage through large and small scale water infrastructure for various uses					
Outcome 2.1 Increased storage in reservoirs for multipurpose utilization	% increase in volume of water stored per capita	TBA	80%	IWRMD Annual water users survey reports	Water allocation aligned to the National Land Use Master Plan
	No. of new feasibility studies for new dams conducted				
	No. of new dams constructed				
Output 2.1.1 Increased water utilization	% of increase in ha. for irrigation			IWRM Quarterly report	
	% increase for water supply coverage				
	% increase in fish production in reservoirs (tons/year)				
	No. of micro hydropower plants completed				

Specific Objective 3: Promote efficient water use to improve agriculture and livestock productivity					
Outcome 3.1 Increased water efficiency in all sector	Number of crops introduces with higher economic value and less intensive use of water	0	100%	IWRMD Quarterly reports	IWRM Mainstreaming guidelines available and endorsed by the Ministry of finance and economic planning
	Number of irrigations schemes practicing water saving technologies e.g. irrigation scheduling	0	100%	IWRMD Quarterly reports	
Output 3.1.2 Water conservation and demand management strategy developed	% reduction in unaccounted for water in WASAC distribution systems				
	No. of water user associations trained in efficient water use technologies				
Specific Objective 4: Ensure equitable water allocation among various competing users according to set priorities					
Outcome 4.1 Water allocation plan in place to ensure equitable allocation of water resources	Number /% of water users satisfied with water allocation system				
Output 4.1.2: Water users with water abstraction permits increased	Number /% of current water users with water abstraction permits				
	Number/% of new water users with water abstraction permits				
	Reduction of water use conflicts				
	Proportion or assurance of demand satisfied				

Specific Objective 5: Strengthen institutional framework and capacity building and transboundary cooperation					
Output 3.1.1 Catchment Coordination Offices are established and operational	Average level of participation in catchment Task Force meetings (%)+disaggregation by gender	0	>80%	IWRMD Quarterly reports	
	CCO Office staff appointed and facilitated	0	Quarterly reports	IWRMD Quarterly reports	
	Functionality of CCO	0%	100%	IWRMD Quarterly reports	
Outcome 3.2 Capacity strengthened in key organizations to assume role in IWRM	% of districts mainstreaming approved catchment plans in their DDPs.	TBA	100%	IWRMD Quarterly report	
Outcome 3.3 Knowledge and best practices documented and shared	Availability of data related to catchment characteristics to update the water MIS at central level.	Catchment characterization reports December 2015	All data related to catchment characteristics to updated and incorporated in the water MIS	IWRMD Quarterly reports	Availability of local skills for systematic data collection
Outcome 5.3 Transboundary cooperation with Uganda	Catchment collaboration framework drafted		100%	IWRMD Quarterly reports	
	Number of exchange visits and best practices documented and shared	TBA	Tbd	IWRMD Quarterly reports	

4. Way forward towards version 2.0

As mentioned earlier in this catchment plan, the current Catchment Plan version 1.0 is only the starting point of a year-long alignment process, in which mutual negotiations take place between sectoral stakeholders at the central level, as well as between national stakeholders and districts, and NGOs, private sector stakeholders, and others. The process towards an officially endorsed Catchment Plan version 2.0 that is completely aligned with sectoral and district 5 year plans, the new Government Seven Year Plan, the Vision 2050 and EDPRS3 under development, is depicted in Figure 33. A detailed planning will be drawn up for sectoral dialogues and district dialogues, in order to jointly developed a detailed and specific programme of measures.

In parallel to this alignment process, the official review of the catchment plan documentation by REMA can take place, and ample time will be available for the wider public and third party stakeholders to respond to the plan. This allows for a continuation of the integrated process of plan development and SEA plan assessment.

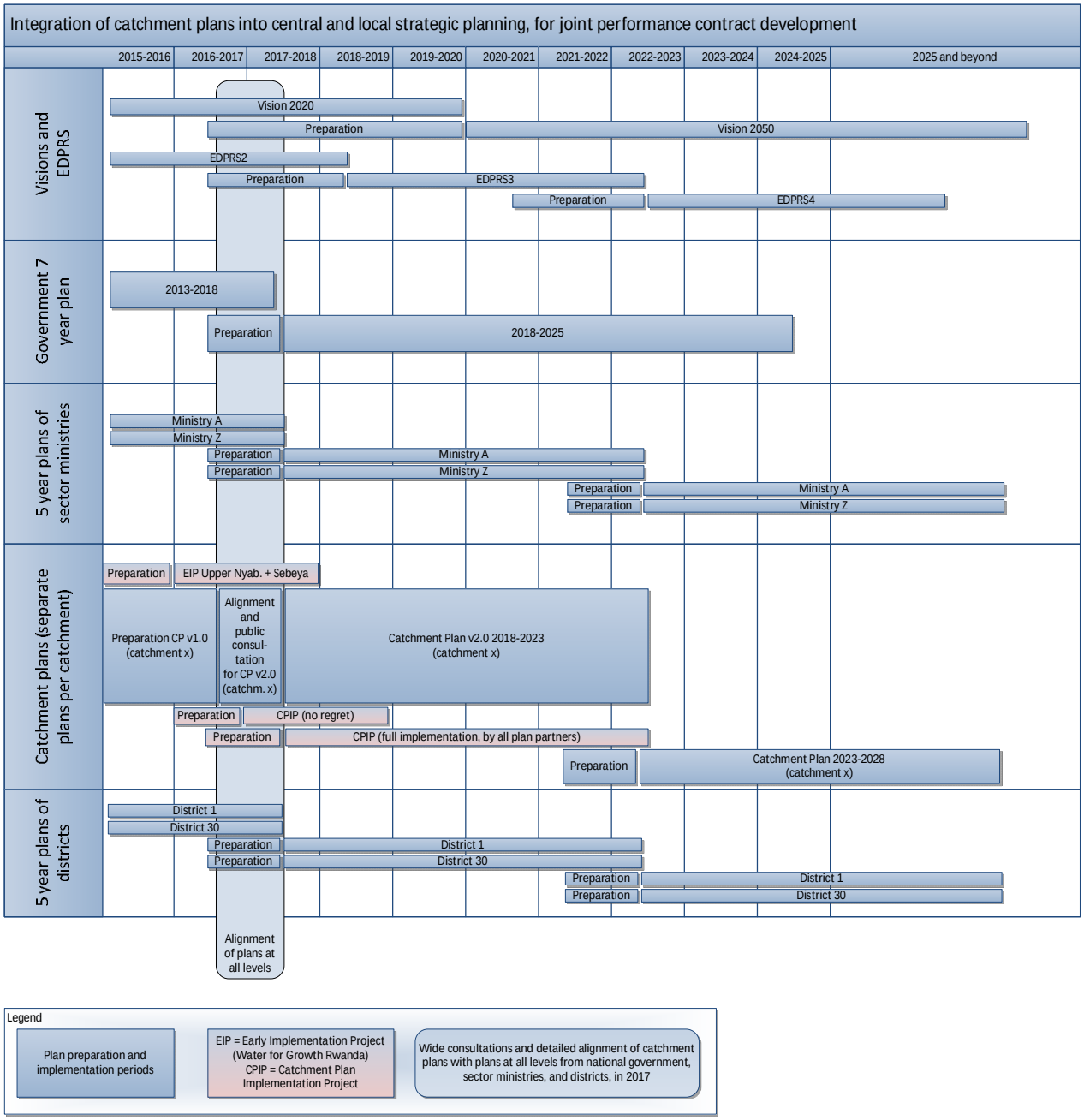
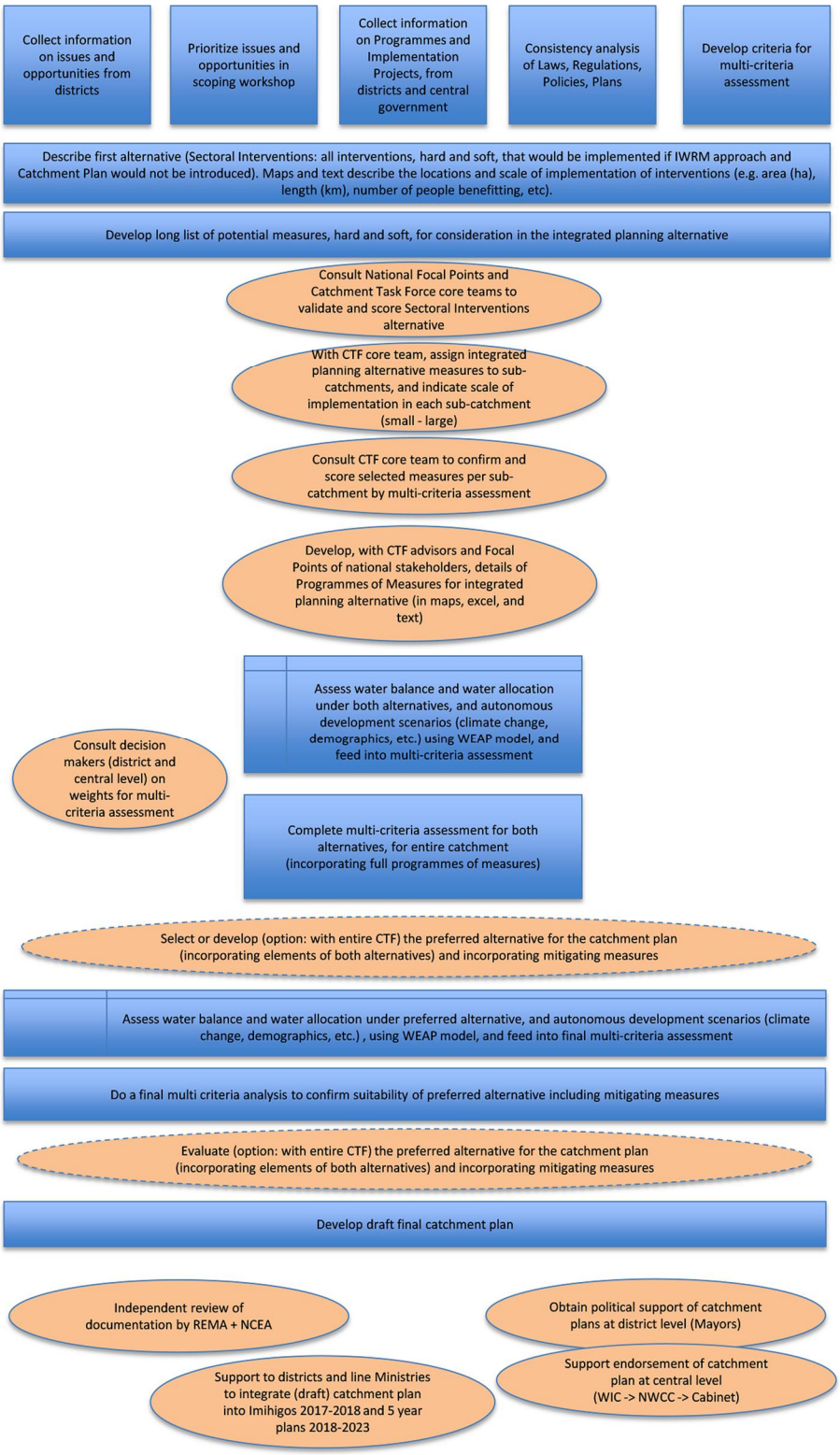


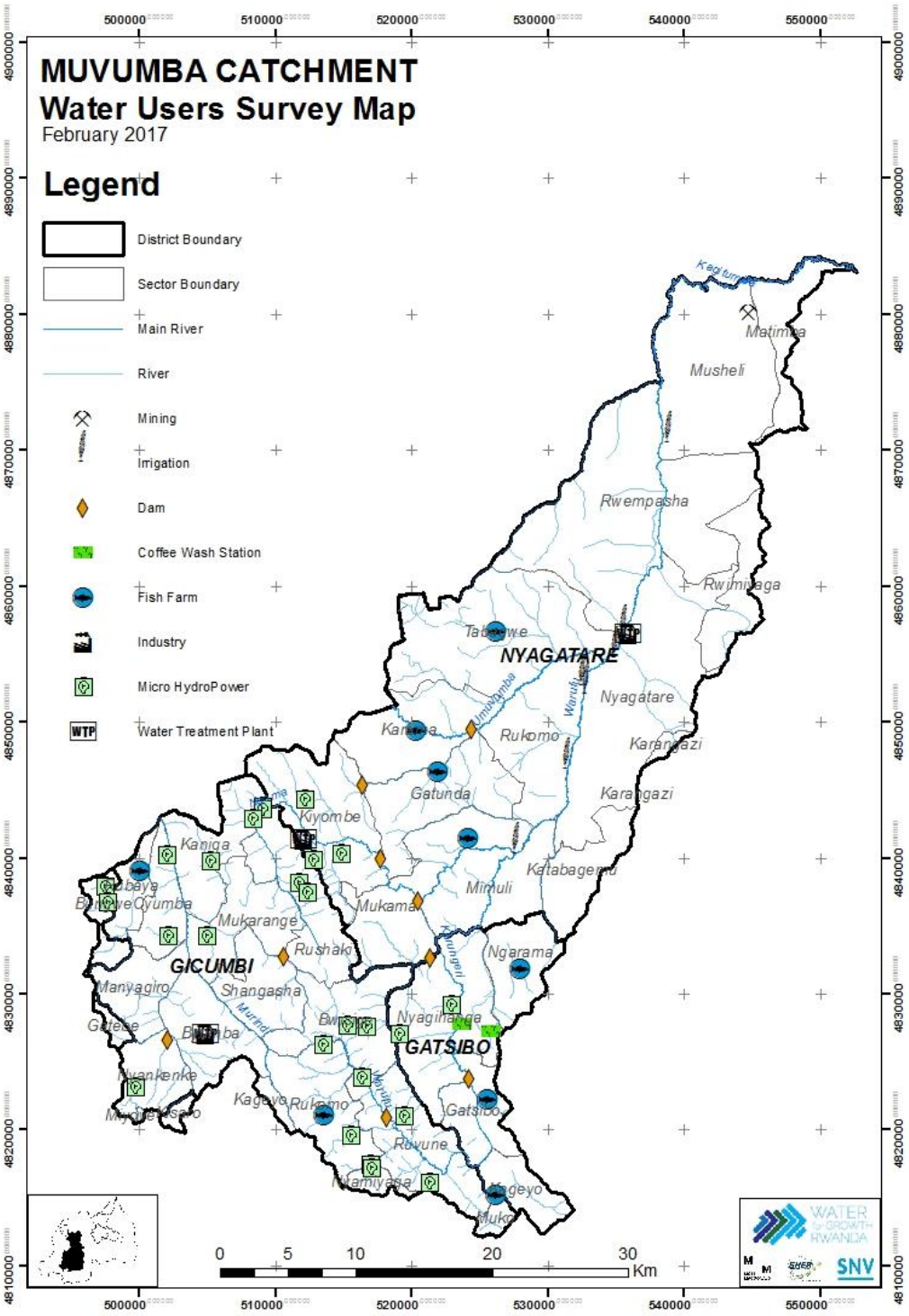
Figure 33: Alignment process between Catchment Plan, National Plans, Sector plans, and District plans

Annex 1. IWRM and SEA process steps



Annex 2. Water users in the catchment

The maps on the following pages were derived from a water users' survey implemented by Water for Growth Rwanda in November-December 2016.



Annex 3. Authorities and stakeholders

Most of development partners operating in 3 Districts of Muvumba catchment are in the category of International and Local NGOs as well as government projects and programmes operating in 13 sectors of socio-economic development. Among those sectors of intervention, 7 are in close relation with water sector while others: justice&Governance, communication, ICT, energy, livestock and education have no direct relationship with water. The share of each sector in relation to stakeholders in detailed in Table 22below.

Among the sectors with close relation to water sector, Social has the majority of stakeholders (49.58 % of all stakeholders and 17.39 % in water domain), followed by health and nutrition (11.76% of all stakeholders and 8.7 % in water domain), and comes agriculture with high rate in water domain (7.56% of all stakeholders and 30.34% in water domain).

With regards to government projects/programmes implemented in the catchment with close relation to water sector, 7 major projects have been identified three of them are planned to be implemented in coming years ones funds are mobilised (currently technical studies are ongoing):

1. Warufu Multipurpose dam for irrigation (2.500 ha), water supply and hydro-power production, Gatsibo district, Nyagihanga, Ngarama and Gatsibo sectors, implemented by MINAGRI through LWH (Land Husbandry, Water Harvesting and Hillside Irrigation Project);
2. Muvumba multipurpose dam for irrigation (8 000 ha), water supply and hydro-power production, Nyagatare district, Rukomo, Musheli, Karama, Tabagwe, Rwempasha and Nyagatare sectors, implemented by RNRA (Rwanda Natural Resources Authority) in partnership with KOICA (South Korean Government International Cooperation);
3. Transport Sector Support Project, Phase 2: Improvement and Asphalting of 73 km Rukomo-Ngarama-Nyagatare section, funded by Arab Bank.

And four of them are currently implemented by government institutions: MINAGRI/LISP/RSSP (2 projects) and WASAC (1project) and MININFRA/RTDA (1 project).

The list of ongoing projects under implementation of government institutions is in Table 23.

The mandate of those institutions to be involved in the implementation of the preliminary catchment is as follows:

- MINAGRI/RAB: Ministry of Agriculture and Animal Resources is focused on increasing agricultural and animal production, modernizing farming, ensuring food security and promoting surplus for the market. Given the close link between agriculture and the catchment management, especially for land husbandry, irrigation, feeder roads improvement and fertilizers application in farms, this ministry will be involved in the implementation of the catchment plan;
- NAEB: The National Agricultural Export Development Board registered under MINAGRI, was set up by bringing together three government agencies responsible for agricultural export and cash crop under the same management (OCIR THE, OCIR CAFÉ and Rwanda Horticulture: RHODA). Given his responsibilities related to the LED potentialities and their exploitation including processing factories, it will be involved in the implementation of the catchment plan;
- MININFRA: The Ministry of Infrastructure will play a key role in supporting the development and rehabilitation of infrastructure that will facilitate the implementation of the catchment plan at national and local level especially in policy and standards formulations and participation in the programme steering committee;

- REMA: The Rwanda Environmental Management Authority is mandated to facilitate coordination and oversight of environmental legislation, policy, and standards. Key areas of intervention relate to prevention of soil erosion, deforestation, pollution and water contamination. REMA should support LODA in ensuring that the focus on LED does not negatively impact to environment, including through destruction or depletion of natural resources, and should work towards promoting innovation and green enterprises;
- RNRA: Rwanda Natural Resources Authority is an authority that leads the management of promotion of natural resources which is composed of land, water, forests, mines, and geology. It shall be entrusted with supervision, monitoring and to ensure the implementation of issues relating to the promotion and protection of natural resources in programs and activities of all national institutions. Given the close link between water and other 3 departments under the responsibility of the Authority (Land and Mapping, Geology and Mines, Forestry, and Nature Conservation), the later will be fully involved in the implementation of the catchment plan;
- LODA: The Local Government Development Agency plays a unique and essential role in supporting and promoting local economic development across Rwanda. As a central agency with staff at the district level and which provides funding to improve the development of Rwanda at the local level, LODA has a key opportunity to support the LED potentialities identified. In close collaboration with MININFRA, LODA will ensure that infrastructure projects needed in the catchment are designed and executed with a sustainable economic impact;
- RDB: The Rwanda Development Board is responsible for supporting private investment and business development in Rwanda. RDB's role relates to developing the private sector, including through addressing the needs of companies and investors. In the catchment plan implementation, RDB will be consulted with regards to Tourism Projects and approving EIAs and mitigation plans for all projects having a negative impact on water resources;
- WASAC: Water and Sanitation Corporation is responsible for ensuring access to clean water and adequate sanitation infrastructure. As assessed during the district surveys, access to water supply for people, animal and industries is among the top priority of 87.5% of the districts. WASAC is then a key player of catchment plan implementation with regard to the growing demand of safe water in most economic activities in the catchment.

Table 22: Role of international and local NGOs

S/N	Sector	Number of Stakeholders	Stakeholders with close relation to water sector	% of stakeholders	% in water domain
1	Social	33	0	49.58	17.39
2	Agriculture	26	26	7.56	30.43
3	Health and Nutrition	21	21	11.76	8.70
4	Environment protection and land	16	16	2.52	4.35
5	Water and sanitation	14	14	3.36	17.39
6	Education	9	0	11.76	0.00
7	Justice and Governance	8	0	4.20	0.00
8	Livestock	7	7	0.84	0.00
9	Energy (Electricity& Alternative)	5	5	1.68	0.00
10	ICT	2	0	0.84	0.00
11	Communication	2	0	0.84	0.00
12	Agro-processing	2	2	4.20	17.39
13	Settlement	1	1	0.84	4.35
	Total	155	99		

Table 23: Ongoing projects under implementation/under study by Government institutions in the catchment

S/N	Name of the project	Implementing institution		Number of Districts
		Study	Implementation	
1	Warufu multipurpose dam (25 million m^3): irrigation (2 500 ha), water supply and hydro-power production in Gatsibo district (Nyagihanga, Gatsibo and Ngarama sectors) funded by WB	MINAGRI/LWH		1
2	Muvumba multipurpose dam (35 million m^3) for irrigation (8 000 ha), water supply and hydro-power production in Nyagatare district (Rukomo, Rwempasha, Musheli, Tabagwe and Nyagatare sectors) funded by KOICA	RNRA/KOICA		1
3	Livestock watering system (LWS) for 627 farms implemented by Livestock Infrastructure Support Project (LISP) in Nyagatare district (Rwempasha, Musheli, Tabagwe, Rwimiyaga and Nyagatare sectors) funded by AfDB		MINAGRI/LISP	1
4	Marshland development (900 ha) with dam construction (3.75 million m^3) in Gatsibo and Nyagatare districts (Karangazi, Gatsibo and Nyagatare sectors) implemented by Rural Sector Support Project (RSSP) funded by WB		MINAGRI/RSSP	2
5	Water supply, Hygiene and Environmental sanitation, Urban drainage development and Capacity building implemented by Lake Victoria Water and Sanitation Program Phase II (LVWATSAN II) in Nyagatare district, (Nyagatare sector) funded by AfDB		MININFRA/WASAC	1
6	Transport Sector Support Project, Phase 1: Improvement and Asphalting of 51.54 km Base-Gicumbi-Rukomo section, funded by AfDB		MININFRA/RTDA	2
7	Transport Sector Support Project, Phase 2: Improvement and Asphalting of 73 km Rukomo-Ngarama-Nyagatare section, funded by Arab Bank	MININFRA/RTDA		2

Annex 4. Multi-Criteria Analysis of alternatives

On the following page, the detailed results of the MCA are provided from one of the groups involved in the group work exercise on MCA of the catchment plan alternatives, during the catchment task force meeting of 30 January 2017.

The criteria from the water balance (WEAP) and the expert judgement based multi-criteria analysis both point in the same direction for the preferred alternative: PCB-.

		CRITERIA Water Balance (WEAP)													Multi-Criteria Assessment				
		Water Demand (% improvement versus projection)	Water Shortage (% improvement versus projection)	Water Short Months (% improvement versus projection)	Evaporation Demand (% improvement versus projection)	Evaporation Shortage (% improvement versus projection)	Mean Flow (% improvement versus projection)	Peak Flow (% improvement versus projection)	Low Flow (% improvement versus projection)	Fast Runoff (% improvement versus projection)	Slow Runoff (% improvement versus projection)	Groundwater Recharge (% improvement versus projection)	Floodplain ecosystem services	total weighted change (pos/neg)	Ecosystem Services	Economic Development	Social Development	Water Governance & Institutional Development	total weighted score
	weights	1%	40%	20%	1%	1%	1%	8%	10%	10%	3%	2%	3%	100%	25%	35%	30%	10%	100%
	11_23_Fut_med																		
Alternatives	13_23_Alter_PASB	12%	13%	2%	6%	8%	3%	-3%	11%	-2%	3%	2%	-10%	6%	2	3	3	0	2.45
Alternatives	14_23_Alter_PCB	23%	24%	5%	9%	14%	11%	-9%	75%	-4%	13%	9%	-10%	18%	5	6	5	8	5.65
Alternatives	21_23_Alter_PCB+	43%	44%	9%	19%	24%	15%	-4%	114%	8%	22%	16%	-10%	33%	1	8	6	8	5.65
Alternatives	22_23_Alter_PCB-	46%	51%	8%	13%	18%	20%	-17%	159%	-5%	19%	14%	0%	38%	7	5	7	6	6.2
	33_30_Fut_med																		
Alternatives	35_30_Alter_PASB	12%	21%	4%	5%	7%	5%	-2%	31%	-2%	6%	4%	-10%	12%	3	3	4	2	3.2
Alternatives	36_30_Alter_PCB	23%	31%	7%	10%	14%	12%	-8%	66%	-3%	13%	9%	-10%	20%	6	8	6	6	6.7
Alternatives	43_30_Alter_PCB+	43%	49%	9%	20%	24%	15%	-5%	127%	7%	20%	14%	-10%	36%	7	7	6	8	6.8
Alternatives	44_30_Alter_PCB-	41%	50%	9%	14%	20%	23%	-19%	112%	-5%	21%	16%	0%	33%	9	6	6	8	6.95
	55_50_Fut_med																		
Alternatives	57_50_Alter_PASB	11%	24%	11%	5%	8%	4%	-3%	53%	-1%	6%	4%	-10%	17%	2	1	2	2	1.65
Alternatives	58_50_Alter_PCB	22%	41%	23%	10%	15%	9%	-6%	112%	-3%	13%	9%	-10%	32%	6	6	6	6	6
Alternatives	65_50_Alter_PCB+	41%	57%	31%	20%	25%	9%	7%	148%	6%	18%	13%	-10%	46%	7	6	6	8	6.45
Alternatives	66_50_Alter_PCB-	43%	64%	32%	17%	25%	29%	-17%	134%	-6%	30%	22%	0%	46%	10	8	6	8	7.9

Annex 5. SDGs informing catchment vision

The United Nations have recently (2015) adopted the Sustainable Development Goals (SDGs). To support participants in their thinking of the values for IWRM in Rwanda, Session 2 contained an exercise to show how the SDGs could apply to catchment planning. To allow people to step away from thinking from their won angle and prevent direct problem solving and think about priorities for development of catchment sector district perspective, the participants were asked a very broad question:

- what do you find important for the future of your catchment?
- what are your values for future development?
- in that respect, which SDGs are most important to you?

Above questions resulted in three Session steps identifying a vision for the catchment:

1. identification of three SDGs from 14* main categories per thematic group. VM = vice mayors/economy; E/RN = environment and natural resources; A = Agriculture; Privé = Private Sector; CNF = National Women's Council/gender & social; ONG = Non-Government Organisations. The group at the bottom represent the vision of the catchment planner and Program Officer for Sebeya;
2. aggregation of selected SDGs for the entire group;
3. individual voting after having heard the motivations of all groups.

Participants divided into 7 Groups (National water, National non-water, Environmentalists, Agronomists, Private sector, NGOs and Gender) reviewed the 16 SDGs relevant to Rwanda and the catchment against their values and identified the 3 most important for the future of the catchment. After the presentation in plenary by all 6 groups, the 7 SDGs that appealed in many groups are:

4. SDG 15: Ecosystems protection, combating desertification and reverse of biodiversity loss: 31 scores;
5. SDG 6: Ensure availability and sustainable management of water and sanitation for all: 29 scores;
6. SDG 2: End hunger, achieve food security improved nutrition, and promote sustainable agriculture: 13 scores;
7. SDG 5: Achieve gender equality and Empower all women and girls: 9 scores;
8. SDG 11: Make cities and Human settlement inclusive, safe, resilient and sustainable: 8 scores;
9. SDG 16: Promote peaceful and inclusive societies for sustainable development and inclusive institutions at all levels: 6 scores;
10. SDG 13: Take urgent action to combat climate change and its impacts: 5 scores.

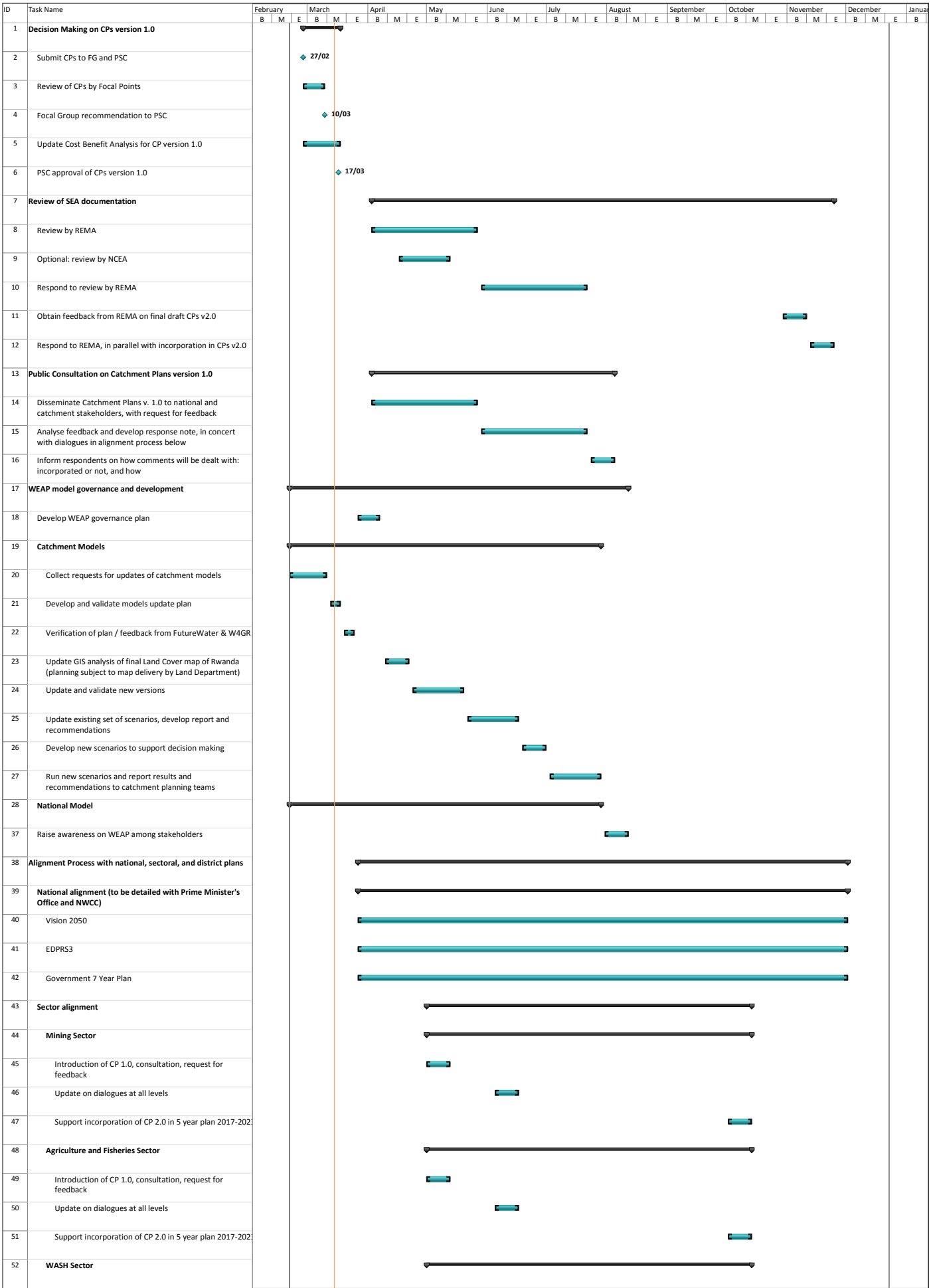
Summarizing the outcomes, the group came to a selection of three SDGs, which were indicated as most important for identification and formulation of the vision of the catchment. SDG 15: Ecosystems protection, combating desertification and reverse of biodiversity loss: SDG 6: Ensure availability and sustainable management of water and sanitation for all. SDG 2: End hunger, achieve food security improved nutrition, and promote sustainable agriculture.

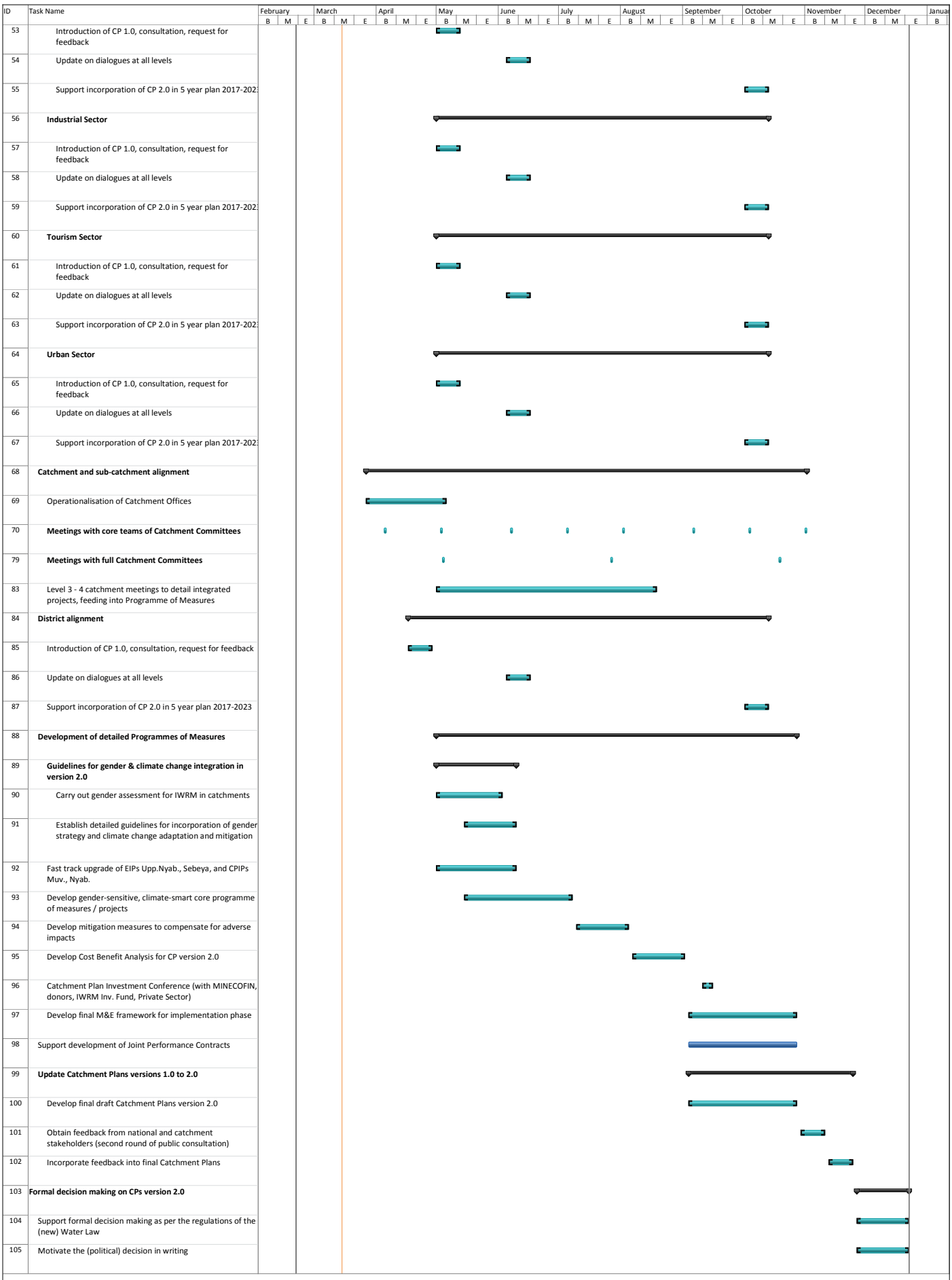
Participants considered the value of ecosystem and biodiversity management as most important for the catchment vision. The outcomes of the main issues and opportunities of session 1 are addressed in this value; soil erosion caused by poor agriculture practices and lack of anti-erosion measures, deforestation

caused by wood energy use and land use change for settlements; flooding and landslides. Sustainable management of water and sanitation for all and food security are also addressed as important issues but not as highly important as the value of ecosystem protection.

Annex 6. Roadmap 2017 – alignment and endorsement of the Catchment Plan

The Gantt chart on the following pages presents the roadmap for the full process of alignment, quality review, and endorsement of the final catchment plan 2018-2023. A final roadmap will be developed jointly with the plan partners.


ID
Task Name
February
March
April
May
June
July
August
September
October
November
December
1 Decision Making on CPs version 1.0
2 Submit CPs to FG and PSC
27/02
3 Review of CPs by Focal Points
4 Focal Group recommendation to PSC
10/03
5 Update Cost Benefit Analysis for CP version 1.0
6 PSC approval of CPs version 1.0
17/03
7 Review of SEA documentation
8 Review by REMA
9 Optional: review by NCEA
10 Respond to review by REMA
11 Obtain feedback from REMA on final draft CPs v2.0
12 Respond to REMA, in parallel with incorporation in CPs v2.0
13 Public Consultation on Catchment Plans version 1.0
14 Disseminate Catchment Plans v. 1.0 to national and catchment stakeholders, with request for feedback
15 Analyse feedback and develop response note, in concert with dialogues in alignment process below
16 Inform respondents on how comments will be dealt with: incorporated or not, and how
17 WEAP model governance and development
18 Develop WEAP governance plan
19 Catchment Models
20 Collect requests for updates of catchment models
21 Develop and validate models update plan
22 Verification of plan / feedback from FutureWater & W4GR
23 Update GIS analysis of final Land Cover map of Rwanda (planning subject to map delivery by Land Department)
24 Update and validate new versions
25 Update existing set of scenarios, develop report and recommendations
26 Develop new scenarios to support decision making
27 Run new scenarios and report results and recommendations to catchment planning teams
28 National Model
37 Raise awareness on WEAP among stakeholders
38 Alignment Process with national, sectoral, and district plans
39 National alignment (to be detailed with Prime Minister's Office and NWCC)
40 Vision 2050
41 EDPRS3
42 Government 7 Year Plan
43 Sector alignment
44 Mining Sector
45 Introduction of CP 1.0, consultation, request for feedback
46 Update on dialogues at all levels
47 Support incorporation of CP 2.0 in 5 year plan 2017-202
48 Agriculture and Fisheries Sector
49 Introduction of CP 1.0, consultation, request for feedback
50 Update on dialogues at all levels
51 Support incorporation of CP 2.0 in 5 year plan 2017-202
52 WASH Sector
Project: 20170310 CP plan proces
Date: Wed 15/03/17
Task
Split
Milestone
Summary
Project Summary
External Tasks
External Milestone
Inactive Task
Inactive Milestone
Inactive Summary
Manual Task
Duration-only
Manual Summary Rollup
Manual Summary
Start-only
Finish-only
Deadline
Progress



Project: 20170310 CP plan proces
Date: Wed 15/03/17

Task	Project Summary	Inactive Milestone	Manual Summary Rollup	Deadline
Split	External Tasks	Inactive Summary	Manual Summary	Progress
Milestone	External Milestone	Manual Task	Start-only	
Summary	Inactive Task	Duration-only	Finish-only	