



IWRM Programme Rwanda

TR22 - Catchment Plan Sebeya 2017-2023

March 2017



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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	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
MIGEPFOP	Ministry of Gender and Family 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 Sebeya

The Sebeya catchment (Figure 1) is the largest of the catchments in western Rwanda, which discharge into Lake Kivu. The area is among the most upstream sub-catchments of the mighty Congo River Basin. Originating in the mountain ridge of the Congo-Nile divide, the catchment combines valuable natural ecosystems, such as the Gishwati National Park, with the densely-populated area along the national road from Musanze to Rubavu, and further to the Democratic Republic of the Congo. The Catchment Task Force highly value the catchment's ecosystem services.

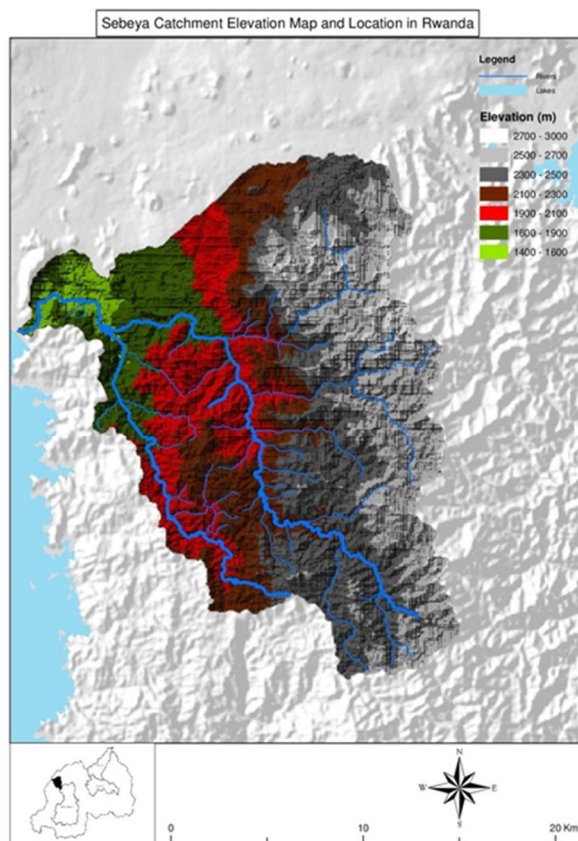


Figure 1: Sebeya catchment altitude map and geographic location in Rwanda

Home to some 250,000 inhabitants – a mainly rural population – the catchment enjoys abundant water resources that are used for a variety of purposes: drinking water supply (including the out-of-catchment town of Gisenyi, which gets its water mostly from Sebeya River), agriculture, hydropower, and mining to mention just a few. But this is going to change. Developments beyond the control of water managers, such as population growth, climate change, and macro-economic development, gradually but clearly lead to increased water demands, and subsequently to water shortages (Figure 2) that may hamper economic development and jeopardize food security and energy security.

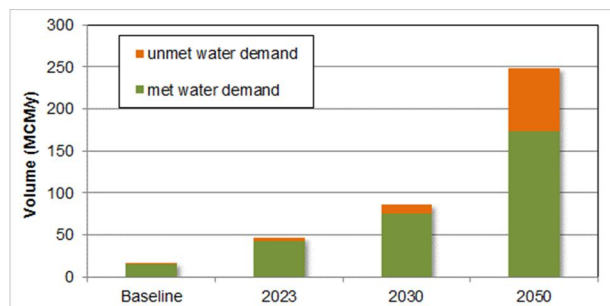


Figure 2: Projections of met water demand and unmet water demand (water shortages) up to 2050, if no measures are taken

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, in uphill areas), there is no time to waste in the implementation of the catchment plan. Climate change impacts are already occurring in Rwanda – 2016 faced numerous climate change related problems such as long drought in the east, and delayed planting seasons everywhere. 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 Sebeya catchment. One IIF project has already been started up in the catchment: The Early Implementation Project on landscape rehabilitation and land husbandry in a few sectors of Rubavu and Rutsiro Districts.

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 by expert judgement were refined.

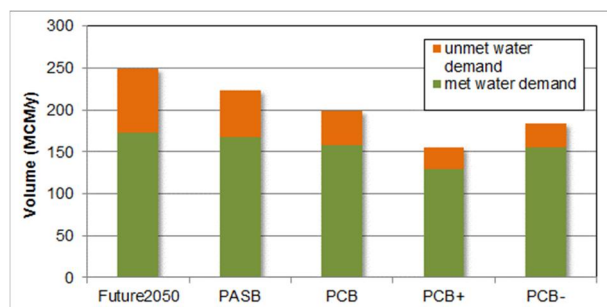


Figure 3: Simulated met and unmet water demand in different alternatives¹

The ‘Planning by Catchment Boundaries plus’ (PCB+) alternative (see footnote) was selected as preferred alternative for Catchment Plan version 1.0 as the result of the multi-criteria assessment. This alternative is based on planning at catchment level, but with extra strong focus on climate change resilience, water efficiency, and soil water capacity, which enhances the capture and utilisation of rainwater on the hillsides and to replenish groundwater.

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 and which will present a final preferred alternative, must 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 Sebeya 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 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

¹ Legend: 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.

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 plan implementation modalities.

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 Sebeya catchment, a level 2 catchment within the larger level 1 Lake Kivu catchment. Located on the Western flanks of the Congo-Nile divide, the Sebeya and Lake Kivu catchments are part of the most upstream parts of the Congo River Basin, with its ultimate outflow into the Atlantic Ocean.

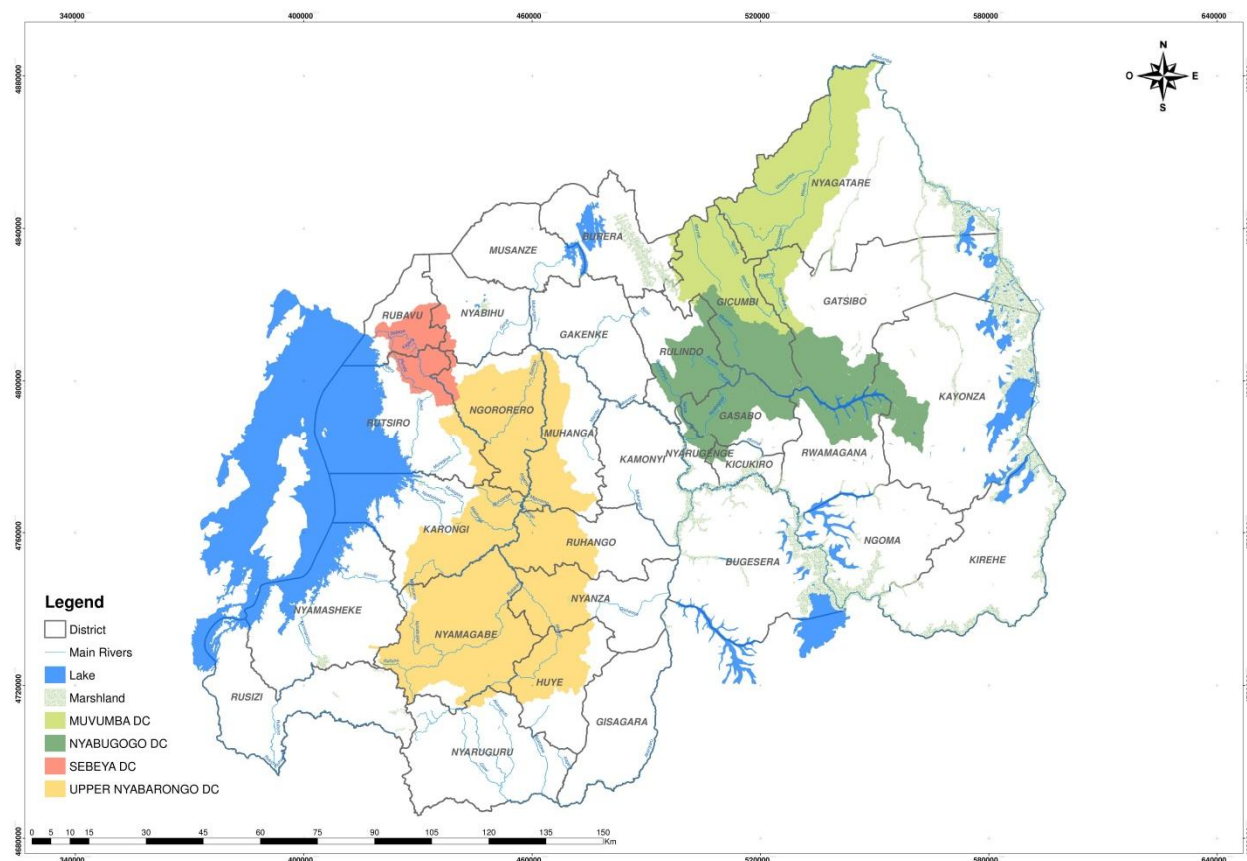


Figure 5: Demonstration catchments of Water for Growth Rwanda

The development process for the Sebeya 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 Sebeya catchment is part of the Congo-Kivu (level 1) catchment in the upper part of the Congo basin. It is one of the larger of many small (level 2) catchments that drain the western slopes of the Nile Congo watershed in the western part of Rwanda. The total surface area of the Sebeya catchment is 336.4 km², which represents 1.38 % of the total surface area of Rwanda (26 338 km² including water bodies). The length of the Sebeya River is 48.39 km and it runs in a north-westerly direction from a maximum altitude of 2 660 meter above sea level (masl) on the Nile Congo basin watershed into Lake Kivu at an altitude of 1 470 masl. Almost 80% of this land (particularly in the east of the catchment) is of high altitude (above 2000 masl), peaking at 2950 masl. The outflow of the catchment is at 1470 masl altitude, where the Sebeya river discharges into Lake Kivu. See Figure 6 for a map on the typology of the Sebeya catchment.

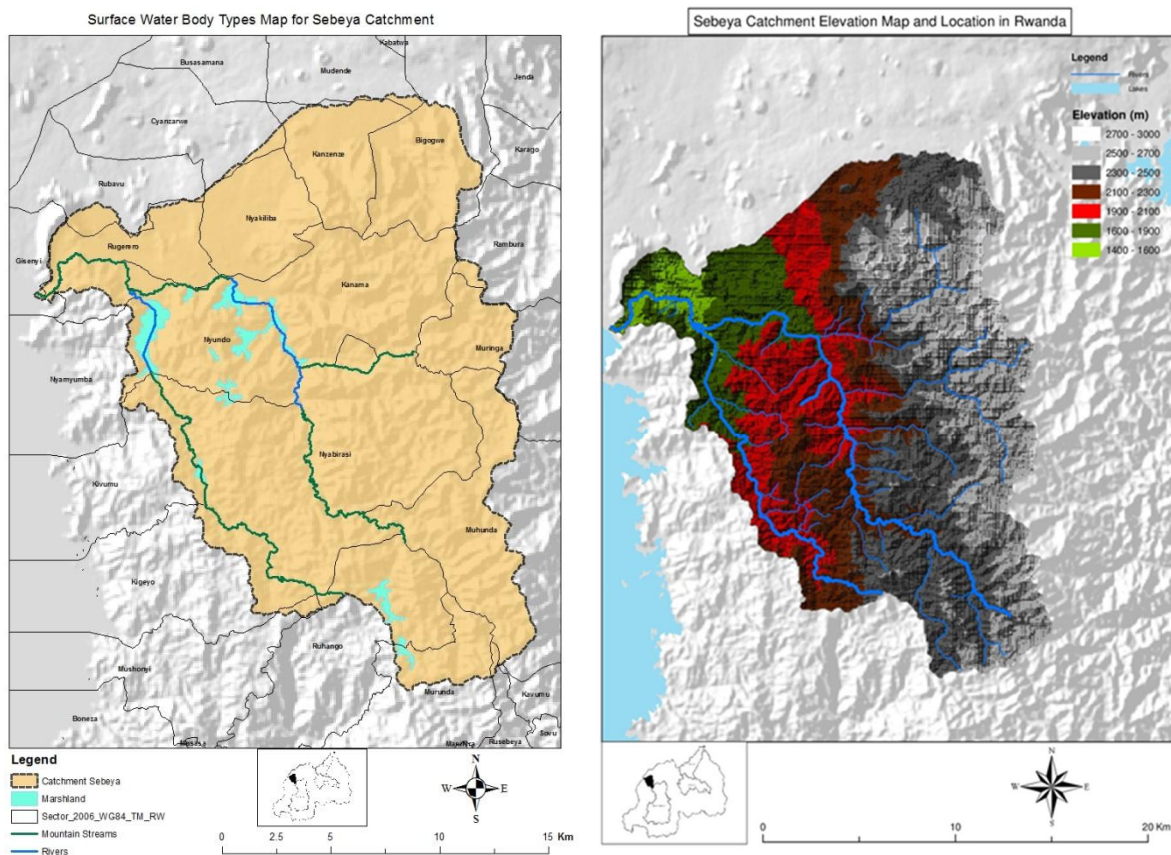


Figure 6: Typology of main water bodies and elevation map of Sebeya catchment

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 7, along with selected main infrastructure for ease of the reader's understanding of the map.

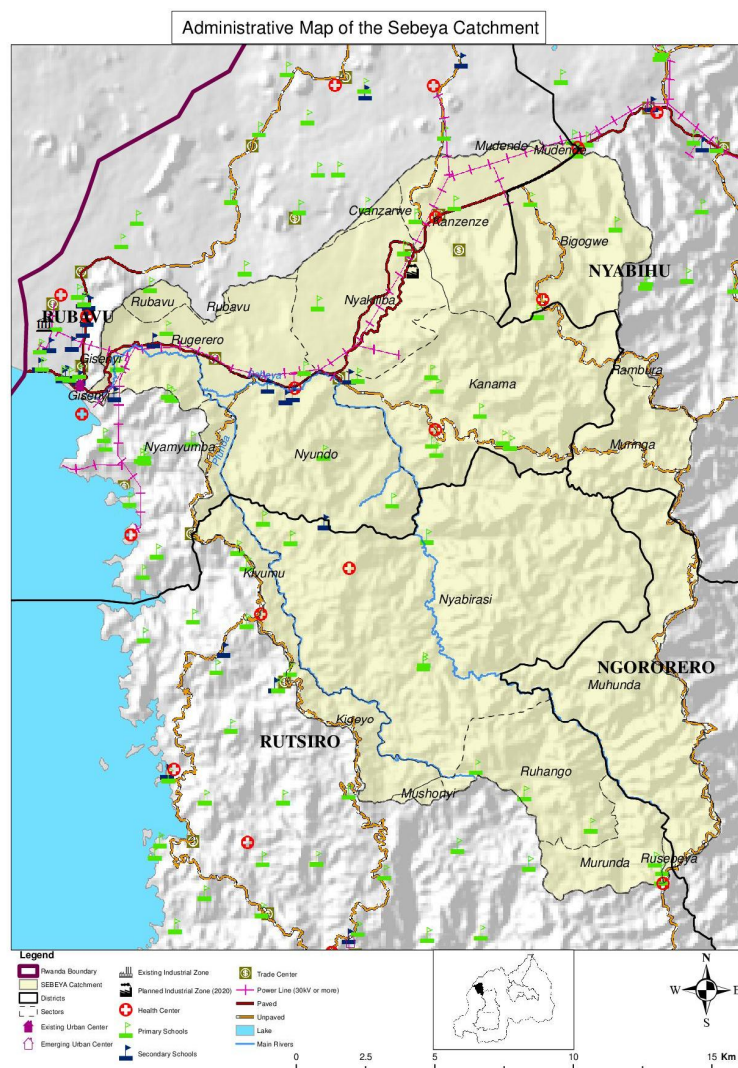


Figure 7: Overlay of administrative and hydrological (catchment) boundaries

Table 1: Overlay of districts and catchment surface areas

Catchment		District		Overlap between district & catchment		
Name	Area km ²	Name	Area km ²	Area km ²	% catchment	% district
Sebeya	363	Ngororero	679	37	10	5
		Rutsiro	1,157	139	38	12
		Nyabihu	532	38	11	7
		Rubavu	388	150	41	39
Total:				363	100	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 2020³ and the second Economic Development and Poverty Reduction Strategy (EDPRS2)⁴ 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 1.3.6.

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 8. They are further listed side by side with the SEA process steps in Annex 2. An integrated (IWRM-cum-SEA) catchment planning process is presented in Section 1.3.2 below.

³ Republic of Rwanda, Ministry of Finance and Economic Planning, Vision 2020, 2000/2012

⁴ Republic of Rwanda, Ministry of Finance and Economic Planning, Economic Development and Poverty Reduction Strategy II, 2013

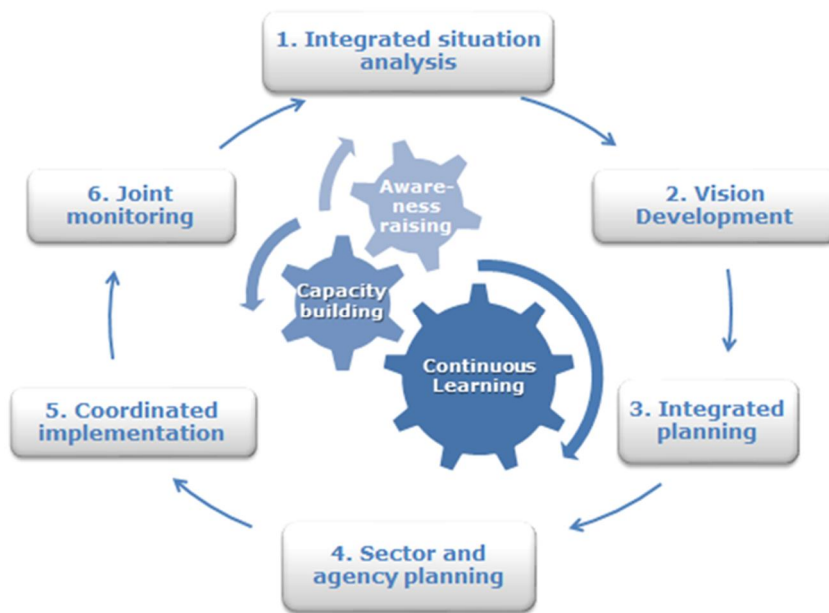


Figure 8: IWRM planning cycle, with integrated elements of capacity strengthening

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 February 7th in Rubavu) 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 February 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. A first so-called Early Implementation Project is already under implementation in Rubavu and Rutsiro Districts. 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 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 by competent authorities, within boundaries set by catchment plan

Step	Details
implementation	§ 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 9) 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 or 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.

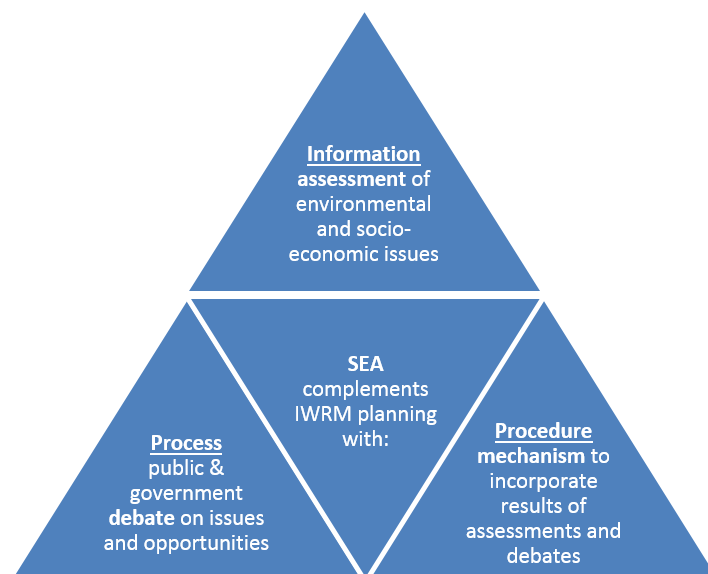


Figure 9: Added value of SEA to the catchment planning process, through information, process, and procedure (Source: NCEA⁵)

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 Growth⁶. 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) 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 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.

⁵ 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.

⁶ Water for Growth Rwanda, 2017, TR10 – Gender Strategy

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 is 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 Rwanda⁷ 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 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

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.

(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 characteristics

Except for the northern fringe of the catchment which is located in the lave region, the catchment features a dense drainage network with steep slopes draining predominantly mature, deeply weathered soils with high infiltration rates. The catchment watershed is dominated by a granite basement aquifer, with a highly permeable volcanic and basalt layer in the north. The granite aquifer has low storage capacity. The volcanic and basalt layer on the contrary has excellent infiltration, storage, and transmission characteristics to the extent that permanent surface water courses are almost absent. Also, the soil characteristics in the Sebeya catchment show the high infiltration rate, the soil characteristics are dominated by deeply weathered, well drained, erodible tropical soils and dark surface layer soils originating from volcanic materials with high infiltration capacity during rainfall. Maps of the lithology and soil characteristics are provided in Figure 10.

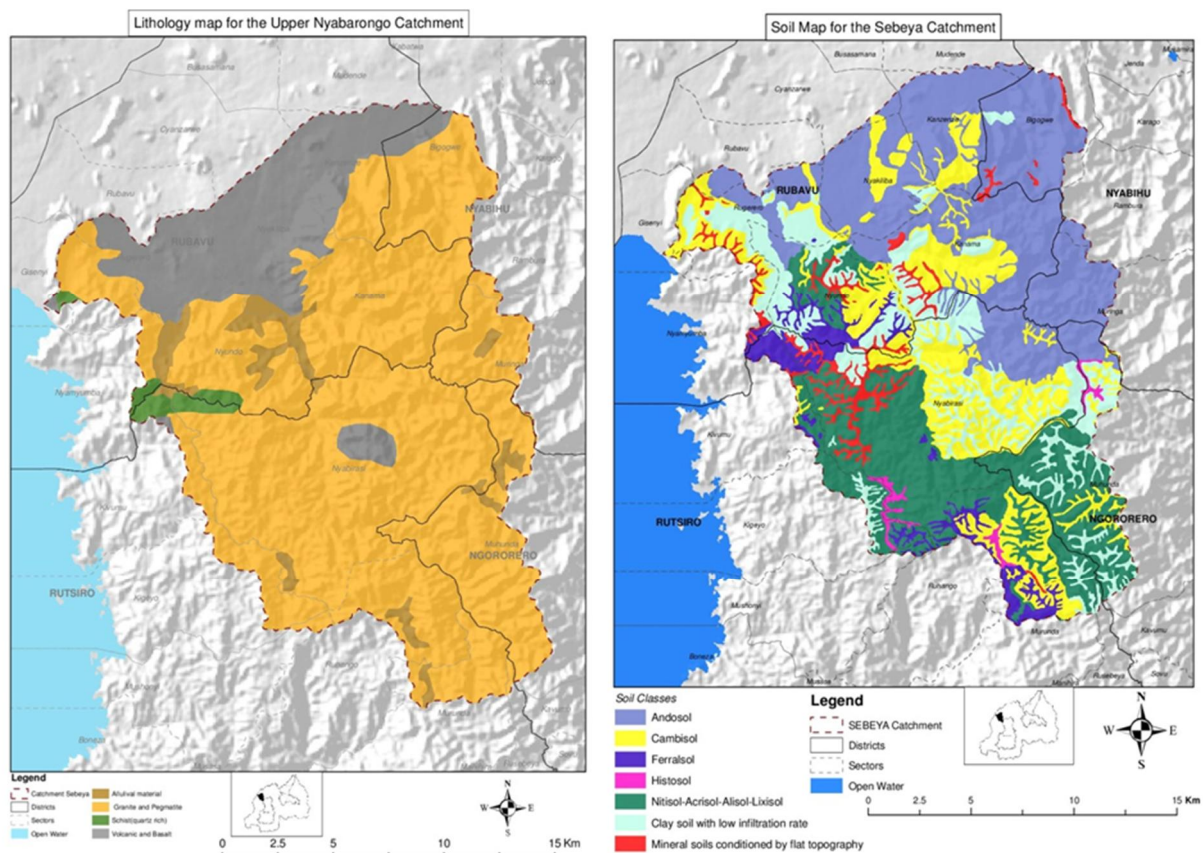


Figure 10: Lithology and soil map of the Sebeya Catchment

2.1.2 Ecology

2.1.3 Climate

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.

2.2 Socio-Economic Analysis

2.2.1 Demography and poverty

Population density is high throughout Rwanda and the Sebeya catchment area (Figure 12) is no exception. There is a significant urban population part (a quarter of the population) located in the northern part of the catchment (sectors Rubavu, Nyakiliba, Rugerero and Gisenyi). The sectors along the shores of Lake Kivu and along the main road from Rubavu to Musanze are still very densely populated with more than 1000 hab./km² while the sectors in the highlands of the south-east show lowest population density in the bracket of 250 to 500 hab./km². The population is young with over 40% of the population younger than 15 and almost 55 % of the population is below 20. The total female population exceeds the male population by about 9 %. The population is predominantly rural (74% pop.). Although there is a significant reduction of the percentage of the extreme poor especially over the last 10 years, still 47% of the population is living in Umudugudu or dispersed housing (30% HH).

Poverty levels among the population in the four districts that have part of their territory in the catchments, are high, particularly in the predominantly agricultural districts of Ngororero and Rutsiro (see Table 3). Access to the national road network is very limited in these districts.

Table 3: Population % identified as poor and extreme poor for the Sebeya catchment

District	District population	
	% poor ⁹	% extreme poor
Ngororero	51.9	29.5
Rutsiro	53.0	26.1
Nyabihu	28.6	11.9
Rubavu	35.8	19.0

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

⁹ The percentage poor population comprises the percentage extreme poor population

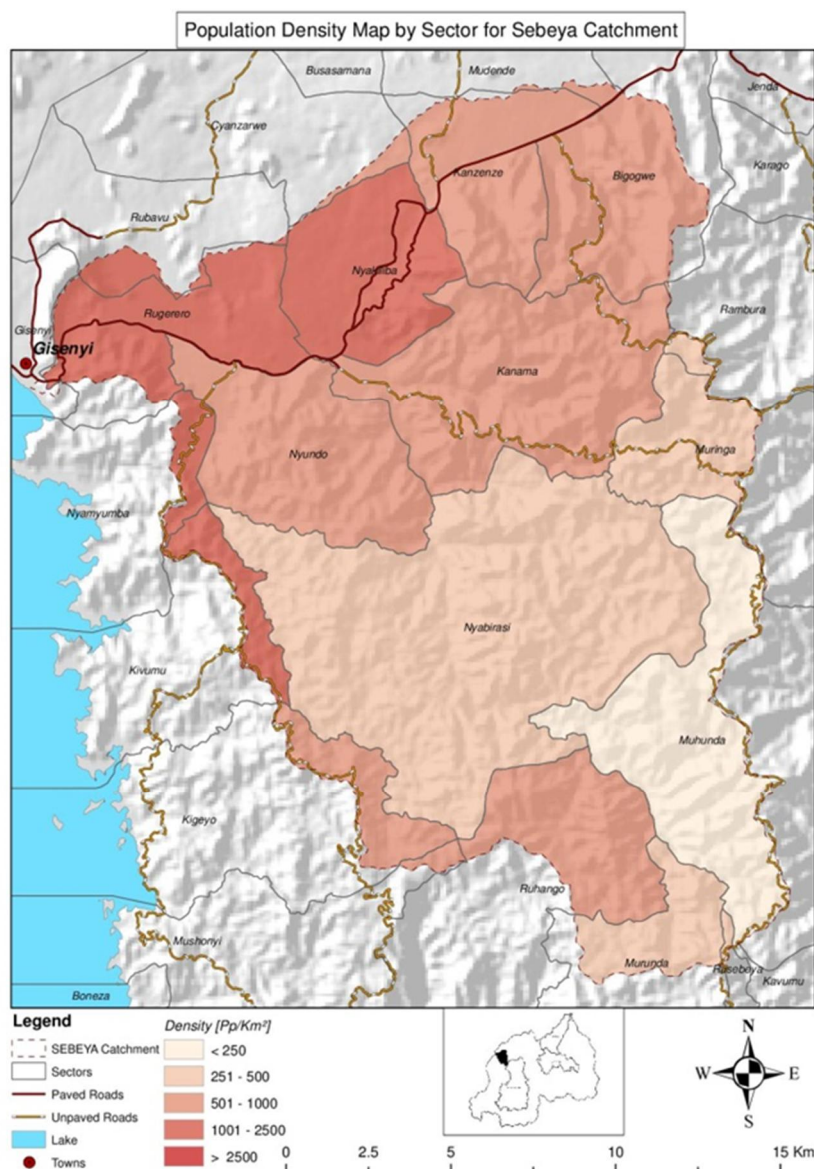


Figure 12: Population density map by sector for the Sebeya Catchment

2.2.2 Economic activities and Infrastructure

Sebeya catchment is strongly reliant on rain-fed agriculture both for rural livelihoods and exports of tea and coffee (90 per cent of the country population is still engaged in agricultural activities). Gishwati forest has been largely converted to livestock grazing land (Nyabihu district being the largest producer of milk in Rwanda). Fisheries development depends on Kivu Lake and is not viewed as a major economic development pillar. Parts of the area of Gishwati - Mukura have recently (2016) been established as National Park; this will help in terms of biodiversity and nature conservation, but will also play a key part in increasing tourism revenues. Sebeya catchment is one of the national Destination Management Areas due to Kivu Lake and the Volcano National Park (including good species of birds). However, many sites remain undeveloped such as the tourist sites in Ngororero district.

Sebeya catchment contains two main rivers: Sebeya and Pfunda. These rivers are the source of water for Gihira water treatment plant, Keya & Sebeya hydropower plants; and indirectly (through WASAC) for the

brewery of BRALIRWA. The catchment includes the district capital of Rubavu (Gisenyi) which is one of the six secondary cities of Rwanda with increasing demands for potable water and energy. Apart from the main paved road, other roads are of varying quality, with the majority vulnerable to damage from heavy rainfall, floods and landslides. There is a significant increase of rural grouped settlements (umudugudu) which facilitates the provision of basic services (WASH - electricity - schooling -healthcare, etc.).

The paved road network is located in the northern part of the catchment along the road axis Rubavu - Musanze. The unpaved road network does not seem very dense which is a clear indication of difficult accessibility. The access to electricity is low (17% of HH) and the majority of households use firewood for cooking (80% of HH). Many sectors in the central and southern part of the catchment show more than 90 % of households using firewood. In sectors with an urban character (Gisenyi, Rugerero, Bigogwe) the use of firewood drops significantly to be replaced by charcoal.

About 80% of the households in Sebeya catchment use a private pit latrine. Households use compost, farm, and bush for waste disposal (90% HH). 75% of the population has access to a public tap or a protected spring for improved source of water supply or unprotected spring or a river for unimproved source of water supply. In comparison with the national data, the Sebeya catchment presents a slightly higher percentage access to improved source of potable water (80% or about 10% better than the national average); with lower than average protected spring and significantly higher public tap. A number of sectors (mainly in the southern part of the catchment) have rather poor access rates (somewhat over 50 % for Muhanda, Ruhango and Murunda). This results in a much higher percentage of insalubrious sources of water supply like unprotected springs and, worse, direct access to river water.

2.2.3 Land use

The principal land use is rain fed agriculture (about 226 km² or 62% of the catchment area) and natural open land which is former Gishwati forest area converted to grazing land. Along with a number of mining sites, these land uses are reputed to generate significant erosion and the extreme sediment charges of the Sebeya River. The catchment features a rather limited area of marshland, most of the marshlands are located in the vicinity of the main road axis. Natural forest and forest plantation area each cover about 11% of the catchment area. The surface area for 'irrigated / agricultural wetland' is not very important and there is no 'natural wetland' land use. Land class data are important 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;
- § rain-fed agriculture;

- [illegible]



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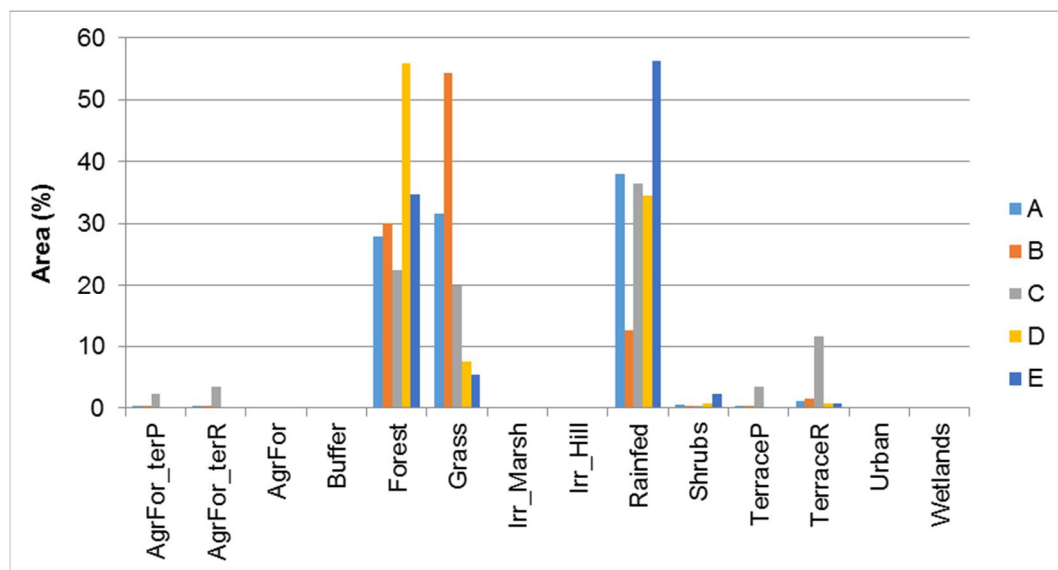


Figure 14: Land cover distribution in the sun-catchments

The role of women is still predominantly played as water user at the household level and the question remains as to how their expertise and demands can be heard when water management decisions at higher echelons are to be taken.

Only one person out of 6 Sebeya Catchment Task Force members, who is at the same time the National Women Council District Coordinator (Ref 13976/16.03/RNRA/05), is a woman and most technical positions at RWAF are filled by men. Furthermore, policy makers, managers and technical in natural resource management staff have limited knowledge on how and why different situations and interests of men and women should be taken into consideration. Nor is there sufficient knowledge on the identification of issues where gender 'blind' planning can have a negative impact on the implementation of development initiatives.

2.2.4 Water use

The current status of water resources monitoring (rainfall, surface water, ground water) is limited. A recent Water for Growth water users' survey in the catchment identified the main water users. 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. The self-estimates of actual water use by these users appear unreliable as of yet.

A water balance and allocation study was carried out by Water for Growth Rwanda in 2016-2017. This study gathered inputs from the NWRMP, augmented with data from the National Institute of Statistics of Rwanda, MINECOFIN, results of the water users survey, and other sources. Based on the results of the water users survey and these other supplementary sources, the following water consumption figures have been derived (in the case of domestic water demand the figures have been raised compared to current Rwandan standards, to be more future proof).

- § rural water demand, 20 litres/cap/day;
- § urban water demand, 80 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, 200mm – 250 mm/ha/year;
- § hillside irrigation, 600mm – 800mm/ha/year;
- § livestock, for each 5 people one animal (excluding chickens) is present. Water consumption was taken as 125 l/head/day;
- § environmental flow requirements, 30% of the surplus or available water resources.

Results of the water balance and allocation study are provided in Section 0. In general terms, consumptive water use in Rwanda is still very limited and is thought to vary between 1-5% of the annual renewable resources per catchment. The current known water demand locations within the catchment are presented in Annex 3 and further detailed in Water for Growth Rwanda's technical report TR28 – Water Users' Survey (January 2017). These demand locations correspond to existing water related infrastructure e.g. irrigation schemes, hydropower dams, mining areas and urban centres.

2.3 Water resources analysis

2.3.1 Hydrology

The hydrological response to rainfall within a catchment is determined largely by land morphology. The Sebeya catchment is a highlands plateau with hardly any land below the 1620 m elevation (Lake Kivu level is about 1470 m). Regarding hydrology, there is a sustained flow during the dry season months (July and August) and a very restrained hydrological response during the small rainy season from the months of September up to December. The large rainy season from February up to May shows a more robust increase of monthly flow levels which indicates that groundwater reserves are finally replenished. This kind of hydrological response is typically caused by significant infiltration and groundwater storage of rainfall along the Sebeya River and its tributaries. The high infiltration rates along with the deeply weathered groundwater holding layers constitute significant groundwater reserves that are difficult to access for large abstractions, but that effectively regulate surface flows in a range from 1 to 2.5 m³/s for most of the year.

Whereas the current status of resources monitoring (rainfall, surface water, ground water) is considered generally insufficient, the data for the Lake Kivu catchment are assumed to be representative for the Sebeya catchment. The NWRMP provide the following conclusion on the water resources availability in the Lake Kivu catchment: *'Both surface and groundwater resources availability are rather constant throughout the year (ranging between 70 and 100% for monthly average values). The resources availability during the once in twenty years' dry year remains at 78% of the resources availability of the average year.'*

Table 4: Historical hydrological monitoring data (Source: NWRMP Exploratory Phase report, 2014)

Station Name	Area km ²	Start year	End year	MQ [m ³ /sec]	MNQ [m ³ /sec]	BFI	Recharge (mm/yr)
Nyundo	214	1976	1997	1.99	1.49	0.75	219
Gisenyi	334	1975	1984	2.76	2.14	0.78	201

In which:

- MQ: mean flow in m³/sec;
- MNQ: mean of all lowest daily flows in m³/sec;
- BFI: base flow index; the ratio of annual baseflow in a river to the total annual runoff;
- Recharge: annual surface flow recharge from groundwater flow in mm/yr.

The Sebeya catchment outflow at Gisenyi is derived from the Nyundo station, which covers about two thirds of the catchment area (214 over 334 km²). The table indicates a high base flow index of the order of 75% for the observed stations which is confirmed in the monthly regime curves which shows sustained flow during the dry season months (July and August) and a very restrained hydrological response during the small rainy season from the months of September up to December. The large rainy season from February up to May shows a more robust increase of monthly flow levels which indicates that groundwater reserves are finally replenished. This kind of hydrological response is typically caused by significant infiltration and groundwater storage of rainfall along the Sebeya River and its tributaries. It should be noted that instantaneous flow levels may be significantly higher than the monthly average flow levels.

The seasonal distribution of discharge intensity is depicted in Figure 15. The significance of the different colours is as follows. Q95 is the average monthly flow exceeding 95% of monthly flow events in m³/sec; similarly, Q65 is the flow exceeding 65% of events, etc.

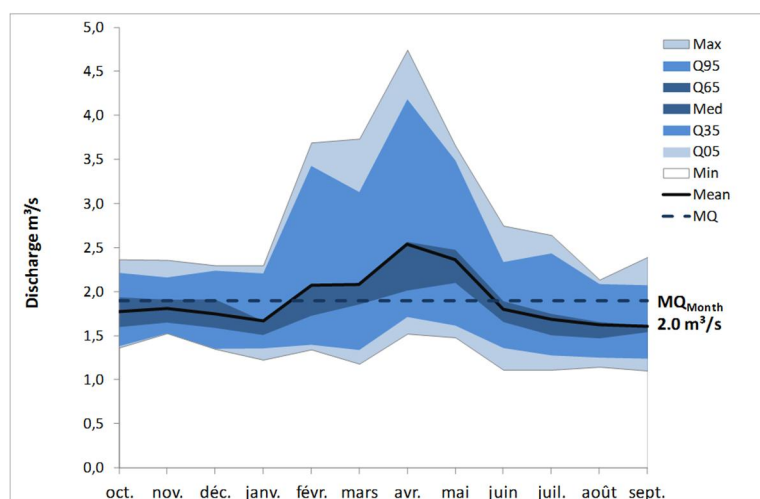


Figure 15: Flow regime curves Nyundo monitoring station on Sebeya River (source: NWRMP Exploratory Phase report, volume of annexes, 2014)

In the above Figure 15, Q₉₅ refers to average monthly flow exceeding 95% of monthly flow events in m³/sec; (similar for Q₆₅ exceeding 65% of events, etc.). Meteorological data, more especially observed flows and rainfall data are essential for purposes of deriving runoff estimates. Some historical data are available for the station at Nyundo, 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 precipitation data set¹⁰.

¹⁰ CHIRPS 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

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 model¹¹ to derive water balance estimates for each of the 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 Nyundo, is illustrated below:

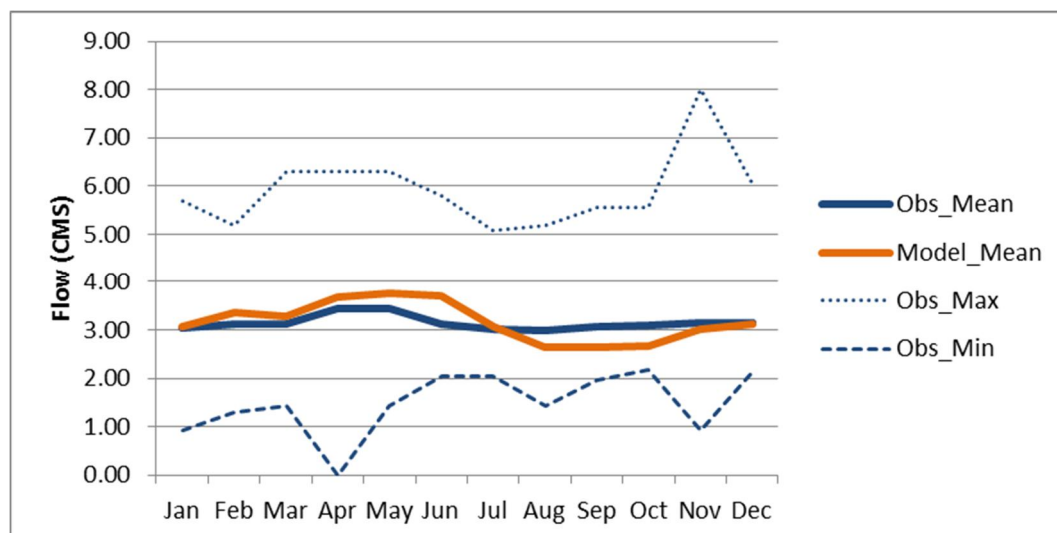


Figure 16: Observed and simulated mean, min, and max flow for station Nyundo

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	471	Evapotranspiration	250
Return flows	11	Withdrawals	15
Storage change	-3	Outflow	100
		Groundwater recharge	113
Total	479	Total	478

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

<http://chg.geog.ucsb.edu/data/chirps/>. 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.

¹¹ Future Water and eLeaf (2017). Water Balance and Allocation Modelling in Rwanda

In	(MCM/y)	Out	(MCM/y)
Runoff	1	Domestic	1
Baseflow	104	Industry	14
Groundwater	1	Irrigation	0
Return flows	11	Livestock	0
		Outflow	100
Total	117	Total	115

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.

2.3.2 Water quality

Systematic monitoring of water quality data in Rwanda has only been taken up recently by the RNRA-IWRM¹² department at a limited number of locations throughout the country. Currently, water quality is monitored at the point where the River Sebeya flows into Lake Kivu. Data analysed from these measurements and findings corroborated from the NWRMP indicate that there are:

- § very high sediment loads and turbidity, due to mining and to traditional farming methods;
- § high loads of e. coli and coliform bacteria (and others not measured) from untreated sewage;
- § high organic loads and high biological oxygen demands (BOD) and chemical oxygen demands and resulting low concentrations of oxygen (mg/L).

Recorded turbidity and TSS values were 1102 NTU and 4414.5 mg/L respectively. All turbidity values recorded are above WHO and RSB drinking water standards (5-25 NTU).

2.4 Stakeholder analysis

A stakeholder analysis was carried out during the scoping workshop in March 2016. Results are presented in Annex 4. Key stakeholders comprise:

- § 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;
- § District authorities, as the main catchment level plan owners, represented by their members of the Catchment Task Force;
- § 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.

¹² RNRA-IWRMD (2017). Semi-annual water quality report 2016/2017

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 to 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. These secondary stakeholders are "indirectly affected" by outcomes. In the catchment, they would be the local Government or constituent districts, NGOs, WASAC, RURA, EWSA, electricity companies (e.g. REG), and others in the basin such as DEMP, LVEMP II, LAFREC. 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 often highly involved in the catchment planning process, and should remain so (or become so) during catchment plan implementation.
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):

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 learnt	Formal meetings lesson learning workshops	Commitment to collaboration on similar projects or activities in the Nile Basin. Contribution towards regional	It is envisaged that the IWRM Catchment Investment Plan will be in harmony with other investment plans for the

Type of stakeholder	Timing of involvement	Type of participation required	Tools for participation and communication	Outcome of involvement	Comments
				environment and economic development goals	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 programmes

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 Sebeya catchment, see Catchment Plan interim report TR13 – 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 agrochemicals, 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 n° 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 agrochemicals, 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. Many farmers and other rural water users, especially women are illiterate which poses a challenge for their involvement in training and service provision that are modelled to benefit literate farmers/water users.

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.

There are serious gender gaps in institutional arrangements in the water sector. Despite women's clear role in day-to-day water management in Rwanda, at the central level women are underrepresented in the ministries and departments that deal with water management (MINIRENA, including Rwanda Water and Forestry Authority/RWAFA, MININFRA, and MINALOC). At the community level, they are underrepresented in decision making related to agriculture, water and sanitation. As illustration, only one person out of 6 Sebeya Catchment Task Force members, who is at the same time the National Women Council District Coordinator (Ref 13976/16.03/RNRA/05), is a woman and most technical positions at RWAFA are filled by men. Furthermore, policy makers, managers and technical in natural resource management staff have limited knowledge on how and why different situations and interests of men and women should be taken into consideration. Nor is there sufficient knowledge on the identification of

issues where gender ‘blind’ planning can have a negative impact on the implementation of development initiatives.

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

2.6.1 Consultation of district priorities

The scoping workshop for the catchment plan of Sebeya, held in March 2016, resulted in a prioritised list of issues and opportunities in the catchment. Participants comprised the members of the Catchment Task Force as well as key representatives of national government (MINIRENA and partner ministries). A district-prioritised overview of issues and opportunities is provided in Table 8, as one of the sources for the development of the catchment plan.

Table 8: Priority issues and opportunities in Sebeya catchment, as scored for priority by the district representatives in the Catchment Task Force (March 2016)

Issues	Score	Opportunities	Score
Mining exploitation increasing siltation to rivers	37	Abundant water	12
- Nyabihu: 7 - Rubavu: 4 - Ngororero: 11 - Rutsiro: 15		- Nyabihu: 1 - Rubavu: 7 - Ngororero: 1 - Rutsiro: 3	
Soil erosion (including riverbank erosion by agriculture & cattle)	31	Tourism	12
- Rubavu: 15 - Rutsiro: 9 - Nyabihu: 7		- Rubavu: 3 - Rutsiro: 9	
Deforestation reducing the soil cover	6	Institutions, rules, regulation available	12
- Nyabihu: 1 - Ngororero: 4 - Rutsiro: 1		- Ngororero: 12	
Soil overexploitation (agriculture and livestock) leading to land degradation	5	Hydropower	8
- Nyabihu: 2 - Ngororero: 1 - Rutsiro: 2		- Rubavu: 4 - Rutsiro: 4	
Insufficient Rainwater harvesting for households	4	Good implementing partners available	6
- Nyabihu: 2 - Rubavu: 2		- Nyabihu: 0 - Rubavu: 3 - Ngororero: 3	
Insufficient cattle drenching places - Ngororero	1	Forest – Nyabihu: 6	6
Inaccessibility – Ngororero	1	Radical terracing - Nyabihu	6
Flooding – IWRMD		Secondary city – Rubavu	5
		Modern grazing area - Nyabihu	3
		Minerals – Rutsiro	3
		Fertile soils – Rutsiro	2

2.6.2 Analysis of main issues and opportunities

Following the main issues mentioned in Table 8, the following causes and possible impacts of the problems can be summarized:

§ Issue: mining exploitation

Causes: inappropriate mining (artisanal)

Impacts: increasing siltation and pollution of rivers

§ Issue: soil erosion and landslides (Rubavu, Rutsiro, Ngororera and Nyabihu)

Causes: Inappropriate mining (artisanal), inappropriate agricultural practices/overexploitation of soil, conversion of forest land to livestock grazing areas (Gishwati), deforestation

Impacts: Siltation to rivers, gullies, reduction in soil productivity, land degradation damages of hydropower plants, destruction of settlements in high risk zones

§ Issue: insufficient provision of water for domestic use and livestock (Ngororero, Gishwati area for livestock)

Causes: Lack of investment, poor management, scattered settlement

Impacts: Water borne diseases, high cost of water, river bank destruction by livestock, water pollution

§ Issue: flooding (Rubavu (Kanama & Nyundo sector)

Causes: High rainfall, steep slopes, reduced infiltration due to bad agricultural practices, clogging of caves, insufficient room for river

Impacts: Road and bridges destruction, river bank destruction, destruction of crops

An analysis of the opportunities mentioned by the districts, and confirmed by the representatives of national government, reveals that Sebeya catchment is blessed with rich natural resources and abundant rainfall. Despite the risks that the rains pose through flooding, soil erosion, and landslides, the positive impact of the high rainfall is that agriculture and natural ecosystems are very productive. Moreover, the steady base flow of the main river Sebeya provides good opportunities for hydropower and abstractions for water supply to households, farms, and industry. Nature is a key attraction in the catchment, which could be exploited more for tourism.

2.7 Ongoing Catchment Management Initiatives at National and Local Level

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

- § initiatives to reverse land degradation through sustainable use of land resources and agroforestry systems;
- § initiatives to manage floods and landslides;
- § initiatives to manage solid waste and sewerage facilities;
- § initiatives to increase coverage of safe water and sanitation facilities.

2.7.1 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 watershed management protection initiatives under LVEMP II include establishing radical and progressive terraces on hillside areas, agroforestry, protection of

riverbanks, lakes and wetlands, funding of small community driven projects among others with a focus on 12 priority districts in the Lake Victoria Basin in Rwanda. The projects within the Sebeya are in Ngororero.

2.7.2 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.

The project will enable MINIRENA/REMA to fulfil its mandate and effectively implement environmental policies, as well as develop management and operational tools such as EIA guidelines and procedures, SEA training, and environmental awareness educational materials, in addition to in-house capacity building e.g. GIS. The project will also support sustainable livelihoods initiatives by implementing environment priorities identified in the Districts by using innovative practices (e.g. improved cooking stoves, soil conservation technologies, etc.), and by building public-private-civil society sectors in integrating conservation and development and targeting communities in/ around protected areas where degradation threatens livelihoods sustainability.

DEMP has contributed to improving productivity and sustainability of key sectors including land, water resources management and agriculture within the demonstration catchments in all Districts of Western Province.

2.7.3 Landscape Approach to Forest Restoration and Conservation (LAFREC)

The Landscape Approach to Forest Restoration and Conservation (LAFREC) for Rwanda was designed to restore and maintain critical landscapes in Rwanda that provide environmental benefits and contribute to enhanced resilient economic development and livelihoods. Project start-up was January 2015 and implementation is envisaged over 5 years to December 2019. It's source of funding is the Global Environment Facility (GEF) and the Government of Rwanda. The programme is implemented by REMA with support from MINIRENA.

Within the area, drained by ebeya, the project area covers the districts of Ngororero and Rutsiro within the Giswati forest area – Mukura landscape. Implementation was centred around rehabilitating forests and biodiversity within the Gishwati and Mukura Forest Reserves, enhancing sustainable land management in the agricultural lands between them, and introducing silvo-pastoral approaches in the rangelands of the central former Gishwati Reserve. These interventions are to be complemented by livelihoods diversification and the establishment of flood warning and response systems, that will further enhance climate resilience within one of the most disaster-prone areas of Rwanda.

Environmental benefits from improvements in vegetation cover and soil conservation will come in the form of: (i) improved native biodiversity within a global priority ecoregion; (ii) carbon sequestration; (iii) improved watershed function, reducing sedimentation and related costs to downstream water

infrastructure and fisheries; and (iv) higher productivity and diversity of natural-resource-based livelihoods.

Within the area, drained by Sebeya, the project will particularly focus on establishing an EWS through the introduction of operational precipitation and flood forecasting. This is a multi-sectoral activity which will be a joint effort of the Rwanda Meteorology Agency (RMA, responsible for development of precipitation forecasts, including utilization of data from a Doppler radar that will be installed soon, and issuing warnings to authorized government and municipal authorities), RWFA (real time stream gauging, flood modelling and forecasting), and MIDIMAR (issuing warnings to public, guiding mitigation activities) and local authorities/communities.

2.7.4 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 Western Provinces. PAREF is funded by the Belgian Technical Cooperation (BTC) and the Netherlands government and implemented by RWFA. 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 RWFA for their medicinal products and role in conserving biodiversity. The interventions of PAREF within the catchment located are predominantly in Rubavu, Nyabihu, Ngororero and Rutsiro. The dominant species which have been planted are *Eucalyptus ssp*, *Alnus acuminata* and *Acacia melanoxylon* which adapt well in highland regions.

2.7.5 Reducing Vulnerability to Climate Change by Establishing Early Warning and Disaster Preparedness Systems and Support for Integrated Watershed Management in Flood Prone Areas (LDCF)

The project "Reducing Vulnerability to Climate Change by Establishing Early Warning and Disaster Preparedness Systems and Support for Integrated Watershed Management in flood prone areas (Rwanda LDCF)" was implemented by the United Nations Environment Programme (UNEP) and the United Nations Development Programme (UNDP) in collaboration with the Government of Rwanda's (GOR) through Rwanda Environment Management Authority (REMA). The project was implemented from 1 October 2010 to 31 December 2014, and received a no cost extension up to 30 June 2015 enable the completion of a few ongoing activities. The goal of the project was to contribute to climate change risk and flood disaster preparedness in Rwanda. The project had four components (1) Climate risk assessment and forecasting; (2) Climate change adaptation planning and response strategy; (3) Reduction in the adverse effects of floods and droughts; and (4) Knowledge of good practices to reduce vulnerability to climate change based on the Gishwati pilot.

Under component 1, a modern and fully functional Early Warning System (EWS) was put in place and is already delivering climate information and early warnings. In addition, the human (training) and

institutional (Meteo Rwanda) capacity was strengthened to effectively utilise the hydro-meteorological network and to conduct climate risk assessment and forecasting. Cluster computers were installed in Meteo Rwanda and seven modern automated weather stations were put in place in the four pilot districts. These weather stations are fully operational. Through the LDCF project and co-financing from UNDP Africa Adaptation Program (AAP), a network of 22 automated weather stations was established across the whole country. A communication and outreach mechanism was agreed upon through which Meteo Rwanda would issue and send forecasts and warnings three times daily by email and SMS to stakeholders, districts and communities.

Under component 2, climate sensitive land use plans were developed and District Development Plans (DDPs) of the four pilot districts (Nyabihu, Ngororero, Rubavu and Rutsiro districts) were climate proofed. Under component 3, climate resilient land use practices were implemented in Gishwati region. A total of 1,373 hectares of degraded land was rehabilitated through tree planting, agro-forestry and establishment of graded and radical terraces. Land rehabilitation was also extended to river banks protection for river. The project put in place and demonstrated alternative livelihood projects, including, mushroom production, bee keeping, poultry and piggery implemented through community cooperatives. Under component 4, village leaders, disaster management committees, communities and farmers were trained in climate resilient practices.

2.7.6 Rwanda's Rural Drinking Water Supply and Sanitation Sub-Program (PNEAR II)

Access to safe water within the catchment is low and ranges from 42.3% in Rubavu to 53.2% in Nyabihu (Table 9). This is ironic given the abundance of water availability. The situation is attributed to poorly developed water supply infrastructure.

Table 9: Access to safe water (MININFRA, 2015)

District	2012 water coverage rate (%)
Rutsiro	49.4
Rubavu	42.3
Nyabihu	53.2
Ngororero	51.0

Existing rural water supply infrastructure is dilapidated and needs to be rehabilitated. Ongoing projects that still require supplementary funding include:

- § rehabilitation and extension of Mbona-Nyabirasi –Kivumu WSS (691.2m³/day);
- § rehabilitation and reinforcement of AEP Mukura – Nyabirasi- Kivumu (345.6 m³/day);
- § reinforcement and extension of Mbona – Nyamyumba WSS (259.2m³/day)/ WASH;
- § reinforcement of Gihira water treatment plant.

2.7.7 Early Implementation Projects EIPs under the Water for Growth Programme

Early Implementation Projects (EIPs) in the demonstration catchment areas will be implemented at the beginning of the year 2017 in order to address urgent needs of the sector, ahead of the official development and endorsement of the 4 Catchment Plans for the 4 DCs. In Sebeya catchment, the targeted area is of approximately 968.6 hectares, located in Rubavu and Rutsiro, within three adjacent sectors namely Nyundo, Nyabirasi and Kanama. The location and illustration of the interventions to be

undertake are illustrated under Figure 17 and Figure 18 below. The EIPs are designed to reduce soil erosion by protection the land through interventions promotion of Agroforestry, construction of Progressive, bench and narrow cut terraces, re-afforestation, river and reservoir buffer zone protection and gully rehabilitation.

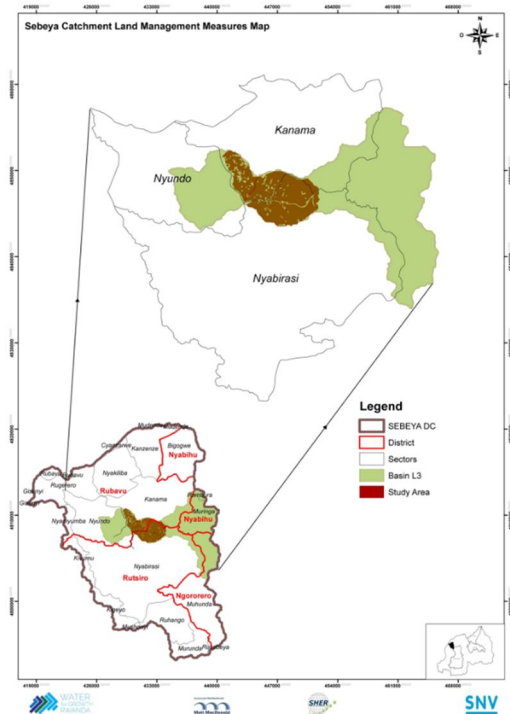


Figure 17: Location of, EIP within Sebeya catchment

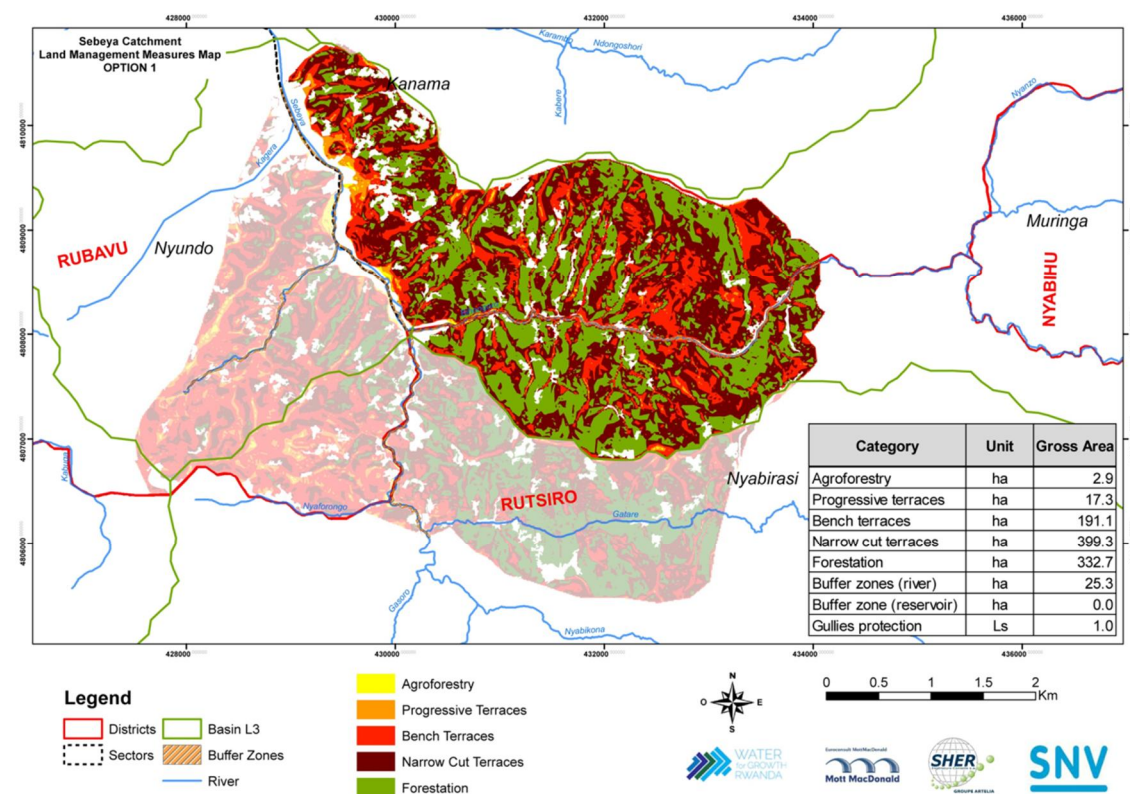


Figure 18: Land management measures of the Sebeya catchment first Early Implementation Project

3. The catchment management plan

3.1 Introduction

The current document constitutes the Catchment Plan – version 1.0 – for Sebeya. 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 issues¹³. Hence the following guiding principles are taken into account in the process of formulating the catchment plan:

1. **Equity** - Unequal access to or control of environmental resources are to be addressed in order to avoid negative effects and/or to enrich opportunities for mitigation. 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. Since men and

¹³ National Policy on Water Resources Management, 2011

women at household and community level have different roles and constraints in use and management of resources; they have to be involved as well in their own right.

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 the scoping workshop in May 2016 a broad range of catchment stakeholders reached a common understanding of the water and land resources issues and opportunities and put forward what should be addressed and achieved in the future for the Sebeya catchment, taking the United Nations (UN) Sustainable Development Goals (SDGs) as a starting point (see Annex 6 for details). Summarizing the outcomes of the exercise, key aspects mentioned for catchment vision were the following:

- § ecosystem and biodiversity management (= sustainable land management), focus on sustainable use of land and fresh water ecosystems, reduce disasters;
- § water supply and sanitation, quality, and management of water, focus on integrated water resources management;

§ food security, focus on sustainable agricultural production.

Participants considered the value of ecosystem and biodiversity management as most important for the Sebeya catchment vision. The main issues and opportunities are well addressed in this value. Prevention of deforestation, erosion and flooding are typical measures within ecosystem restoration and sustainable land management.

Experts from the IWRM Department and Water for Growth's consultants subsequently discussed and synthesized the workshop messages and outcomes in a series of work sessions, then formulated an agreed vision for the Sebeya catchment as follows:

A well-managed catchment, that is home to prosperous communities, living in harmony with nature and drawing social and economic benefits from water and environmental resources.

3.2.3 Objectives

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

To effectively manage land and water resources to contribute to sustainable socio-economic development and equitably improved livelihoods.

Specific objectives

1. to strengthen land protection and conservation, and river bank protection to reduce vulnerability to flooding and landslides;
2. ensure sustainable access to water for domestic and livestock consumption;
3. to ensure equitable and efficient allocation of water resources to all users within the catchment;
4. strengthen the water governance framework to ensure effective implementation of integrated programmes.

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, gully 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 availability to authorized users and improvement of how the infrastructure developed in the process is operated and maintained. An example under this strategic area would be the increased investment for water supply infrastructure (irrigation facilities, micro hydropower plants etc.).
3. **Water sharing for equity and development** – This area is less important in a water-rich catchment like Sebeya. 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 Sebeya catchment, the disasters identified are those related to occurrence of landslides and floods. Measures may include prevention, such as better land use planning (taking flood risks and risks of landslides into account) as well as mitigation measures, such as improved dissemination of early warnings 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 10 and Table 11 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 10: Programme of Measures of alternative 'Planning by Administrative and Sectoral Boundaries' (PASB)

Measure	Location	Size / Magnitude
River Buffer zone protection by SEBEYA Project (RNRA) in Rubavu district (Kanama and Nyundo sectors)	Rubavu District	57 km
Afforestation by PAREF NL I and II	Rubavu: (Kanama, Nyundo, Nyakiliba and Rugerero sectors)	229.5 ha
Developing terracing and agroforestry by GWLM and PAREF NL II	Nyabihu (Bigogwe), Rubavu (Cyanzarwe, Rubavu & Kanama)	243 ha
Agroforestry by PAREF NL II	Rutsiro (Nyabirasi & Kivumu sect.) & Rubavu (Rubavu sect.)	358 ha
Developing terracing and agroforestry by LAFREC	Rutsiro (Murunda sect.)	205 ha
Radical Terracing LWH and GWLM and Agroforestry by LAFREC and PAREF NL II	Nyabihu (Muringa & Bigogwe, Rambura sect.), Rutsiro (Nyabirasi & Murunda sect.), Rubavu (Kanama sect.)	1395 ha
Afforestation by LAFREC, PAREF NL I and II	Rutsiro (Ruhango, Murunda & Nyabirasi); Rubavu (Kanama, Kanzenze, Nyakiliba, Rugerero & Nyundo); Nyabihu (Muringa, Bigogwe & Rambura) + Ngororero (Muhanda)	2172.5 ha
Silvopastoralism (forestry & grazing of domesticated animals) by LAFREC	Rutsiro (Nyabirasi sect.) and Nyabihu (Bigogwe)	140 ha
IDP model village (under implementation)	Muhira cell, Rugerero sector, Rubavu district	
River Buffer zone protection by SEBEYA Project by RNRA)	Rubavu district (Nyundo & Rugerero sectors)	23.5 km
River Buffer zone protection by LAFREC and SEBEYA Project by RNRA	Rutsiro (Murunda sect.) and Rubavu (Kanama, Nyundo, Gisenyi & Rugerero sect.), Ngororero (Muhanda sect.)	80.3km
Silvopastoralism by LAFREC	Rubavu (Kanama), Nyabihu (Bigogwe), Ngororero (Muhanda), Rutsiro (Nyabirasi)	393.75 ha
Tea plantations	Nyabihu (Rwanda Mountain Tea Muringa/Nyabihu + Pfunda)	
Kagohe WSS	Nyabihu (Bigogwe sect.)	
Mizingo-Mutura WSS	(Bigogwe), Rubavu (Kanzenze, Cyanzarwe, Rubavu)	
Mbona-Nyamyumba water supply system	Rutsiro (Nyabirasi & Kivumu sect.)	123km
Gihira Water Treatment plant	Rubavu district	4024 CM/day
Various public rural water supply systems (Rutsiro-Musasa-Boneza-Mushonyi & Nyabirasi-Kivumu)	Rutsiro district	123 km
Yungwe - Bikore Water Treatment Plant	Rubavu (Kanama, Nyakiliba, Rugerero, Nyundo, Rubavu)	
Development of rainwater infrastructures at HH and public institutions	Nyabihu & Rubavu districts	
Existing of Hydropower plants of Gisenyi & Gihira	Rubavu district	2.4 MW
Arusha and Mizingo Milk Collection Centers (MCC)	Nyabihu (Bigogwe) and Rubavu (Kanzenze)	

Table 11: Programme of Measures of alternative 'Planning by Catchment Boundaries' (PCB)

Measure	Location	Quantity
1. Environmental protection and conservation		
Enhancement of food security through a sustainable land use (new terracing and agroforestry projects on a larger scale with focus on sustainable agricultural practices, trenches, green manure, involving community and support to farmers)	All 4 districts	17,445 ha
Upscaling Afforestation in new areas in line with District land use and Forest Master Plans Pilot incentive schemes to protect forests, i.e. initiatives on beekeeping and Improved Cooking Stoves(ICS)	All 4 Districts	2,913 ha
Land husbandry and landscape rehabilitation (W4GR EIP, integrating agroforestry, terracing, afforestation, etc)	Rubavu and Rutsiro districts	968.6 ha (agroforestry and afforestation areas are included in figures above)
Increase modern agricultural practices (cash crops, biological fertiliser use, diversification of income such as livestock next to crops, build capacity of producer cooperatives)	All 4 districts	TBA
Extend the buffer zone protection, and rehabilitation of marshlands against flooding downstreams, More room for rivers Introduction of leaky weirs/retention ponds	Rubavu & Rutsiro districts Sebeya main river	Area of buffer zone and marshlands protected against flooding to be assessed
Support the implementation of program on sustainable mining practices through recycling of washing water, rehabilitation of old mining sites, Increase of enforcement of the law and awareness raising by government, Diversify & modernise local economy through creation and enhancement of sustainable off-mining employment (i.e. construction of VTCs)	All 4 districts	Concession (ha) of model mining concepts to be assessed
Resilience to landslides, early warning systems for floods and support the construction of green villages that reduce vulnerability to climate change by relocation of population from high risk zones for efficient water service delivery (water, electricity...), land consolidation, and rehabilitating ecosystem	All 4 districts	Number (%) of households relocated from high risk zone to green villages to be assessed
2. Water resources development and management		
Protection of tributaries of Sebeya and Pfunda rivers and rehabilitation of sources (Yungwe, Ntongoshori, Bukeri, Bihongora)	Rubavu & Rutsiro districts	Number of tributaries and sources to be protected to be assessed
Develop and implement water resources protection plans for all WSS, that address storm water management, sanitation systems, erosion and waste water discharge, solid waste management and disposal through Involvement	All 4 districts	TBA

Measure	Location	Quantity
of all stakeholders in policy and strategy formulation; Integrated gender responsive planning; joint monitoring of water resources usage		
Upgrading, rehabilitation & extension of WSS in Nyundo, Nyakiriba, Gisenyi & Kanama sectors	Rubavu district	25.76 km or increase in % of HHs with access to safe drinking water
Reinforcement of RWHS program in Rubavu & Nyabihu districts, and extension and intensification of the program to investment in rainwater tanks in Rutsiro and Ngororero districts	Rubavu, Nyabihu, Rutsiro & Ngororero districts	% of residential houses and public institutions with rain water harvesting facilities (to be assessed)
Rehabilitation and extension of Mbona-Nyabirasi –Kivumu WSS (691.2m ³ /day);	Rutsiro district	TBA
Rehabilitation and reinforcement of AEP Mukura – Nyabirasi- Kivumu (345.6 m ³ /day);	Rutsiro district	TBA
Reinforcement and extension of Mbona – Nyamyumba WSS (259.2m ³ /day);	Rubavu district	TBA
Increase number of boreholes and sustainable instruments to maintain functioning of pumps (implement structure of water user committees at cell level)	Ngororero district	TBA
Rehabilitation of Yungwe and Ntongoshori intakes and their catchments	Rubavu district	TBA
Rehabilitation of infrastructure, water supply in farms by schemes & protection	Nyabihu, Rutsiro & Ngororero districts	To be assessed
Develop tourism facilities linked to ecotourism and water around Gishwati National Park and Kivu lake, And protect natural forest to avoid encroachment	Rutsiro, Rubavu districts (Gishwati national park, Kivu lake)	TBA
Upgrading and Extension of Gihira WTP to increase the production (New Intake on Pfunda, Upgrade existing WTP, reservoirs/tanks)	Rubavu district	Increasing production by 8000m ³
Development of microhydropower plants in rural areas Increase and sustain river flow	Rubavu & other districts	TBA
3. Governance/Community Empowerment		
Awareness raising around sustainable mining, IWRM, sustainable land use	All 4 districts	TBA
Enforcement of the laws and regulations related to environment protection, water, mining etc.	All 4 districts	TBA
Identification and dissemination, to relevant households, of efficient and alternative sources of energy to reduce dependence on biomass fuels and the pressure on natural resources (i.e. Biogas, ICS & LPG, micro-hydropower development, etc.)	Ngororero, Rutsiro & Rubavu districts	Off-farm jobs created to reduce the pressure on natural resources

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 extra strong catchment rehabilitation component

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 force¹⁴. 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 Annex 5.

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.

¹⁴ CTF meeting in Rubavu, 7 February 2017

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 12. The baseline is taken to be the withdrawals for the period 2009 to 2015.

Table 12: 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)	17	1	3	12	5
2023	47	5	4	12	4
2030	86	11	6	11	3
2050	249	76	12	9	3

Table 12 illustrates that water demands and shortages are expected to increase substantially by the year 2013 due to combined impact of population growth and economic development. Significant water shortages (unmet demand) are expected to occur progressively to the year 2050 as water demands increase (Figure 19).

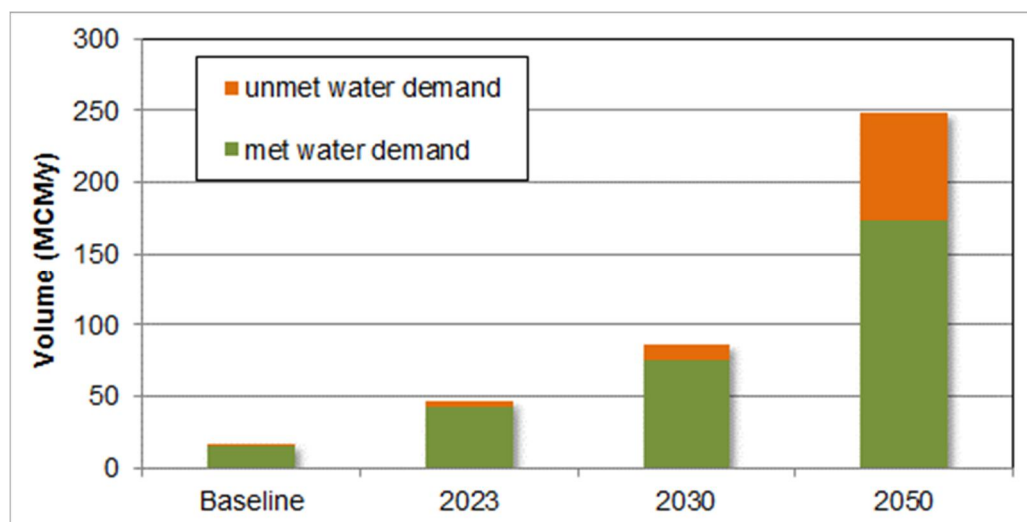


Figure 19: Met water demands and unmet demands (shortages) in the three target years, compared to the baseline (2015), based on the future medium projection

Peak flows will become higher due to the effects of climate change. At the same time will low flows are likely to be lower, leading to severe water shortages. Fast runoff is also likely to increase hence more erosion and increased flooding, are expected in the future.

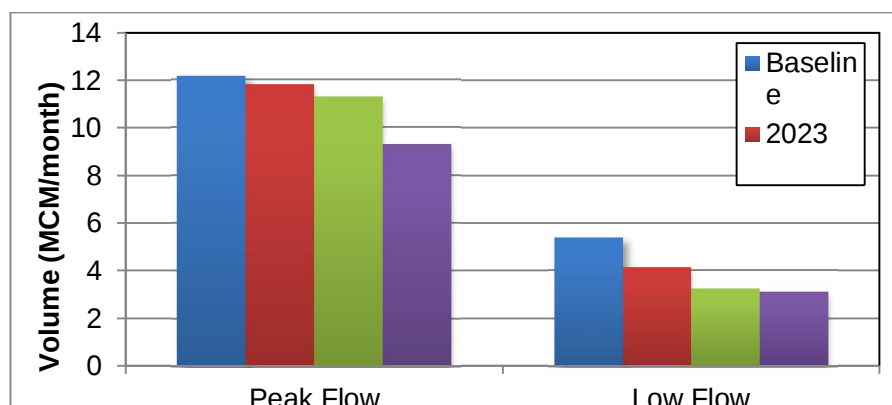


Figure 20: Simulated expected peak flows and low flows by 2050, based on the future medium projection

Two main planning alternatives (with pre-defined packages of measures) designed to address key issues and opportunities were analysed against the projections in Table 12. 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 13 and illustrated in Figure 21, Figure 22, and Figure 23.

Table 13: 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		249	76	59	9	3
2050	PASB	223	55	49	6	3
	PCB	199	41	46	5	3
	PCB+	155	25	35	3	2
	PCB-	183	28	47	7	3

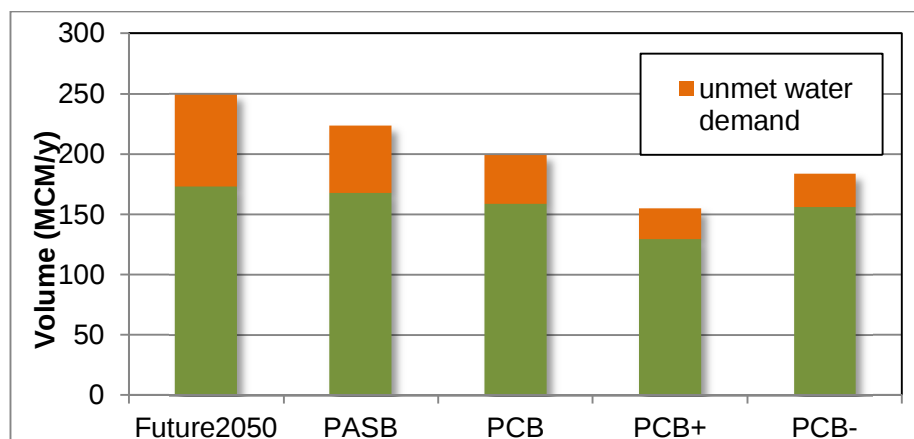


Figure 21: Impacts of implementation of various alternatives on met and unmet water demands, based on the future medium projection

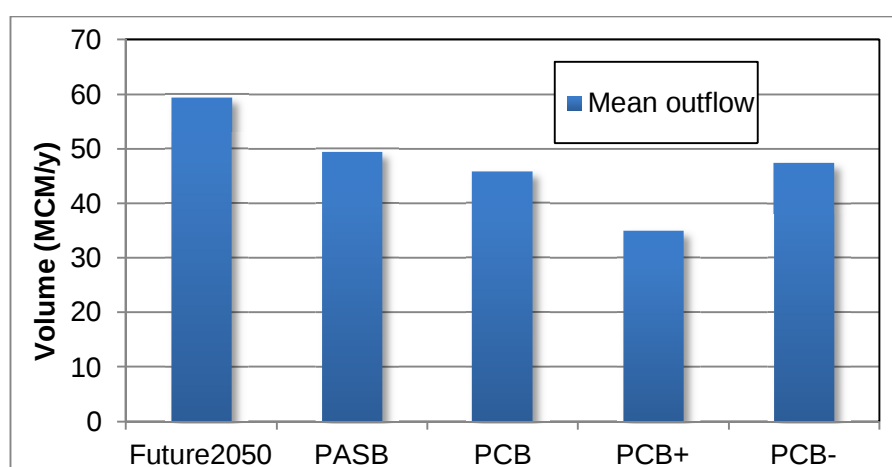


Figure 22: Impacts of implementation of various alternatives on mean outflows based on the future medium projection

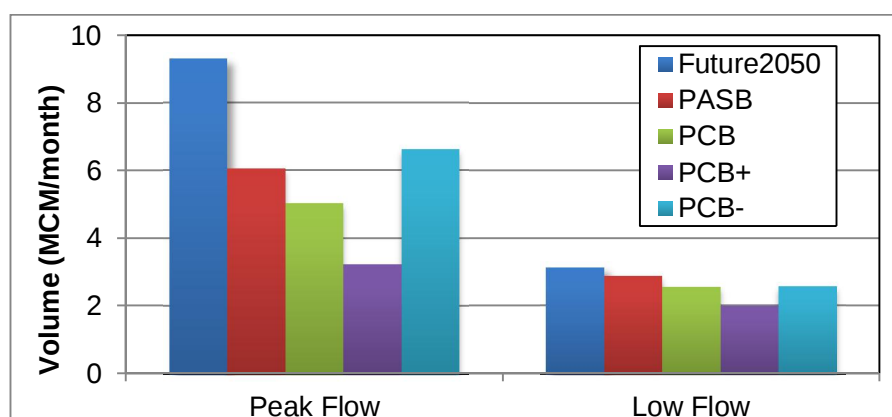


Figure 23: Impacts of implementation of various alternatives on peak flows and low flows based on the future medium projection

Impacts of the alternatives:

- § 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 and has positive impact on food security.
- § PCB+ and PCB- are able to reduce projected water shortages by 60% to 70%.

3.6 The consensus catchment plan

The multi-criteria assessment resulted in the selection of the PCB+ alternative as preferred alternative. 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-forestation and land husbandry

The core intervention 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 *sygygium*, in addition to exotics like *Alnus acuminata*, *Acacia Agustima* and *Acacia melanoxylon*.

Farmlands will be protected by construction of progressive and radical terraces will 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 24 below illustrates the range of measures and scope over the spatial extent of the catchment.

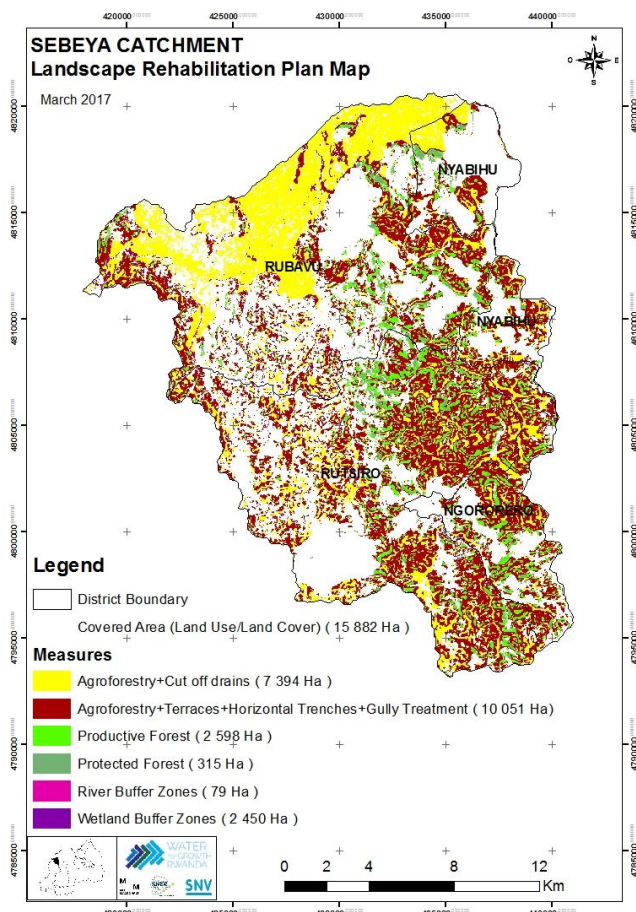


Figure 24: Rehabilitation plan of the Sebeya catchment

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 14 below indicates the opportunities for enhanced management of forest plantations.

Table 14: Opportunities for improved management of forest plantations

Measure	Area (ha)
Improve management of existing eucalyptus woodlots.	2,424
Improve management of existing Pine timber plantations	647
Total	3,071

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 m³ and 8 m³ 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 subsidising 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. The 18 sites within the catchment are presented under annex 1, with most sites identified being rated between 50 kW and 1 MW. Development of these sites will support efforts to reach the set targets of 70% access to electricity by 2017/2018 and 100% by year 2020¹⁵. Technical and financial feasibility studies will be conducted and thereafter the sites can be tendered out to private developers. Initiatives elsewhere by SNV¹⁶ 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. A pilot pico-hydroelectric project can be implemented at one of the identified sites where the population has no access to electricity.

Specific activities will include:

- § trainings of local entrepreneurs in turbine manufacture and plants operations and maintenance;
- § Training on the dimensioning of turbines;
- § Provide subsidies for pico-hydro equipment from the basket fund;
- § Assist entrepreneurs or village cooperative 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 \$4,500¹⁷. 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-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)¹⁸. Due to the topography found in most of the demonstration catchments, 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 25 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.

¹⁵ Rural Electrification Strategy, Republic of Rwanda, Ministry of Infrastructure, June 2016

¹⁶ Rwanda Pico Hydropower Development (DPHER), The Netherlands Development Agency (SNV), 2016.

¹⁷ Scott Gladstone *et al.* (2014). Implementing pico-hydropower sites in rural Rwanda. *Procedia Engineering* 78 (2014) 279 – 286.

¹⁸ Meir and Fisher (2011). Assessment of the Pico and Micro-Hydropower Market in Rwanda.



Figure 25: System components of the Power Pal T5 Hydropower package Vietnam (Meir and Fisher, 2011)

3.6.4 Resilience to landslides, early warning systems for floods and green villages

Areas most prone to incidences of floods and landslides within the demonstration catchments are identified by district¹⁹ and indicated as Nyabihu, Rutsiro, Rubavu and Ngororero. Implementation of activities to reduce vulnerability to Climate Change by Establishing Early warning and disaster preparedness systems in these areas is a measure proposed in each of the catchment plans. The Ministry of Disaster and Refugee Affairs (MIDIMAR) has identified the number of households living in high risk areas in each of the districts, these are shown in Table 15 below. These households have been tagged for resettlement in *imidugudu* where the target is to have 65% of the rural population living in such grouped settlements by the year 2020. This will enable the Government of Rwanda to achieve economies of scale with respect to providing them with basic services such as access to electricity, water and sanitation and reduce pressure on fragile ecosystems. Catchment specific figures for persons eligible for resettlement in land slide and flood prone areas are not readily available but exposure²⁰ estimates are available by district and includes analysis by gender, age, and levels of poverty).

¹⁹ National Contingency Plan for Floods and Landslides, Rwanda. Ministry of Disaster Management and Refugee Affairs, 2014.

²⁰ MIDIMAR (2015), The National Risk Atlas of Rwanda.

Table 15: Exposure assessment by gender in very high risk areas that are eligible for resettlement in *Imidugudu*

District	Population exposed to landslides (No. of persons)
Ngororero	42,066
Rutsiro	39,976
Nyabihu	26, 281
Rubavu	23,981

The Rwanda Government supported Green villages²¹ typically serve 100 households, with a typical household having 5 persons. This implies that a total of 400 model villages are required to re-settle population exposed to landslides. Integrated Development Program (IDP) activities/ interventions are proposed to target exposed households in these districts as follows:

- § resettle households in flood and landslide prone areas to ensure that they would not be at risk of future occurrences and reduce human pressures on the damaged ecosystem. Utilize IDP model green villages to do so;
- § within the green villages, demonstrate energy and water self-sufficiency through the generation of biogas for cooking, lighting from consolidated domestic human and livestock waste, rainwater harvesting for domestic use, and small-scale and household level irrigation for food production;
- § building capacity to integrate climate change considerations into the management (see final bullet point) and operation of planned pico-hydropower generation facilities;
- § raise opportunities for off farm employment in model villages for women and youth;
- § implement climate resilience building interventions against flooding, like spate irrigation (diverting short duration floods, reducing their energy and spreading water gently over the (agricultural) land; diversion ditches (diversion of overland flows away from exposed slopes to safe discharge points like stabilized outlets or a sediment basin); stilling basins (used to dissipate the energy of water exiting the spillway of a dam during peak flows reducing erosion and dam damage); and detention basins (where excess water can be stored during peak flows to protect against erosion, and if the ground layer is made sufficiently permeable these basins also serve as groundwater recharge points, building drought resilience in the area).

Flood hazard mapping has been conducted in the volcanoes area (Water for Growth Rwanda, report TR26) and an example of areas susceptible to flooding is illustrated in Figure 26.

²¹ A Toolkit for the Development of Smart Green Villages in Rwanda, REMA, 2015

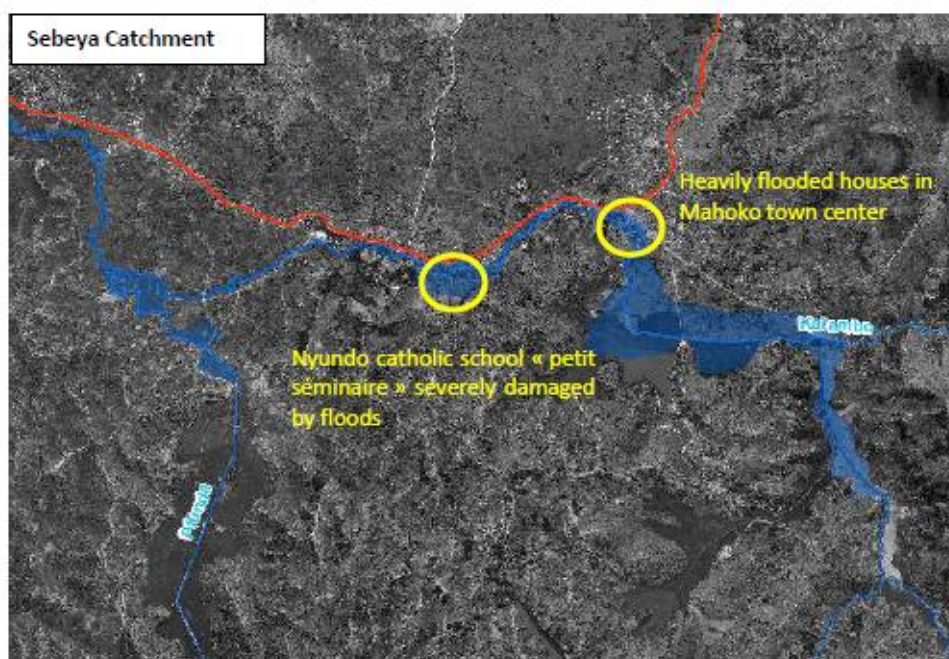


Figure 26: Example of a flood hazard map along Rivers Sebeya and Pfunda

The interventions require preparation of designs and construction of appropriate structural protection works to minimise the physical impacts of floods in this area. The works envisaged are lateral protections against erosion, hydraulic structure resizing, river training, river diversion and very local containment. Some of the measures include the town centre of Mahoko diversion channel to be built, strengthening Gisunyu gully damaged bridge, river training at the confluence of Karambo & Gisunyu, the town centre of Mahoko and Petit Séminaire de Nyundo and implementation of early warning systems near the high school.

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

An investment plan to support achievement 100% of water supply and sanitation coverage by 2017 and to ensure 100% sustainable water supply over a planning horizon of the next 25 years have been elaborated by the Ministry of Infrastructure²² (MININFRA). The document provides estimates of the funding required, available resource envelope and deficits with a proposal to source funding from various development partners. The requirements are derived using the base year 2016 to sustain 100% coverage for the next 25 years. The deficits required to achieve 100% coverage for the year 2017/2018 for the districts within the catchment are tabulated below:

Table 16: Cost estimates for new water supply infrastructure (MININFRA, 2013)

District	Name of project	Deficit in RwF (Funding gaps)
Rutsiro	Rehabilitation and extension of Mbona-Nyabirasi –Kivumu WSS (691.2m ³ /day	913,143,936
Rutsiro	Rehabilitation and reinforcement of AEP Mukura – Nyabirasi- Kivumu (345.6 m ³ /day)	600,000,000
Rubavu	Rehabilitation, extension, and reinforcement of Yungwe - Bikore WSS (5600 m ³ /day) to increase production	2,400,000,000

²² Republic of Rwanda (2013). Water and Sanitation Sector Strategic Plan 2013/14 – 2017/2018. MININFRA.

Nyabihu	Construction of Mutobo Crête-Ouest WSS (3110.4 m ³ /day)	6,000,000,000
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Other activities that can supplement these investment proposals should include:

- § institutionalization of sustainability mechanisms e.g. Water User Committees and District Water; Boards to ensure functionality of new infrastructure, improve operational efficiency and reduce water losses;
- § protect drinking water sources through regulation, which involves effluent control in water bodies and land use management to influx of sediment loads. Enact effective supporting water safety plans;
- § develop and implement water source water protection plans including measures for enforcement and drinking water monitoring. Protection plans should address storm water management, private and community sanitation systems, erosion and waste water discharge, solid waste management and disposal. Terms of Reference (ToR) for development of such water source plans are widely available from guidelines developed by WASAC.

No funds have been earmarked for these investment requirements as of yet.

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 27 below illustrates the spatial extent of potential irrigable areas which are located within marshlands and others that can be harnessed through the development of dams.

All marshlands have been cultivated. A total of 727.8 ha. has already been cultivated while the remaining 265 ha. can be developed for commercialized irrigated agriculture. There is also an additional potential to increase the area for irrigated agriculture by 255.7 ha through the development of multipurpose dams. The potential irrigable areas are consolidated and outlined below (Figure 27). The total irrigation potential has been estimated to be 520 ha.

Table 17: Sebeya catchment irrigation plan

Potential command areas linked to water sources	Area (ha)
Marshland development command area	264.4
Dam/multi-purpose reservoir command area	255.7
Groundwater command area	-
River command area	-
Lake command area	-
Total	520.1

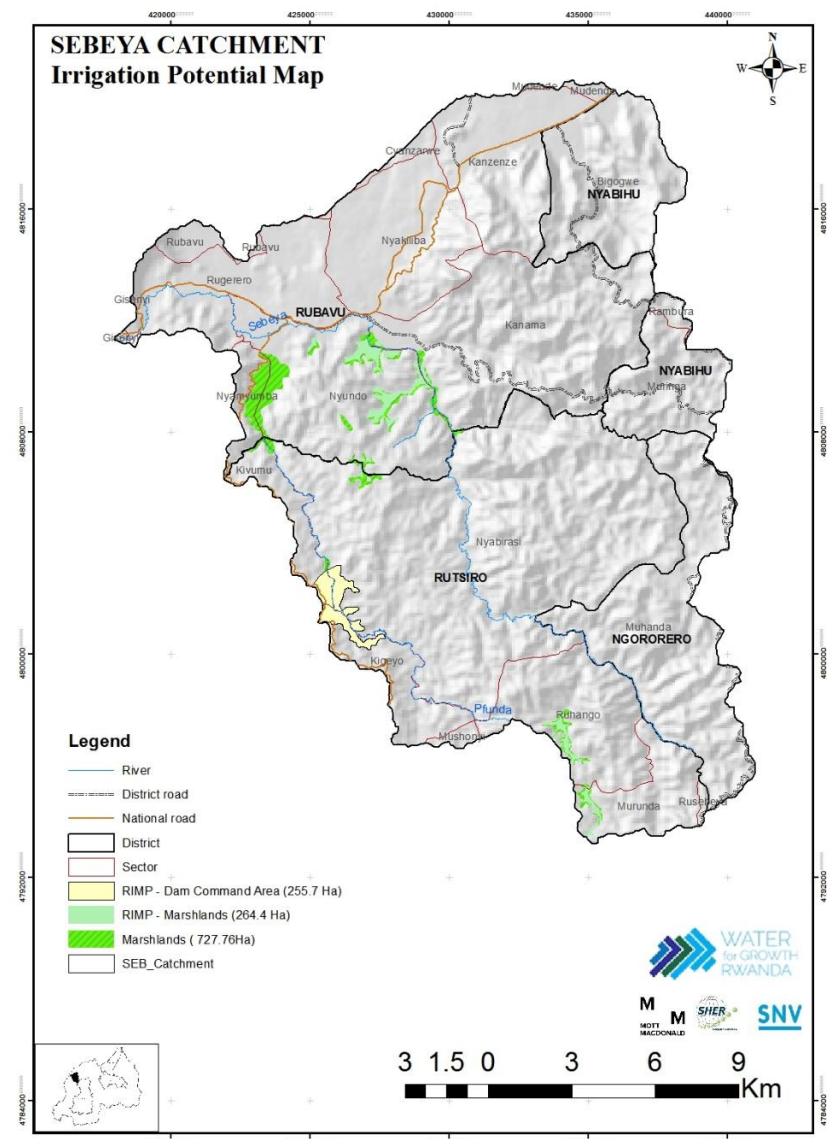


Figure 27: Potential irrigable areas in Sebeya

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 assume that population growth remains at a modest 2.78%.²³ 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.

²³ Rwanda Industrial Master Plan 2009 -2020

Horticulture, fruit, and vegetables

Development of land required for commercialisation of crops such as cassava, fruits and vegetables is a viable option in the land and water management task. It is estimated that 860 ha are required to develop the horticulture sector, mostly driven by large scale private sector development, in Rwanda with a capacity to create 5,800 jobs²⁴. Specific examples of sites in advances stages of development are illustrated below:

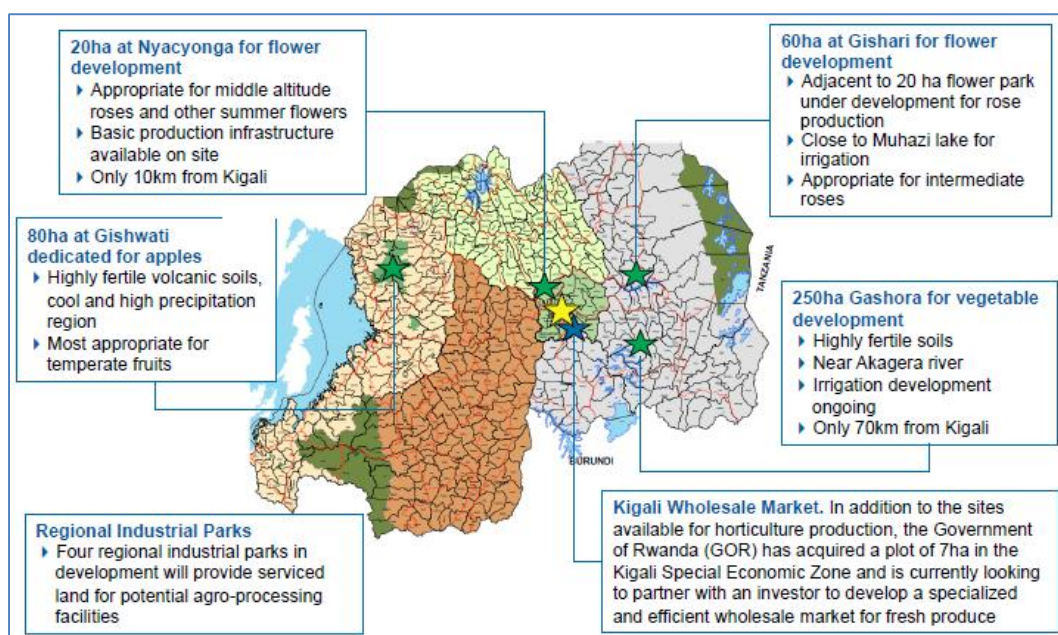


Figure 28: Sample sites for investment opportunities in Rwanda's Horticulture sector (Source: National Agriculture Export Promotion Board -NAEB)

Additional sites can be developed in each of the demonstration catchments and provided with irrigation infrastructure.

Beekeeping

Productivity and production of bees have sharply increased and consequently improved rural incomes in areas with marginal land for agriculture. Beekeeping activities have been modernized following the development of a strategic plan²⁵ document and issuance of guidelines²⁶ to support utilization of modern 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

²⁴ Horticulture Strategy, MINAGRI, 2006.

²⁵ National Beekeeping Strategic Plan Document, MINAGRI, 2007-2012.

²⁶ National Beekeeping Guidelines, MINAGRI, August 2009,

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 Rwanda²⁷. 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. In this plan, cage production is identified as the major option to commercialise aquaculture in Rwanda in view of the constraints imposed by scarcity of land. Cage fish culture is the raising of fish in containers enclosed on all sides and bottom with mesh material that secures the fish inside while allowing relatively free water exchange with the surrounding environment. In this system, fish is raised in low cage water volumes typically 4 m³ at optimum high stocking densities of 300 – 500 individuals with expected harvest weights from 150 – 250 kg of fish per m³ of cage. The zones found to have moderate to high potential for cage culture within the demonstration catchments are along the shores of Lake Kivu in Rutsiro and Karongi (Figure 29). Each of these districts should develop at least 5 lake based cages over the period of implementation of this catchment plan.



Figure 29: Floating fish cage farms on Lake Kivu

Opportunities for tank based aquaculture production (Figure 30), where fish is reared in tanks supplied with clean water have been identified along several rivers flowing from the hills in the districts of

²⁷ Masterplan for Fisheries and Fish Farming in Rwanda. MINAGRI, Inland Lakes Integrated Development and Management Project (PAIGELAC), 2011.

Ngororero and Nyabihu. Since these regions are 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 FAO²⁸.



Figure 30: Rainbow trout farming in water tanks (FAO, 2011)

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.

Special economic zones and industrial parks

The Government of Rwanda has identified special economic zones (SEZ) and industrial parks as an effective tool for investment promotion. However, in order to be effective, SEZs and industrial parks will need full infrastructural support for water and solid waste management, as well as to pass stringent environmental requirements. Aggressive promotion of industry and mining to create more jobs and a chive a GDP per capita of \$900 by 2020 requires a corresponding need to adopt a policy for environmental sustainability of industry. The measures required to do so are outlined below.

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;

²⁸ Small-scale rainbow trout farming. FAO, 2011.

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 RWAFA and Rwanda Mines, Petroleum and Gas Board 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, Rwanda Water and Forestry Authority (RWFA), and Rwanda Mines, Petroleum and Gas Board, 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 RWAFA 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 31.

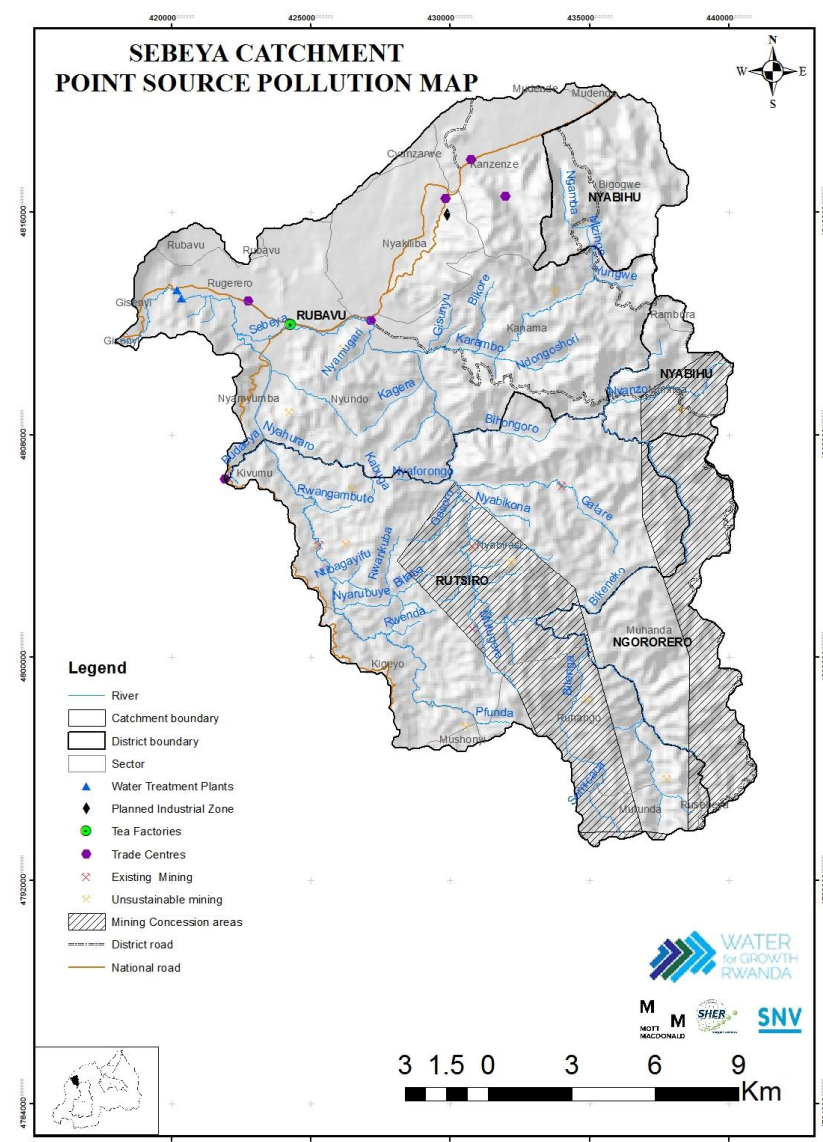


Figure 31: Point source pollution map

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 process²⁹. 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 31).

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 RWAFA. A key issue in respect of point source discharge control is the ability of REMA & RWAFA 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 RWAFA 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.

²⁹ WHO, 1997. Water Pollution Control - A Guide to the Use of Water Quality Management Principles.

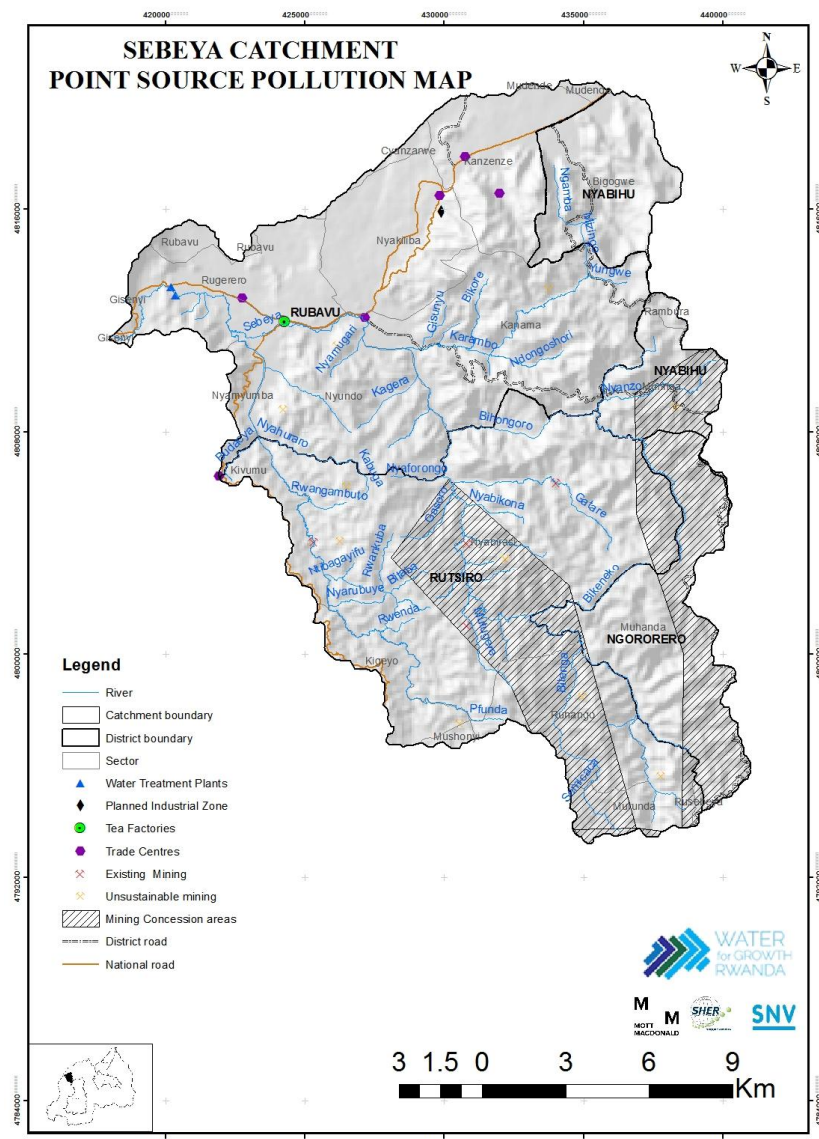


Figure 32: Point source pollution sources of the Sebeya catchment

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 standards³⁰ (Koegelenberg and Breedts, 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 model³¹ to translate MIL information and data into predicted impacts on crop yields, water use and thereby profitability, is illustrated diagrammatically in Figure 33.

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.

³⁰ Koegelenberg, FH, and Breedts, HT. (2003). Manual for the Evaluation of Irrigation Systems. Agricultural Research Council – Institute for Agricultural Engineering, Pretoria, South Africa.

³¹ 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.

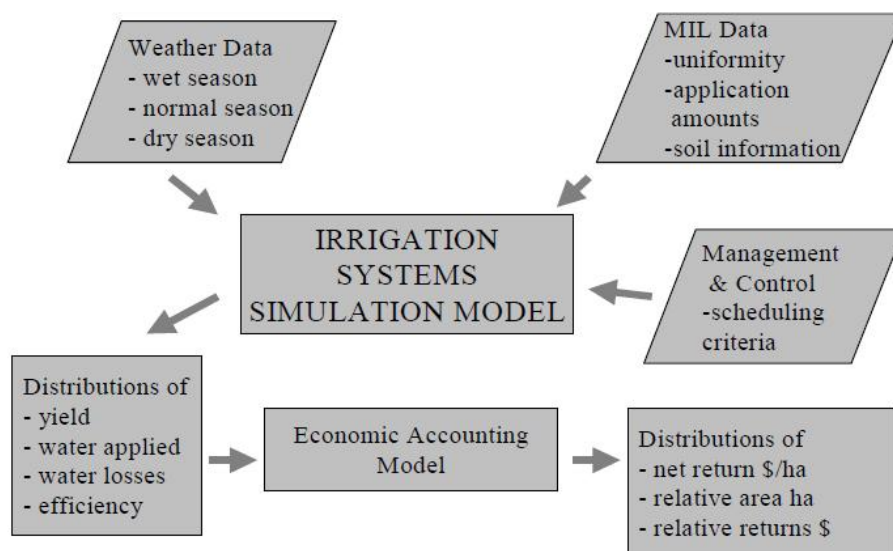


Figure 33: Proposed methodology for evaluation of existing irrigation and water management systems (Lecler, 2003)

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 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 (RWAFA) 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 preferred alternative (PCB+)

The table underneath (Table 18) presents the programme of measures as developed for alternative PCB+.

Table 18: Programme of measures under preferred alternative (PCB+)

SN	Catchment Specific objectives	Components	Activities	Key partners
1	To strengthen land protection and conservation, and river bank protection to reduce vulnerability to flooding and landslides	Water source protection	Develop and implementation of water safety and water resource protection plans. Protection plans should address storm water management, private and community sanitation systems, erosion and waste water discharge, solid waste management and disposal (Gihira Water treatment plant, Yungwe-Bikore & Mizingo-Mutura)	RWFA, WASAC, RURA, REMA, CTF, Water operators
		Regulation	Put in place effective regulatory (licensing) mechanisms for waste water discharge. Support the department of mines to setup regulatory standards for mines and enforce them. Implement model mining concept. (which areas have mines)	RWFA, MINIRENA, REMA Mining Department, Districts
			Support the implementation of program on showcasing sustainable mining practices through rehabilitation of old mining sites, recycling of washing water, to diversify and modernise local economy through creation and enhancement of sustainable	RWFA, MINIRENA, REMA Mining Department,

SN	Catchment Specific objectives	Components	Activities	Key partners
			off-mining employment (i.e. construction of VTCs), and increase of enforcement and awareness raising around sustainable mining by government	Districts
		Landscape rehabilitation & afforestation	Restore and protect 24402.3 ha of sub catchments and wetlands to reduce soil erosion. Adopt appropriate land use and agricultural practices to enhance resilience to climate change. Improve rangelands through restoration of vegetative cover, introduce improved forage species	RWFA, MINIRENA, LVEMPII, MINAGRI, Communities, Districts
		Flood management	Prepare designs and construct appropriate structural protection works to minimise the physical impacts of floods and gullies. The works are lateral protections against erosion, hydraulic structure resizing, river training, river diversion and very local containment. Some of the measures include the town centre of Mahoko diversion channel to be built, strengthening Gisunyu gully damaged bridge, river training near Petit Séminaire de Nyundo and implementation of early warning systems.	MIDIMAR, MINIRENA, Districts
		Promotion of alternative sources of clean energy	Identify and disseminate, to relevant households, of efficient and alternative sources of energy to reduce dependence on biomass fuels (ICS, Biogas, hydropower development); by preparing feasibility studies for 18 micro hydropower plants in the four districts. Lease feasible micro-power plants to private sector developers. Provide subsidies and loans to finance bio-gas digesters Improve the management of 7586.67 ha of forest plantation	REG, RURA RWFA, Districts
		Poverty reduction	Mobilise women and youth to get involved in beekeeping. Establish 1 demonstration apiary and equip it with 20 modern and 10 traditional hives. Establish infrastructure required to establish 80 ha of horticulture (fruits & vegetables...) at Gishwati.	MINAGRI, RWFA
			Integrate crop and livestock production.	MINAGRI
			Implement a payment for ecosystem services as an incentive for farmers to implement the land scape rehabilitation and conservation measures. Engage WASAC and REG to make contributions.	MINIRENA, REMA, WASAC & REG
			Develop tourism facilities linked to ecotourism and water around Gishwati National Park, and protect natural forest to avoid encroachment	RDB, MINIRENA
		Increased storage and small scale	Promote programmes for harvesting runoff, storage, small scale irrigation (255.7 ha) by constructing one multipurpose dam. The dam will contribute to	MINAGRI, RAB, Water Utilities,

SN	Catchment Specific objectives	Components	Activities	Key partners
		irrigation	irrigation, floods control, and water supply	RWFA
2	Ensure sustainable access to water for domestic and livestock consumption	Water supply for domestic use	Increase and sustain 100% access to safe water and sanitation facilities. Ongoing projects that still require supplementary funding include: § rehabilitation and extension of Mbona-Nyabirasi-Kivumu WSS (691.2m ³ /day); § rehabilitation and reinforcement of AEP Mukura-Nyabirasi-Kivumu (345.6 m ³ /day); § reinforcement and extension of Mbona-Nyamyumba WSS (259.2m ³ /day)/ WASH; § reinforcement of Gihira Water Treatment plant	MININFRA, WASAC, Aquavirunga
			Increase rainwater harvesting systems for domestic use and small-scale and household irrigation for food production	MINIRENA, PSF, RWFA, Districts
		Livestock watering	Construct water supply systems in farms at Gishwati area	MINAGRI, Farmers' Cooperatives
3	To ensure equitable and efficient allocation of water resources to all users within the catchment	Water allocation	Advise various water users to comply with the water permit system so as to mitigate water conflicts in the future	MINIRENA, RWFA
			Build capacity of Water User Committees, DHBC and CTF to improve operational efficiency and reduce water losses (unaccounted for water); Adoption of efficient water use technologies/practices by farmers; Water supply designs for various sector users are made considering improvement of efficient water use technologies, and Introduction of new crops with high economic-value and less water intensive	MINIRENA, RWFA & Civil society
4	To Strengthen the water governance framework to ensure effective implementation of integrated programs	Institute and operationalize the Catchment Coordination Office (CCO)	Strengthen the water governance framework by having clearly defined responsibilities and working partnerships with other stakeholders for the catchment.	MINIRENA
			Set up a Catchment Coordination 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 CCO will assist to allocate water and resolve all conflicts over utilization 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	MINIRENA, RWFA, RGB, MIGEPROF, GMO

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 19. 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 19: 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). Implementation of the programme has already commenced with the Early Implementation Project for Landscape Rehabilitation in Rubavu and Rutsiro.

3.7.3 Time frame and phasing of activities or program of measures

Implementation of the programme of will commence as soon as possible. Some activities such as instituting and operationalisation of the catchment coordination office can be immediately implemented in 2017-2018. 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. Others can commence in the core plan period of 2018-2023.

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 Rwanda³², 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 34), 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.

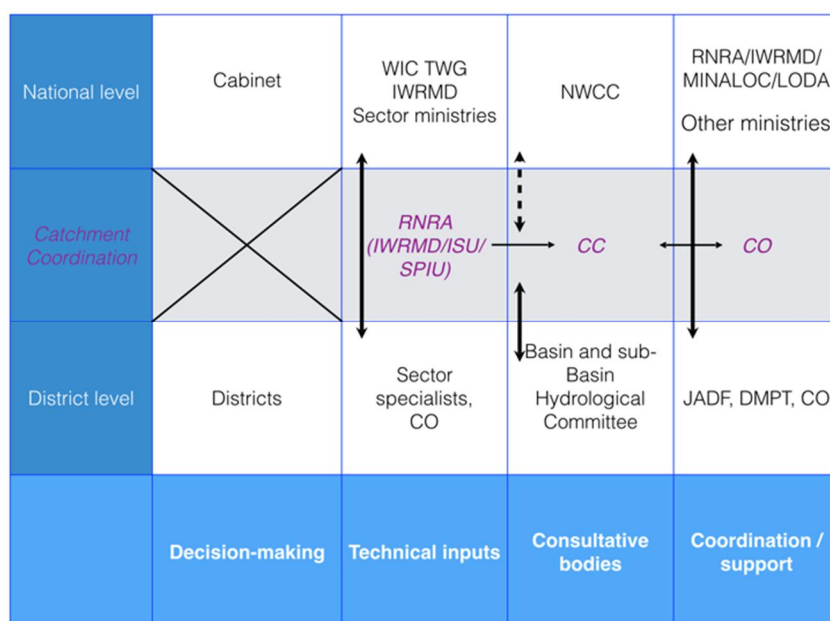


Figure 34: Matrix presenting coordination, consultation, technical input, and decision-making at various levels³³

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;

³² Water for Growth Rwanda technical report TR03 – Institutional Frameworks (January 2017)

³³ CC stands for Catchment Committee, the successor of the Catchment Task Force under the new Water Law under development

- § provide technical inputs to the Catchment Committee and the District Committees for Hydrographic Basins, including capacity building support;
- § 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 a district that is well accessible from within the catchment, and from Kigali. For the Catchment Task Force unanimously voted for Rubavu district, where the vice-chairperson of the CTF is located.

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 flood 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. The City of Kigali will be supported to implement relevant programs of measures in the city master plan;
1. research activities will be carried out through partnerships with key research institutions, which are expected to include the University of Rwanda;
2. depending on the scope of activities, to be determined under the landscape rehabilitation component, the RWFA, Nature Conservation, and Rwanda Mines, Petroleum and Gas Board 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;
3. 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;
4. 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;
5. 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. Water intakes for major urban centres e.g. Rubavu suffer from the sediment carried by the river. Building sediment traps near the reservoir or regular flushing the reservoir from its sediments is costly and complicated for the power company. Instead, the power company would be willing to pay land users and the miners in the catchment for measures that reduce erosion. Possibilities to set up contractual arrangements between the power company and land users to reduce the erosion are explored.

Other possibilities for PES exist around the Gishwati-Mukura National Park. The park harbours a unique flora and fauna of international importance. It also produces clean drinking water for the people living downstream in the catchment. Populations around the forest depend for their livelihoods on the forest abstracting products while damaging nature. Land users are more and more viewed as guardians of the environment that fairly receive a compensation for protecting the ecosystems. 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 20 overleaf.

Table 20: Preliminary Catchment Plan M&E framework

Hierarchy of results	Key Performance Indicator	Baseline 2015/2016	Target 2022/2023	Means of Verification	Assumptions
General objective: Effectively manage land and water resources to contribute to sustainable socio-economic development and improved livelihoods					
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) CM	0.00 (WEAP)	0.00	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		IWRM Annual survey reports	
	Water availability per capita (MCM/cap/Yr)	0.062 (WEAP)	0.048	IWRMD Annual survey reports/WEAP	
Impact 2: Water and land productivity increased	Yield of main crops in the catchment (Metric Tons per Year)	305,102.6 (DDP - NISR/EICV3)	610,205.2	Districts Imihigo Reports	
	Water productivity (RWF/ha)	TBA		IWRMD Annual survey reports	
Specific objective 1: To strengthen land protection and conservation, and river bank protection to reduce vulnerability to soil erosion, flooding and landslides					
Outcome 1.1 Critical sub catchments are rehabilitated and basic ecological functions restored	Area (ha) & % of land protected against soil erosion in the catchment	Rubavu: 47.9-90 (48%) Rutsiro: >90-94.1 Nyabihu: >90-94.1 Ngororero: >60-80		W4GR/IWRMD Reports	Ministries, central agencies and, districts 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 progressive) in combination with agroforestry (ha)	13,196	10,041	MINIRENA Quarterly reports	All stakeholders in the Districts committed to mainstream erosion measures

Hierarchy of results	Key Performance Indicator	Baseline 2015/2016	Target 2022/2023	Means of Verification	Assumptions
Output 1.1.2 Forest plantations increased in public and private lands in line with District Forest Management Plans (DFMP)	Area ha of forestry cover increased	1,516 (both natural & plantations) (Draft Land cover map 2015)	4,420.53	Forest Department Quarterly reports	District to have updated their DFMP with the support of RNRA
Output 1.1.3 Gullies and degraded old mines rehabilitated	Area (ha) and % of gullies and old mines rehabilitated	TBA	100%	IWRMD Quarterly reports	Enforcement of laws regulating mining and quarries
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 law 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 agriculture) farming methods using Farmers Field School (FFS).	TBA	100%	MINAGRI Quarterly reports	The Ministry of Agriculture cooperates to adopt improved farming methods protecting land in FFS
Outcome 1.2 Floods and drought hazards reduced	Area of high risk zones protected against flooding (ha)	TBA	TBA	IWRMD Quarterly reports	Early warning capability for floods or shortage of rains is established and regularly updated by Meteo Rwanda
	Command area for marshlands and hillside irrigation from various sources of water (Groundwater and rivers) increased (ha)	350 (Irrigation Baseline Survey Main Report, 2013)	350	MINAGRI Quarterly reports	
Output 1.2.1 Rural roadsides protected with drainage of excess water	Proportion of feeder road rehabilitated and protected with drainage facilities (km)	1500 Rutsiro 1200 Ngororero 0 Rubavu 487 Nyabihu (DDPs)	60%	MININFRA / RTDA Quarterly reports	
Output 1.2.2 Households relocated from high risk zones too IDP/green Model villages	% of households relocated from high risk zones to IDP/green model villages	TBA		Districts Imihigo reports	

Hierarchy of results	Key Performance Indicator	Baseline 2015/2016	Target 2022/2023	Means of Verification	Assumptions
Output 1.2.3 Rain water harvesting facilities increased to residential houses and public buildings	Number (%) of residential houses and institutional buildings with rain water harvesting systems	Rubavu: 290 HH (63%) Rutsiro: No data Nyabihu: 20.4% Ngororero: 50HH (16.66%) (Source:DDPs)	46125 HH (100%) - 100% 300HHs (100%)	IWRMD reports	
Output 1.2.3 Buffer zones along rivers and wetlands demarcated and protected	Area (ha) and % of buffer zones along rivers and wetlands protected	Rub 17% Ruts 70% Nyab 50% Ngororero 48km (Source DDPs)	100% 100% 100% (8200ha) 152km	IWRMD reports	
Output 1.2.4 Water ponds and dams constructed to collect and conserve water for hillside irrigation in area for short rainy seasons	Volume of water ponds and dams constructed to collect rain water for hillside irrigation (CM)	21,198 CM (CKIV) (Water storage report RNRA, 2016)		MINAGRI reports	
Outcome 1.3 Water pollution from urban and villages areas caused by solid and liquid waste reduced	% reduction in solid and wastewater discharges into rivers	TBA	80%	MININFRA Annual reports	Catchment plan mainstreamed in relevant sectoral plans
Output 1.3.1 Waste water treatment plants and landfills constructed	Number of HHs with access to solid waste collection and nr of HH connected to sewerage systems and subsequent wastewater treatment facilities in Rubavu secondary city	TBA	TBA	MININFRA Quarterly reports	
	Number HHs with access to solid waste collection and nr of HH connected to sewerage systems and subsequent wastewater treatment facilities in rural villages	TBA	TBA	MININFRA Quarterly reports	
Output 1.3.2: Industries and Hotels are supported to adopt Resource Efficient and Cleaner Production	Number and % of Industries and hotels adopting RECP technologies	121 industries and hotels	100%	LVEMP II quarterly report MINEACOM quarterly report	

Hierarchy of results	Key Performance Indicator	Baseline 2015/2016	Target 2022/2023	Means of Verification	Assumptions
(RECP) technologies					
Specific objective 2: Ensure sustainable access to water for domestic and livestock consumption					
Outcome 2.1 Water Supply systems in the catchment upgraded	% of population provided with safe water increased % of farms accessing water increased	63% (Source: EICV3 Districts' Profiles) 0	100% 30%	– MININFRA/WASAC reports – Survey reports – EDPRS Annual progress reports – JSR reports	Capacity and institutions exist for planning, development and management of domestic water supply and livestock consumption
Output 2.1.1 Domestic Water supply and livestock infrastructure are managed sustainably	– National Water supply and sanitation Master Plan established and approved – Water supply and sanitation strategy developed and approved	0 0	1 1	Reports Studies	Government commitment
Output 2.1.2 Sustainable access of the population to safe water for domestic use	– % of households with access to safe drinking water – Number (%) of protected water sources	64 % 847	100% 1342	MININFRA and WASAC Quarterly reports Study Reports	Availability of sufficient water supplies for essential activities (short-term) Rainfall seasons resume (long-term)
Output 2.1.3 Increased access to water for economic purposes	Number and nature of water supply schemes and other hydraulic infrastructure put in place to promote economic production	0	2	MININFRA & MINIRENA reports	Private sector commitment Availability of funds
Specific Objective 3: Ensure efficient and equitable allocation of water resources to all users within the catchment					
Outcome 3.1: Equitable allocation of water resources ensured to sector users	Number (%) of water users satisfied with water allocation framework	TBA	100%	IWRMD Annual water users survey reports	Water allocation framework in place, and aligned to the National Land Use Master Plan
Output 3.1.1: Water users with water abstraction permits increased	% of water users with water abstraction permits (sex-disaggregated data)	TBA	80%	IWRM Quarterly report	Decision makers committed to conduct a Water user survey

Hierarchy of results	Key Performance Indicator	Baseline 2015/2016	Target 2022/2023	Means of Verification	Assumptions
Output 3.1.2 Water demand for main economic sector insured (Domestic, industry, irrigation, electricity)	Water Demand for Domestic use (MCM/y)	0.77 MCM/y (Annual WEAP Model simulations)	1.9 MCM/y	WASAC and other water supply companies	
	Water Demand for industry (MCM/y)	15.29	36.56	Annual water users survey report	
	Volume of water needed for irrigation (MCM/Y)	0.0	0.0 MCM/yr	Annual water users survey report	
	Volume of water needed for electricity generation per day	No results	No results	Water for growth Quarterly reports	General
	Water Demand for livestock				
Outcome 3.2 Efficient water use increased in main economic sectors	Crop/livestock production (yield) Kg/ha				
Output 3.1.1: Water supply designs for various sector users are made considering improvement of efficient water use technologies	Number of designs made			Feasibility/detailed designs	
Output 3.1.2: New crops with high economic-value and less water intensive introduced	Number of crops introduced			MINAGRI/RAB reports	
Output 3.1.3: Farmers are trained in water management, operation and maintenance	Number of trainings and participants			MINAGRI reports	
Output 3.1.4: Efficient water use technologies/practices are adopted by farmers	Number/% of farmers adopting new technologies				
Output 3.1.5: Quantity of water consumed per household reduced	Average consumption per household connection (m3/yr)			WUAs reports or WASAC and other water supply companies' reports	
Output 3.1.6: Water used in irrigation and in livestock regularly monitored	Average of water consumed by animal head (CM/Day)			WUAs quarterly reports	

Hierarchy of results	Key Performance Indicator	Baseline 2015/2016	Target 2022/2023	Means of Verification	Assumptions
Specific Objective 4: Strengthen the water resources governance framework to ensure effective implementation of integrated programs					
Outcome 4.1 An effective water institutional framework that integrates the principles of IWRM strengthened at catchment and District levels	% of districts mainstreaming approved catchment plans in their DDPs and Annual work plans	0	100%	IWRMD Quarterly reports	IWRM Mainstreaming guidelines available and endorsed by the Ministry of finance and economic planning
	% of central institutions mainstreaming approved catchment plans in their strategic and annual work plans	0	100%	IWRMD Quarterly reports	IWRM Mainstreaming guidelines available and endorsed by the Ministry of finance and economic planning
Output 4.1.1 Catchment management committees are established and operational	Average level of participation in catchment Task Force meetings (%)+ sex-disaggregated data	0	>80%	IWRMD Quarterly reports	IWRM-supportive legal & regulatory framework in place
	Number of regular reports produced by CTFs (committees)	0%	100%	Quarterly reports	IWRMD Quarterly reports
	% of representation in meetings (disaggregated by gender)	TBA	100%		
	Number/% of DHBCs operational (sex-disaggregated data)	100%	100%	IWRMD Quarterly reports	
	% of Sector HBCs established and operational (sex-disaggregated data)	0%	80%	IWRMD Quarterly reports	
Outputs 4.1.2 Conflicts among water users identified, discussed & solved	% of water conflicts raised and solved	TBA	80%	IWRMD Quarterly reports	
Outcome 4.2 Human, technical and managerial capacity of institutions involved in water resources management at various levels developed	% of relevant staff in local partner' institutions/catchment committees implementing IWRM principles (sex-gender disaggregated)	TBA	100% 30% increase in gender balanced community and wider stakeholder engagement in water related issues	IWRMD quarterly reports	Strong & high-level government commitment is sustained and willing to make change Stakeholders able to understand, cope & promote IWRM

Hierarchy of results	Key Performance Indicator	Baseline 2015/2016	Target 2022/2023	Means of Verification	Assumptions
	Measurable (%) sustained increase in training & awareness campaigns, including appropriate local level financial allocations for capacity development	TBA	30%	IWRMD Quarterly report	
Output 4.2.1. The Skills Gap Analysis relevant to IWRM conducted in local organizations (GR, NGOs, CBOs, Private Sector)	Availability of the Skills Gap Analysis report	0	The Skills gap Assessment report available	IWRMD Quarterly report	
Output 4.2.2 The capacity building plan relevant to IWRM in local organizations (GR, NGOs, CBOs, Private Sector) elaborated	Availability of the capacity building plan relevant to IWRM in the catchment	0	The capacity building plan available	IWRMD Quarterly report	
Output 4.2.3 Staff of partner organizations (GR, NGOs, CBOs, Private Sector) empowered to effectively participate in integrated water management processes	% of people (disaggregated by gender) at local level trained according to skills gaps identified Number of study tours organized Number of staff that participated in study tours (disaggregated by gender)	TBA	100%	IWRMD Quarterly report	
Outcome 4.3 Knowledge Management for evidence-based decision making in IWRM improved	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 be updated and incorporated in the water MIS	IWRMD Quarterly reports	Availability of local skills for systematic data collection
Output 4.3.1 Water monitoring stations installed and operational	Number of water monitoring stations installed and operational	TBA	TBA	IWRMD Quarterly reports	

Hierarchy of results	Key Performance Indicator	Baseline 2015/2016	Target 2022/2023	Means of Verification	Assumptions
Output 4.4.2 Water related surveys and studies conducted	% of needed surveys and studies conducted and published	TBA	100%	IWRMD Quarterly reports	
Output 4.4.3 Knowledge on IWRM transferred and disseminated	Number of best practices and lessons documented and shared Number of disseminated publications (reports, flyers, brochures, videos & radio shows...)	TBA	TBA	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 35. A detailed planning will be drawn up for sectoral dialogues and district dialogues, in order to jointly develop 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.

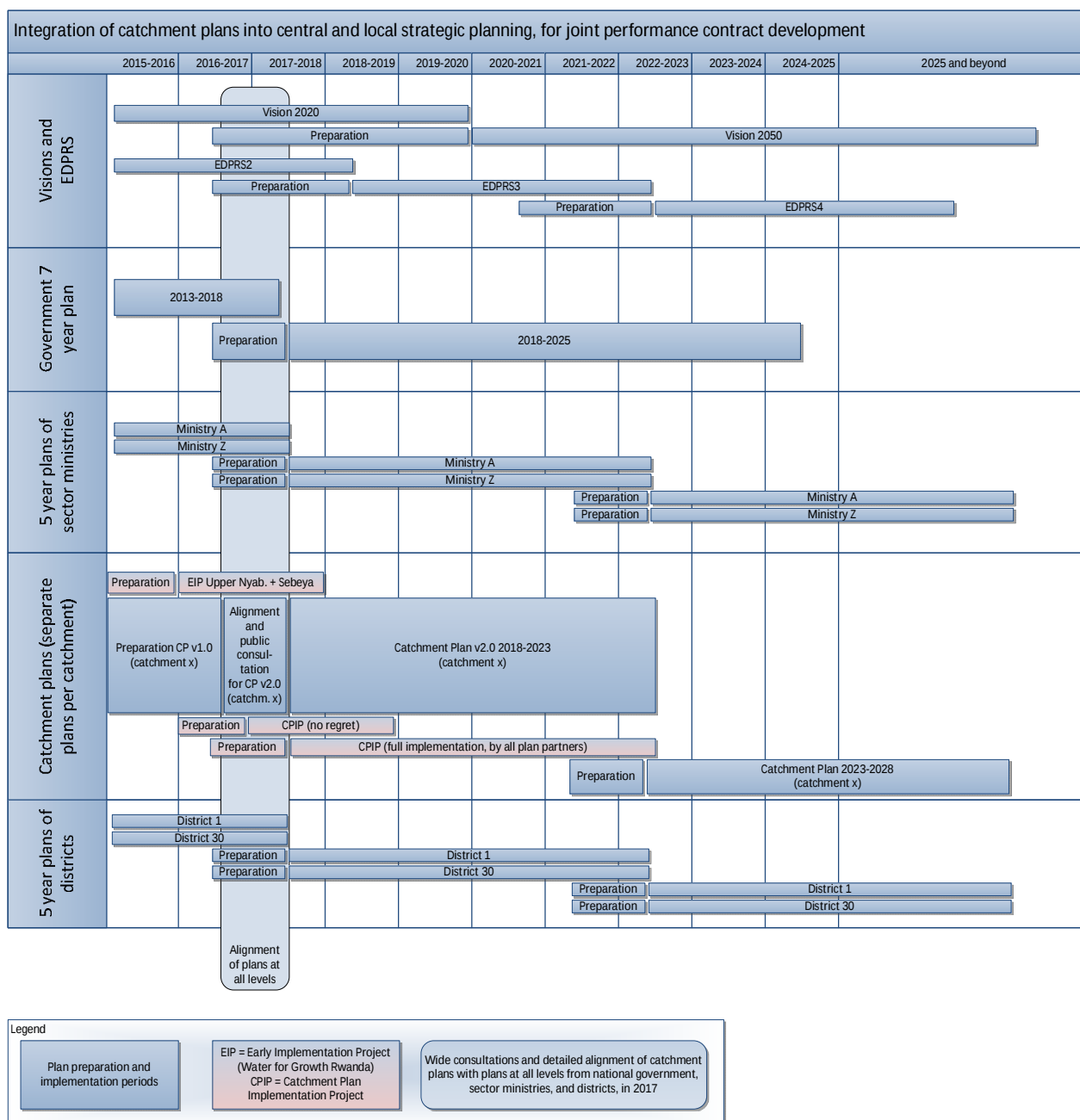
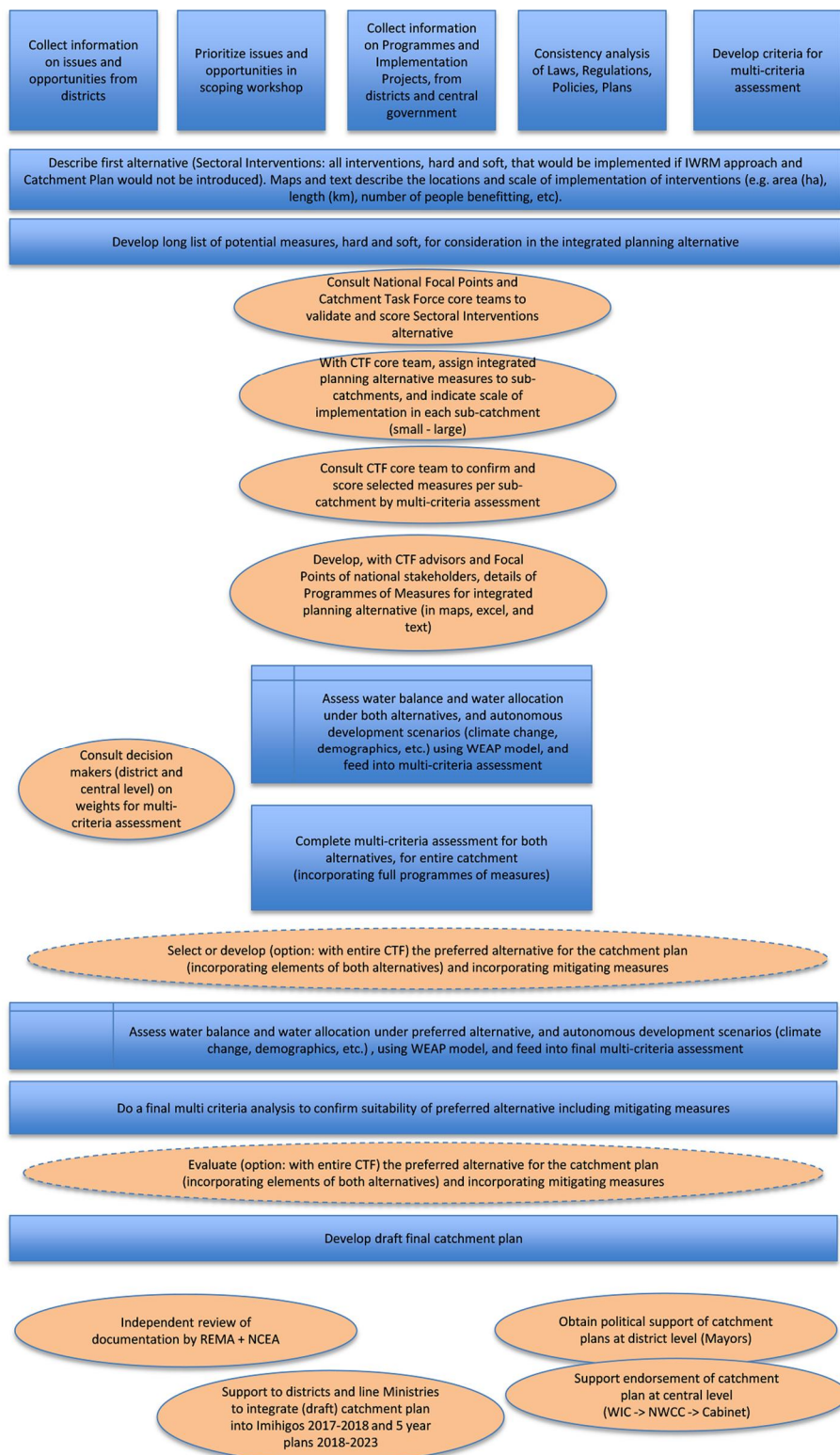


Figure 35: Alignment process between Catchment Plan, National Plans, Sector plans, and District plans

Annex 1. Potential hydropower sites

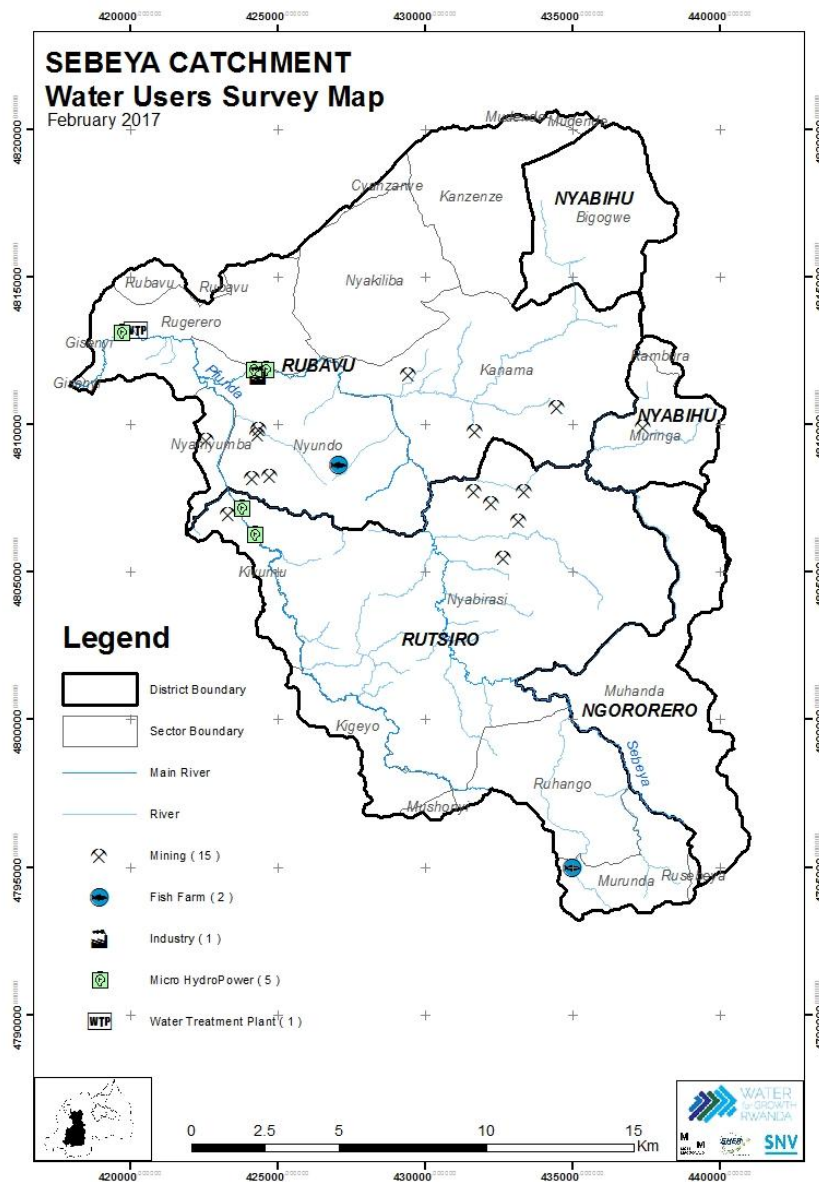
No.	Site_name	District	Sector	Est.Max_Capacity (kW)
1	Biruyi A	Rutsiro	Kigeyo-Mushonyi	250
2	Biruyi B	Rutsiro	Kigeyo-Mushonyi	250
3	Gashashi	Rutsiro	-	200
4	Gatare 1	Rutsiro	Nyabirasi	1271
5	Gatare 2	Rutsiro	Nyabirasi	1037
6	Giciye	Nyabihu	-	4000
7	Kabaya	Nyabihu	Muringa	217
8	Koko	Rutsiro	Ruhango	250
9	Kamuramira	Rutsiro	Murunda	373
10	Keya	Rubavu	Nyundo- Rugerero	750
11	Mukondo	Rutsiro-Rubavu	Kivumu-Nyabirasi- Nyamyumba-Nyundo	250
12	Murunda	Rutsiro	Gihango-Murunda	100
13	Ndaba	Karongi-Rutsiro	Rubengera-Rugabano- Mukura	100
14	Nduruma	Karongi-Rutsiro	Rubengera-Rugabano- Mukura	-
15	Ntaruko	Ngororero	Kabaya	139
16	Pfunda	Rubavu	Nyundo-Rugerero	1200
17	Rugeyo	Rutsiro	Murunda	2137
18	Ruhanga	Nyabihu	Muringa	106
Total				>12.630

Annex 2. IWRM and SEA process steps



Annex 3. 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 4. Authorities and stakeholders

Most of development partners operating in 4 Districts of Sebeya catchment are in the category of International and Local NGOs as well as government projects operating in 7 sectors of socio-economic development. Among those sectors of intervention, 4 are in close relation with water sector while others: justice & Governance, microfinance have no direct relationship with water. Among the sectors with close relation to water sector, Social sector, Agriculture, Environment protection and land, and Water and Sanitation have the majority of stakeholders respectively.

With regards to government projects implemented in the catchment with close relation to water sector, 9 major projects have been identified and are implemented by 6 government institutions: REMA (4 projects), MINAGRI (1 project), MININFRA (1 project), Rwanda Water & Forestry Authority (3 projects), LODA (1 project) and NAEB (1 project).

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

- § **MINAGRI:** 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;
- § **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 are 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;
- § **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;
- § **Rwanda Water and Forestry Authority** is an authority that leads the management of promotion of water and forests. It shall be entrusted with supervision, monitoring and to ensure the implementation of issues relating to the promotion and protection of these natural resources in programs and activities of all national institutions. Given the close link between water and forestry, and two other authorities (Rwanda Mines, Petroleum and Gas Board, and the Rwanda Land Management and Use Authority) under the responsibility of MINIRENA;

- § **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 Local Economic Development (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.

Table 21: Projects directly or indirectly pertaining to land and water management in the catchment

S/N	Name of the project	Implementing institution	Number of Districts
1	Reducing Vulnerability to Climate Change in North West Rwanda through Community-Based Adaptation (RV3CBA)	Rwanda Water and Forestry Authority	Nyabihu (1)
2	Landscape Approach to Forest Restoration and Conservation (LAFREC)	REMA	Rutsiro, Rubavu, Ngororero and Nyabihu (4)
3	Project d'Appui à la Reforestation au Rwanda (PAREF Phase 2): afforestation, agroforestry, and forestry management	Rwanda Water and Forestry Authority	Rutsiro, Ngororero, Nyabihu (3)
4	Lake Victoria Environmental Management Project (LVEMP II)	REMA	Ngororero (1)
5	Land husbandry, Water Harvesting and hillside irrigation project (LWH)	MINAGRI	Rutsiro, Nyabihu (2)
6	Decentralization and Environment Management Project (DEMP) Phase II	REMA	Rutsiro (1)
7	Road Infrastructure Project	LODA	Rutsiro (1)
8	Promotion of coffee and local products to be exported	NAEB	Rutsiro (1)
9	Reducing Vulnerability to Climate Change by Establishing Early Warning and Disaster preparedness systems and support to Integrated Watershed Management in Flood Prone Areas (LCDF)	REMA	All 4 districts
10	Rwanda's Rural Drinking Water Supply and Sanitation sub Program (PNEAR II)	MININFRA	All 4 districts
11	Land husbandry and Landscape rehabilitation (EIP)	Rwanda Water and Forestry Authority	Rutsiro, Rubavu (2)

Table 22: Metadata from Water for Growth Rwanda overview of stakeholders

S/N	Sector	Number of Stakeholders	% of stakeholders	Stakeholders with close relation to water sector	% of stakeholders
1	Social (Education, health, women's empowerment etc.)	103	68.6	103	68.6
2	Agriculture (including livestock)	19	12.6	19	12.6
3	Environment protection and land	9	6	9	6
4	Water and sanitation /Hygiene	3	2	3	2
5	Justice and Governance + Peace Building	15	10		

6	Microfinance	1	0.6		
	Total	150	100	31	100

Table 23: Details on Stakeholders intervening in the catchment

Names of the Stakeholders	Sector of intervention	Main ongoing and future activities	Geographic area (district)	Address (email and phone)
Public/ Government				
MINAGRI	Agriculture and animal resources, irrigation	Land husbandry, Water Harvesting and hillside irrigation project (LWH)	Rutsiro and Nyabihu districts	Vestine 0788478639 Emmanuel TWAGIRAYEZU, Specialist 0788640537 twagem@yahoo.fr
REMA	Promote and ensure protection of environment and sustainable management of natural resources	The Landscape Approach to Forest Restoration and Conservation (LAFREC) project aims to demonstrate landscape management for enhanced environmental services and climate resilience in one priority landscape; the Gishwati-Mukura Landscape: - Buffer zone restoration - Biological connectivity between Mukura-Gishwati Forest reserve (corridor restoration) - Silvopastoralism Community driven development Lake Victoria Environmental Project Phase II (LVEMP) Decentralization and Environment Management Project (DEMP II)	All districts Ngororero district Rutsiro district	NSENGIYUMVA AUGUSTIN nsengaug@yahoo.com 0788677162
RNRA	leads the management of natural resources (land, water, forests, mines and geology). Responsible for implementation, supervision, and monitoring of natural resources	PAREF (Projet d' Appui à la Reforestation) Rwanda is a project that provides Afforestation programs in order to create a vibrant, healthy local ecology that ensure a	Rutsiro, Nyabihu and Ngororero districts	Claudien HABIMANA David HAKIZAYEZU 0783252813 0788696365 (Rutsiro district) Aaron 0783042106 (Nyabihu district)

Names of the Stakeholders	Sector of intervention	Main ongoing and future activities	Geographic area (district)	Address (email and phone)
	related programmes	sustainable management of Forest for sustainable growth of country's economy. Reducing Vulnerability to Climate Change in North West Rwanda through Community-Based Adaptation Project (RV3CBA) Rooftop Rainwater Harvesting in high density areas (RWH) All districts of Kigali City, Musanze, Nyabihu and Rubavu districts 1. Strengthening the existing loan scheme on RWH facilities; 2. Supporting a subsidy & loan system basing on Ubudehe categorization; 3. Disseminating very low cost (artisan) RWH techniques for rural poor households; 4. Constructing RWH systems for selected public buildings and integrated collective household systems.	Nyabihu district Nyabihu and Rubavu districts	Theophile Nshuti 0784869878 Alex Mulisa FONERWA Coordinator info@fonerwa.org
Local Administrative Entities Development Agency (LODA)	Promotes Local Economic and Community Development, Social Protection, and Capacity Building	Road Infrastructure Project	Rutsiro district	P.O.Box: 7305 Kigali, Rwanda 0788562560

Names of the Stakeholders	Sector of intervention	Main ongoing and future activities	Geographic area (district)	Address (email and phone)
				izabetoy@yahoo.fr info@loda.gov.rw Website: www.loda.gov.rw
National Agricultural Export Board (NAEB)	Facilitate the growth of business and to diversify agriculture and livestock commodity export revenues (Tea, Coffee, and Horticulture)	Promotion of coffee and local products to be exported	Rutsiro district	
WASAC Ltd	Providing reliable and affordable water and sanitation services		All districts	
REG	Development and provision of energy		All districts	
Private				
BRALIRWA	Brewery		Rubavu district	Sander Bokelman, Technical Director Bralirwa (Heineken)
Aquavirunga Ltd (Water Private Company)	Water management/ water systems rehabilitation	Manages water systems of Mutera and Yungwe-Bikore in the catchment (Rubavu, Nyabihu and Musanze) Construction of Mizingo water intake, renewal of the supply line and completion, renovation of the treatment plant Establishment of a fund for promotion of individual connections Extension works of Yungwe – Bikore, Mizingo – Mutera and Mutera water treatment plants	All sectors of Rubavu district, except Gisenyi and Nyabihu	P.O. Box 1630 Kigali/ Rwanda 0788524517 0728524517 aquavirunga@rwanda1.rw Website: www.aquavirunga.com
Inyenyeri Company	Environmental protection		Rubavu district	Eric Reynolds

Names of the Stakeholders	Sector of intervention	Main ongoing and future activities	Geographic area (district)	Address (email and phone)
LTD				0787484974 Faridi Karume 0788617876
(I)NGOs/Bilateral Cooperation				
BUCO (Bureau de Cooperation) Suisse	Environmental protection Water and Sanitation	-	Rutsiro district	0788300779 Rwagitareclaudesdc@yahoo.fr
INGO		1.		
International Alert	Environmental protection and conflict resolution	-	Rutsiro district	0788307784 alertinternational@yahoo.com
DelAgua	Environmental protection	DelAgua's health programme in Rwanda is targeted at providing individual households with a ready supply of clean drinking water (water filters) and an improved efficient means of cooking (Cooking stoves).	13 sectors of Rutsiro district All Sectors except Gisenyi, Rubavu, Nyamyumba, Rugerero, Nyundo, Kanama	Marie-Claire Nikuze Programme Coordinator Western Province 0788647895 P.O. Box 1594 Utehrwa Compound Kigali, Rwanda Office: (+250) 725.527.242 Josh Cell: 788300361 Jean Cell: 788481439 josh.kefauver@delagua.org jean.ntazinda@delagua.org
World Vision International	Agriculture Education	-	Rutsiro district	0788442546
Land O'Lakes	Livestock	-	Nyabihu district	0786112468 frank.obrien@idd.landolakes.com
International Fertiliser Development Center	Agriculture	-	Nyabihu district	0788382455 dgisselquist@ifdc.org
Local NGO		-		
Bureau d'Appui aux Initiatives Rurales (BAIR)	Agriculture, and livestock	Promoting modern agriculture and livestock	Nyabihu and Rubavu Districts	Anselme Nzabonimpa 0788523126 anselmenza@yahoo.fr

Names of the Stakeholders	Sector of intervention	Main ongoing and future activities	Geographic area (district)	Address (email and phone)
				0788634922/ 0788523126 bairgis@yahoo.fr
Caritas Nyundo	Farming Environmental protection	Programme d'Appui aux Initiatives Paysannes de Développement (PAIPD IV)	Nyabihu district	Mgr Alex HABİYAMBERE 0788851184 caritasnyundo2@yahoo.fr
REDO RWANDA NZIZA	Environmental management	Support to cooperatives	Nyabihu district	NSABIMANA Aloys 0788530434 arecorwa@yahoo.fr ansabina@yahoo.fr
Rwanda Green Initiative	Environmental management	-	Nyabihu district	NKUNDABANYANGA Ladislav Yassin 0784168819/0788835593 ladykazza2002@yahoo.fr
Arcos	Environment	Mukura	Rutsiro district	
FHA	Environment	Gishwati	Rutsiro district	0788852401
APEFA	Environment		Rubavu district	Oscar Apefa2007@yahoo.fr
Organisation pour le Travail et le Progrès (OTP)	Agriculture		Rubavu district	KIMENYI Clement clekime@yahoo.fr 0783182080 Nyirantibimenya Patricie nyirantibimenyap@yahoo.fr 0788890599

Annex 5. Multi-Criteria Analysis of alternatives

The pages overleaf provide the results of group work of the Catchment Task Force on 7 February 2017. Both groups worked independently but achieved the same results in terms of preferred alternative (PCB+).

Table 24: MCA scores of CTF, group 1

	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	2%	10%	16%	3%	3%	10%	16%	10%	10%	2%	2%	16%	100%	50%	20%	20%	10%	100%	
11_23_Fut_med																			
13_23_Alter_PASB	10%	11%	3%	3%	3%	-59%	41%	-80%	-11%	4%	2%	-10%	-8%	4	4	4	2	3.8	
14_23_Alter_PCB	20%	22%	3%	5%	6%	-57%	38%	-78%	-25%	8%	3%	-10%	-8%	6	8	6	6	6.4	
21_23_Alter_PCB+	38%	41%	8%	11%	10%	-68%	56%	-68%	38%	10%	3%	-10%	5%	7	7	6	8	6.9	
22_23_Alter_PCB-	28%	43%	8%	6%	7%	-54%	36%	-78%	-26%	9%	4%	0%	-3%	8	6	6	8	7.2	
33_30_Fut_med																			
35_30_Alter_PASB	10%	17%	25%	3%	4%	-57%	40%	-60%	-12%	4%	2%	-10%	-2%	3	3	4	2	3.1	
36_30_Alter_PCB	20%	29%	32%	6%	7%	-56%	35%	-62%	-27%	8%	4%	-10%	-1%	6	8	6	6	6.4	
43_30_Alter_PCB+	38%	46%	36%	12%	10%	-72%	66%	-67%	39%	9%	3%	-10%	11%	7	7	6	8	6.9	
44_30_Alter_PCB-	29%	50%	34%	7%	9%	-51%	32%	-62%	-29%	11%	5%	0%	3%	9	6	6	8	7.7	
55_50_Fut_med																			
57_50_Alter_PASB	10%	27%	0%	3%	4%	-17%	35%	-8%	-14%	4%	2%	-10%	3%	2	1	2	2	1.8	
58_50_Alter_PCB	20%	47%	0%	6%	8%	-23%	46%	-18%	-31%	9%	4%	-10%	4%	6	6	6	6	6	
65_50_Alter_PCB+	38%	66%	0%	13%	10%	-41%	65%	-36%	46%	7%	2%	-10%	14%	7	6	6	8	6.7	
66_50_Alter_PCB-	26%	64%	1%	8%	11%	-20%	29%	-18%	-36%	15%	6%	0%	5%	10	8	6	8	8.6	

Table 25: MCA scores CTF, group 2

	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	10%	16%	8%	3%	3%	10%	10%	10%	10%	2%	2%	16%	100%	20%	40%	30%	10%	100%
11_23_Fut_med																		
13_23_Alter_PASB	10%	11%	3%	3%	3%	-59%	41%	-80%	-11%	4%	2%	-10%	-9%	3	5	4	2	4
14_23_Alter_PCB	20%	22%	3%	5%	6%	-57%	38%	-78%	-25%	8%	3%	-10%	-8%	6	8	6	6	6.8
21_23_Alter_PCB+	38%	41%	8%	11%	10%	-68%	56%	-68%	38%	10%	3%	-10%	6%	7	7	6	8	6.8
22_23_Alter_PCB-	28%	43%	8%	6%	7%	-54%	36%	-78%	-26%	9%	4%	0%	-1%	8	6	6	8	6.6
33_30_Fut_med																		
35_30_Alter_PASB	10%	17%	25%	3%	4%	-57%	40%	-60%	-12%	4%	2%	-10%	-4%	3	3	4	2	3.2
36_30_Alter_PCB	20%	29%	32%	6%	7%	-56%	35%	-62%	-27%	8%	4%	-10%	-3%	6	8	6	6	6.8
43_30_Alter_PCB+	38%	46%	36%	12%	10%	-72%	66%	-67%	39%	9%	3%	-10%	10%	7	7	6	8	6.8
44_30_Alter_PCB-	29%	50%	34%	7%	9%	-51%	32%	-62%	-29%	11%	5%	0%	3%	9	6	6	8	6.8
55_50_Fut_med																		
57_50_Alter_PASB	10%	27%	0%	3%	4%	-17%	35%	-8%	-14%	4%	2%	-10%	4%	2	1	2	2	1.6
58_50_Alter_PCB	20%	47%	0%	6%	8%	-23%	46%	-18%	-31%	9%	4%	-10%	6%	6	6	6	6	6
65_50_Alter_PCB+	38%	66%	0%	13%	10%	-41%	65%	-36%	46%	7%	2%	-10%	17%	7	6	6	8	6.4
66_50_Alter_PCB-	26%	64%	1%	8%	11%	-20%	29%	-18%	-36%	15%	6%	0%	9%	10	8	6	8	7.8

Annex 6. SDGs informing catchment vision

During the scoping workshop in March 2016, a separate session was held on developing a catchment vision inspired by the UN Sustainable Development Goals.

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 own sector angle or 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.

* there are 17 SDGs in total. Three were taken out of the exercise: 14) Marine ecosystems is not relevant for land-locked Rwanda, whereas 16) peace, justice, and strong institutions, and 17) partnerships for the goals were considered too abstract at the level of this discussion.

As a result of the session the top 4 SDGs mentioned were:

- 4 SDG 15: Life on land: Sustainably manage forests, combat desertification, halt and reverse land degradation, halt biodiversity loss was clearly considered to be of basic importance to all other goals. Participants argued that if land, ecosystems, and biodiversity are not well managed and integrated into planning, all other goals cannot be achieved;
- 5 SDG 6: Clean water & sanitation, ensure access to water and sanitation for all came second very clearly in the district groups and shared second in the IWRMD/ISU group with SDG 12: Responsible consumption and production, specifically 12.1: sustainable management and efficient use of natural resources;
- 6 SDG 12: Responsible consumption and production: Ensure sustainable consumption and production patterns;
- 7 SDG 2: Zero Hunger: End hunger, achieve food security and improved nutrition and promote sustainable agriculture.

Further detailed group analysis of SDG targets gave added values to the above selection:

- § SDG target 15.1 Conservation, restoration & sustainable use of land and freshwater ecosystems and their services;
- § SDG target 12.2 Sustainable management and efficient use of natural resources;

- § SDG target 6.5 Integrated water resources management (trans boundary cooperation);
- § SDG target 11.5 Reduce disasters, including water-related disasters (poor & vulnerable).

Annex 7. 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	January
		B	M	T	W	Th	F	S	S	M	T	W	Th
1	Decision Making on CPs version 1.0												
2	Submit CPs to FG and PSC												
3	Review of CPs by Focal Points												
4	Focal Group recommendation to PSC												
5	Update Cost Benefit Analysis for CP version 1.0												
6	PSC approval of CPs version 1.0												
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 2017-2022												
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 2017-2022												
52	WASH Sector												

Project: 20170310 CP plan process

Date: Wed 15/03/17

Task

Milestone

Summary

Project Summary

External Tasks

External Milestone

Inactive Task

Inactive Milestone

Manual Task

Duration-only

Manual Summary Rollup

Manual Summary

Start-only

Finish-only

Deadline

Progress

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