



FINAL REPORT AKAGERA LOWER CATCHMENT

Socio-economic and Livelihoods Assessment in Akagera Lower Catchment, Rwanda

Executive Summary

This assessment aims to analyse current status of socio-economic and livelihoods conditions of communities living in Akagera Lower (NAKL) Catchment. The study was conducted further to provide analysis on economic and financial benefits through Cost-Benefit Analysis (CBA) of landscape restoration options, livelihoods opportunities, interventions and key stakeholders. The assessment has employed both primary and secondary data to validate the study's objectives and respond to the research questions. Primary data was collected from stakeholders' consultation workshop, Focus Group Discussions (FGDs) with opinion leaders, Key informant interviews, and Household Survey among 325 households from five districts covered by the NAKL Catchment: Nyagatare, Gatsibo, Kayanza, Ngoma and Kirehe. With respect to secondary data, social and economic characteristics in the NAKL Catchment were collected from secondary sources such as District Development Strategies (DDS), national survey reports released by National Institute of Statistics of Rwanda (NISR), and other relevant administrative data.

This report provides the findings on socio-economic profile and biophysical conditions driving people's livelihoods in the NAKL Catchment, economic and financial Cost-Benefit Analysis (CBA) of Landscape Restoration options. It also provides innovative suggestions on prioritizing proposals, combining livelihood improvements/ opportunities and biophysical catchment restorations for optimizing economic and ecological benefits. Survey results sustain that the NAKL catchment is characterized by high population density and growth with over-reliance on natural and forest resources. The increased population density in Akagera Lower area is evident and the area has received high different migrants as 63.4% of people moved to the area by purchasing land or through government resettlement. Only 47.4% of the residents confirmed to have gained ancestral land where they live and cultivate. This in turn increases the demand for land both for agriculture, livestock and settlement. Further, results portray a low rate of secondary school attendance which possibly translates into low employment in white collar jobs, which require high education and skills level. The dominant agriculture sector mainly regarded as subsistence farming becomes then the option at hand. Moreover, about 74% of respondents drawn their income from selling of crop and livestock products. However, the sector is still facing some challenges such as little value addition, minimal mechanization and irrigation, invasion by pests and diseases as well as inadequate post-harvest holding facilities. Knowing the context we are in currently, the study also assessed the impacts of Covid-19 on people's income mainly drawn from farm related activities.

Along with livelihood capitals considered for this assessment, key livelihoods issues and proposed solutions have been identified and suggested by the community during the survey. The proposed solutions are expected to improve people's livelihoods in the NAKL Catchment as described below. These are yet to be explored further in the course of developing a catchment management plan:

Issue # 1: There is water shortage for home consumption, agriculture, and livestock. Water shortage has been identified as one of the major issues facing improved livelihood conditions. Majority of respondents use public taps and tap on property (41.5% and 12.6%, respectively) as their primary source of water for home consumption. **Proposed solution (s) # 1:** Construction of a robust irrigation system to support

farmers finding water in sunny season and construction of stretched dams to collect and store water for both farming and livestock.

Issue # 2: Citizens in the NAKL Catchment face the challenge of insufficient access to alternative energy sources for cooking, resulting in intensive use of forestry resources, mainly for firewood. After the resettlement of some families in the region (during 1997), cutting trees for firewood and charcoal has increasingly been a significant issue facing the park and the entire catchment. Survey results show that about 87% of respondents still rely on firewood and hence cutting trees and the main source of energy. **Proposed solution (s) # 2:** Establish more tree nurseries nearby different villages to facilitate more tree plantation and forestation.

Issue # 3: Land ownership is not an issue; instead, its efficient management and use are the main issues facing the NAKL catchment population. Households allocate their lands mainly for agriculture and livestock farming activities individually or combined for some farmers. However, challenges remain about the household's ability to manage the lands, address soil erosion, and increase its fertility for improved yield. **Proposed solution (s) # 3:** Increase adoption of agriculture technologies and best practices, promote agroforestry systems for increasing organic fertilizer supply and enforce cultivation of crops based on soil suitability guidelines.

Issue #4: Markets for agricultural products are imperfect and distant, leading to low agricultural income. A big share of produced maize is sold, followed by beans to earn agricultural income. But survey respondents have claimed for lower commodity prices and distant markets. They mainly rely on local markets and cannot sell in other national markets to benefit from positive marginal prices. **Proposed solution (s) # 4:** Facilitation of access to markets through cooperatives, introduction of E-commerce, especially for commercial crops, and investment in post-harvest handling facilities (i.e., cold rooms for vegetables and other horticulture crops).

Issue # 5: Women are less financially included as compared to men: Women are less financially included, 68.9% than 80.1% of men. The majority of respondents rely on financial products and services by SACCOs (58.4%) and less on commercial banks (17.9%) and revolving savings/loan schemes (15.8%). **Proposed solution (s) # 5:** Design and implement innovative financial products adapted to women through Business Development Fund (BDF) and other financial institutions

Issue # 6: Most of the activities performed through cooperatives are related to farming than other off-farm activities. Agriculture-related activities are the most performed through these cooperatives and less on other non-farm activities (63%) followed by savings and lending-related activities (27.4%). **Proposed solution (s) # 6:** Create more cooperatives involved in off-farm activities or encouraging diversification of their activities and construction of "Udukiriro" with preliminary equipment.

Furthermore, the financial CBA analysis has been performed to to inform on potential benefits associated with the investment in land restoration, and the analysis of financial options. Main focus was given to large and small scale irrigation as the main landscape restoration option reported by the study's findings. The assessment also considered financial models/ opportunities of other landscape restoration options necessary to address the described catchment related issues. These include water reservoir with dam

sheet and water boreholes and land husbandry options such as radical terraces, progressive terraces, agroforestry/forestry, rainwater harvesting and river bank protection with bamboos. In line with livelihood opportunities identified along the five sustainable livelihoods approach's capitals from key livelihoods issues, the assessment suggested interventions for improved livelihood conditions and landscape restoration (landscape strategies) as well as relevant key stakeholders likely to implement the proposed landscape strategies. More importantly, the assessment summarized key landscape issues with their respective landscape restoration responses using DPSIR framework.

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List of Acronyms

AFR	Access Finance Rwanda
BDF	Business Development Fund
BMGF	Bill & Melinda Gates Foundation
BNR	Bank National du Rwanda
BRD	Development Bank of Rwanda
CBA	Cost Benefit Analysis
CROM DSS	Catchment Restoration Opportunity Mapping Decision Support System
EC	European Commission
EIB	European Investment Bank
EKN	Embassy Kingdom of Netherlands
FAO	Food and Agriculture Organization
FGDs	Focus Group Discussions
FONERWA	Rwanda Green Fund
GMO	Gender Monitoring Office
ICRAF	International Centre for Research in Agroforestry
IFAD	International Fund for Agricultural Development
IUCN	International Union for Conservation of Nature and Natural Resources
JADF	Joint Action Development Forum
KIIs	Key Informant Interviews
KIIWP	Kayonza Irrigation and Integrated Watershed Management Project
LODA	Local Administrative Entities Development Agency
MFIs	Micro-Finance Institutions
MINAGRI	Ministry of Agriculture and Animal Resources
MINICOM	Ministry of Trade and Industry
MININFRA	Ministry of Infrastructure
MINIRENA	Ministry of National Resources of Rwanda
MoE	Ministry of Environment
MYICT	Ministry of ICT and Innovation
NAEB	National Agricultural Export Development Board
NAKL	Akagera Lower Catchment
NDCs	Nationally Determined Contribution
NISR	National Institute of Statistics of Rwanda
NPV	Net Present Value
NST-1	National Strategic Transformation
PSTA	Strategic Plan for Agriculture Transformation
RAB	Rwanda Agriculture and Animal Resources Board

RCA	Rwanda Cooperative Agency
REMA	Rwanda Environmental Management Authority
RFA	Rwanda Forestry Authority
RMB	Rwanda Mines, Petroleum and Gas Board
ROAM	Restoration Opportunities Assessment Methodology
RWB	Rwanda Water Resources Board
SACCO	Saving and Credits Cooperatives
SDGs	Sustainable Development Goals
SLA	Sustainable Livelihood Approach
UNDP	United Nations Development Programme
UNECA	United Nations Economic Commission for Africa
UNEP	United Nations Environment Programme
WASAC	Water and Sanitation Corporation
WB	World Bank
WFP	United Nations World Food Programme

1. General introduction

1.1 Background

Concerns over sustainable land and water resources management in upstream and downstream catchments have received much attention worldwide for their crucial role in improving nearby community's livelihoods (Tantoh et al., 2019; Behnke et al., 2017; Tantoh and Simatele, 2018; FAO, 2008). Despite previous efforts, land degradation and mismanagement of water resources continue to be significant threats to sustainable livelihoods and decrease the resilience of the ecosystem (Hochstrasser et al., 2014; Stoorvogel et al., 2017) while affecting human well-being (Bossio et al., 2004; Groot, 2016). These deficiencies, among others, are strongly linked to rampant poverty, food insecurity, disease epidemics, economic and social instability, and migrations in different parts of Africa (Stoorvogel et al., 2017; Gibbs and Salmon, 2015; Nyasimi, 2007).

Linkages between degradation of the environment and poverty status have been so far established. On the one hand, environmental degradation causes an obstacle to overcome poverty, but also the latter can aggravate environmental problems resulting from unsustainable practices of the use of natural resources (UNDP and UN Environment, 2018). Several studies point out the environment-related problems like climate change, heavy rainfall, flooding, overflows of rivers, landslides, soil erosion, soil infertility, the change in temperatures, etc., that affect the livelihoods. Such problems are linked to food insecurity in households and a lack of products for markets (UNDP and UN Environment, 2018; Thiry et al., 2018). The natural resources commonly affected by environmental problems are soil and water. Globally, it is estimated that nearly 15% of the population, equivalent to over one billion people, live in degraded areas caused mainly by human activities, negatively affecting the well-being of about 3.2 billion people (FAO, 2015; IPBES, 2018).

Without quick actions on this matter, land degradation will continue to make people vulnerable to the shocks. Subsequently, the restoration of the catchments calls on adapted land-use methods, which will influence both the biophysical and socio-economic conditions of affected communities (Keiti et al., 2016). The restoration approaches of the catchments include immediate and long-term actions for water and land resources management. Further, the restoration is expected to be done through participatory integrated watershed methods to support a productive environment and sustainable management of ecosystem services (Adimassu et al., 2017; Liu et al., 2011; Rutebuka et al., 2019).

Landscape restoration interventions are meant to consider both the notions of bio-physical and socio-economic dynamics, focusing on land and water resources and livelihoods of communities in the up-and down-streams. As already indicated, there is ample evidence of the nexus between catchment restoration and socio-economic development and livelihood conditions of people or communities in the catchment (IPBES, 2018; UNDP, 2019). This nexus is explained by the extent to which society affects landscape condition, and in turn, landscape affects the community's livelihoods. Therefore, better land and water resources management is essential for sustainable economic development (UNESCO, 2015).

From the global perspective, land and water resources are typically captured under three Sustainable Development Goals (SDGs):

- *SDG-6* on ensuring availability and sustainable management of water and sanitation for all;
- *SDG-13* entails the need for urgent action to combat climate change and its impacts;

- SDG-15 protects, restoring, and promotes sustainable use of terrestrial ecosystems; sustainably manages forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss (UN, 2017).

Within the SDGs framework, the economic, social, and environmental dimensions must be advanced together to explicitly integrate natural resources in poverty alleviation programs by 2030 (Thiry et al., 2018). The initial gap analysis of the integration of SDGs in Rwanda has shown that some indicators of these goals are already considered in the sector-level planning strategies while others are yet to be integrated and monitored (Bizoza, 2016).

1.2 Country context

Efficient management of natural resources remains a core development goal towards socio-economic transformation in Rwanda. This is reflected as critical in the national development policies, including the National Policy for Water Resources Management (MINIRENA, 2011) and its master plan (MINIRENA, 2015), and National Strategy for Climate Change and Low Carbon Development to deeply prevent the degradation of natural resources including land and water. Recently released Vision 2050 and its National Strategic Transformation (NST1) have prioritized protecting the country's natural capital (such as land and water) as an integral part of Rwanda's quest towards sustainable transformation.

Studies indicate that the contribution of natural resources to economic growth and poverty reduction is increasingly being compromised. This is partly due to imbalances between the population and the natural resources, especially in rural areas (MoE, 2017), aggravated by the high vulnerability caused by the undulating terrain, susceptibility to erosion, and climatic hazards. Approximately 72% of the total population earns their livelihoods from rain-fed subsistence agriculture (NISR 2015), whereas 13% of households in Rwanda have experienced cases of environmental problems, most of them (57%) about heavy and destructive rains and droughts (NISR, 2018). Notably, rural areas (94%) with land majorly allocated for agriculture farming and livestock production are more susceptible to natural hazards (NISR, 2018) while they are the primary source of income. Therefore, the country has engaged in the sustainable management of natural resources as reflected in various policies.

In Rwanda, the degradation of the catchments constitutes a severe threat to economic development and sustainable resource management (IUCN, 2017). A catchment is based on a geo-hydrological landscape comprising land, water, and other resources used to sustain human and socio-economic development. Cognizant of the importance of land and water, the remaining issue is how the community, with or without government interventions, could manage these two resources effectively and efficiently to help achieve the development goals in a sustainable way and without compromising their use by future generations. Catchment restoration presents multiple economic benefits, especially to farmers and communities, such as improved productivity (the Republic of Rwanda, 2017). Its related interventions like reforestation of high erosion risk areas combined with land husbandry measures (like terracing and water supply by irrigation) and climate-smart agriculture practices could allow farmers to continue farming and sustain the soil's long-term productivity without causing any form of land degradation (MoE, 2018).

Currently, land and water resources face challenges of degradation arising from pressures of rapidly growing demographic patterns, the demands of intensified socio-economic development, unsustainable and inappropriate land-use practices, and the uncertainties created by climate change (UNEP, 2011; Nambajimana et al., 2019; Kagabo et al., 2013; Karamage et al., 2016; Rutebuka et al., 2019). The behavior

and use of natural resources vary in respective to contrasting agro-climatic conditions in Rwanda. The catchments in the highlands are prone to water erosion-related disasters. In contrast, those in the eastern lowlands dominantly have issues related to droughts and rainfall shortage, negatively affecting agriculture and other land investments. There is erosion in steep lands and floods or siltation in the valley from on-site or off-site sources (Mupenzi et al., 2011; Okoba and De Graaff, 2005). Loss of biodiversity is affecting the ecosystem services of the two study sites.

Countrywide, 13.1% of households were affected by environmental destruction (disasters), with 56.8% resulting from heavy and destructive rains, 22% from mountains slides, 6% from floods, and 15.1% from other disasters (NISR, 2018). However, this indicates the households' perceptions, while multiple problems were not captured. UNEP (2011) highlighted multiple variables influencing soil erosion rates: soil type, drainage, vegetation cover, the slope of the land, land-use practices, while Nambajimana et al. (2019) showed that socio-economic causes are one of the major driving forces of accelerated soil erosion in Rwanda. The fact is that the environment can have adverse effects on humans; hence effective measures should be taken.

Rwanda and its partners have initiated different interventions to manage natural resources better, mainly land and water. The catchment development plan must establish national or regional integrated water resources management incorporating community-based or participatory context (GoR, 2011). This catchment planning necessitates the protection of natural resources in ways that would allow financial, economic, social, and environmental benefits. For this reason, the water resources master plan came up with a catchment-based water resource management approach (MINIRENA, 2015). Subsequently, the country is subdivided into nine levels one catchments and twenty levels two catchments that could help to manage and develop land and water resources within an integrated and sustainable manner (Figure 1). This Master plan targets to secure and provide water resources to satisfy the social and economic needs of the present and future generations with the full participation of all stakeholders in the decision-making process. Principally, the nine level one catchments are derived from two hydrographic basins of the country territory, namely the Nile basin at 67% coverage and the Congo Basin at 33% coverage (MINITERE, 2005). Thus, this study implements a catchment-based development plan in Akagera lower.

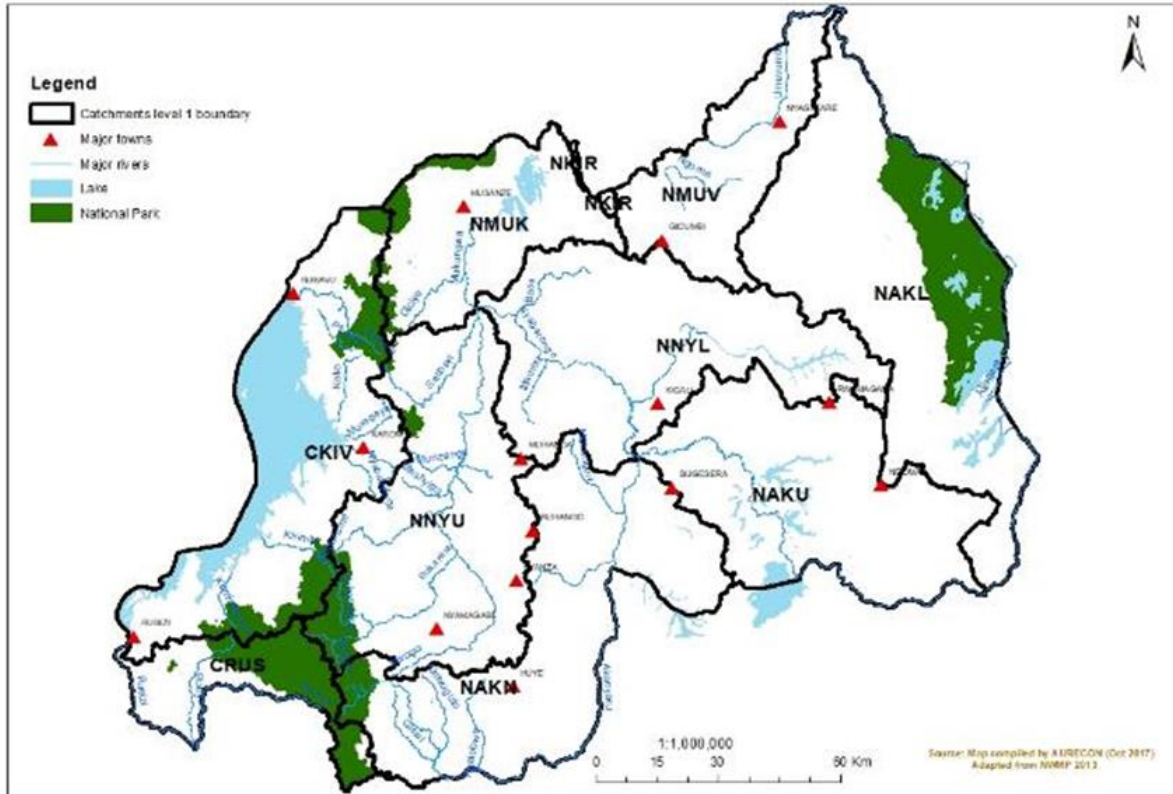


Figure 1: Rwanda level one catchments

1.3 Physical Characteristics of Akagera lower catchment

The Akagera lower (NAKL) catchment concerned in this study is one of the nine catchments in Rwanda, as previously described. The catchment is located in the low eastern plateau (Figure 1). Like other places of the Eastern part of Rwanda, the lower Akagera catchment is mainly affected by drought, and steep slope lands can induce erosion, flooding, and siltation in the lowlands and valleys that might be resulted from on-site and off-site effects. They consequently produce the destruction of humans and the environment as well. The catchment is quite extensive, occupying 4228 km², and features numerous lakes and two tributaries. It touches parts of the Nyagatare, Gatsibo, Kayonza, Kirehe, and Ngoma districts of the Eastern Province (Figure 2).

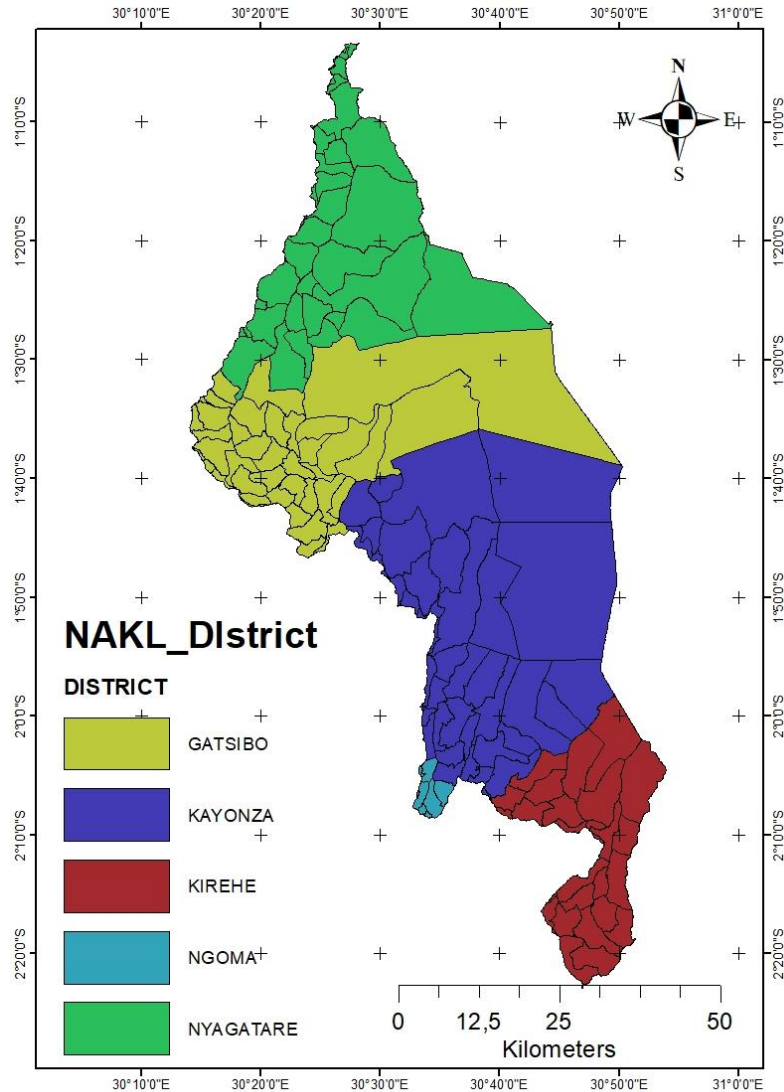


Figure 2: Illustrative map of Akagera lower catchment (NAKL)

Furthermore, the Akagera lower catchment is the driest part, receiving only 835mm/year on average. This makes it a government's priority in terms of development interventions due to low rainfall amounts and the availability of water from the Akagera River and mild terrain slopes; it renders the development more accessible from the technical, economic, and operational points of view. This catchment drains the flow from the Upper Akagera and the Ruvubu rivers. The Lower Akagera River flows through a broad and highly flat valley with numerous lakes such as Ihema, Nasho, Kimvumba, Rwanyakizinga, Mirindi, Cyambwe, and Hago, which either function as buffers during extreme flows or drain into the river. The river forms the boundary between Rwanda and Tanzania for its entire course to the North, from where it takes a sharp turn East towards Lake Victoria. The river is a significant feature of the Akagera National Park (1,021km², 24% of the total catchment area).

1.4 Past experiences of catchment restoration

Since 2008, the catchment restoration approach has been successfully implemented in other areas such as Gishwati with a coverage of 6,600 ha and various sites across the country with Land Husbandry, Water harvesting, and Hillside irrigation interventions. This was made possible by the strong community involvement in the development initiatives and adopting an integrated watershed management approach. The latter involved relocating people residing and using high erosion risk lands, empower and build the capacity of resettled residents with the active involvement of stakeholders. Consequently, this has facilitated establishing comprehensive water and land management infrastructures to address frequent landslides and flooding effectively. As a result, such infrastructures have allowed sustainable exploitation of the land, leading to benefits for local farmers and the country's economy in general.

1.5 Rationale of the study

The rationale of this study is to document prevailing socio-economic conditions in the NAKL catchment to contribute to the development of the management plan of the same catchment. The study is also to provide relevant information needed for socio-economic profiling of the NAKL catchment to inform the planning and implementation of livelihood interventions and the development and management of the catchment. In addition, based on the assessment of landscape restoration options, this piece of the study identifies the needs and opportunities that support sustainable livelihoods considering available land and water resources by optimizing economic and ecological benefits therein NAKL catchment, Eastern Rwanda.

1.6 Overall goal and specific objectives of the study

The overall objective of this assignment is tripartite. First, the aim is to conduct a socio-economic assessment to thoroughly understand the livelihood conditions that rely on land and water resources. In the same line, assess the opportunities to reduce over-reliance on these natural resources, favoring alternative and innovative income-generating activities in Akagera lower catchment. Secondly, conduct a Cost-Benefit Analysis (CBA) of the dominant possible landscape restoration options identified based on biophysical analysis. The third is to provide innovative suggestions on prioritizing proposals, combining livelihood improvements and biophysical catchment restorations for optimizing economic and ecological benefits.

1.7 Scope of the socio-economic assessment of the NAKL Catchment

Concerning the scope, this study analyzed people's livelihood conditions as linked to land and water resources management, economic-based feasibility conditions of the landscape restoration of the affected catchments, and the financial appraisal of proposed development options to address the frontiers of improved people's livelihoods. For this to happen, two clusters of activities were carried out to validate the above study's objectives: *activities required to make a robust household economic analysis and activities related to economic and financial analysis of catchment restoration options based on biophysical analysis.*

Cluster 1: Activities required to make robust household economic analysis:

- (1) Assess the socio-economic situation in Akagera lower catchment to understand the available resources and assets, opportunities and constraints, and goals of the communities;

- (2) Conduct livelihood analysis in the two catchments with considerations of households' food security and seasonal food availability;
- (3) Identify gender & culture responsive and inclusive alternative income-generating activities for livelihoods diversification that will reduce pressure from over-reliance on land and water resources;
- (4) Develop proposals for interventions based on livelihood assessment and critical stakeholder/expert consultations, outlining financing resources requirements for implementing the identified livelihoods. The resource requirements should include capacity building, enterprise development, and marketing options, among others.
- (5) Identify the roles and responsibilities of all stakeholders who are and will be involved in livelihoods opportunities identified;
- (6) Present the assessment results to stakeholders in a validation workshop to represent communities engaged, government, and relevant collaborating groups. The feedback thus provided should be incorporated into assessment and recommendations.

Cluster 2: *Activities that are in line with economic and financial analysis of catchment restoration interventions based on biophysical analysis:*

- (1) Collect and analyze market data and economic value for ecosystem goods and services from restoration interventions.
- (2) Prepare enterprise budgets for each restoration intervention in the opportunities mentioned in the content scope.
- (3) Conduct a Cost-Benefit Analysis for investment in priority restoration options for Akagera with projections under different scenarios.
- (4) Analyze market dynamics that influence/contribute to catchment degradation and land restoration and identify opportunities for using market-based solutions to catchment degradation and land restoration.
- (5) Analyze financing opportunities available to implement restoration measures and propose financing models that will foster sustainability measures considering resilience and food security of communities that rely on the catchment resources.
- (6) Recommend strategies that will foster gender responsiveness and inclusivity of the proposed restoration interventions.

2. Methodology

This section describes the methodology process opted in gathering needed information to respond to this study's questions in the Akagera Lower catchment in the Eastern Province, Rwanda. The logic of the methodology used is to collect data and conduct the analysis in a sequential phase, as described in the following sub-sections.

2.1 Study approach

A deeper analysis of raised issues facing the study area calls for a mixed research approach. A multiscale and participatory integrated catchment management approach was applied to collect both quantitative and qualitative data (Q²approach). Besides the in-depth review and collection of existing relevant secondary data and interviews with key stakeholders and partners at catchment and national levels, the field level data collection involves a three-stage process:

Stage 1: Categorizing landscapes based on vulnerability levels to degradation of natural resources in the catchments. Three categories of the landscape have been clustered and mapped: (1) with low, (2) moderate, and (3) high vulnerability classes aligning to land and water degradation risks. These classes are retrieved from the current information developed by the CROM DSS (Catchment Restoration Opportunity Mapping Decision Support System) tool (MoE, 2020) (Figure 3), Restoration Opportunities Assessment Methodology (ROAM), and the use of other available biophysical databases with the help of GIS tools. This categorization informs on commendable landscape restoration options from both biophysical and livelihood perspectives. This categorization of the landscape helps to respond to this study's scope, providing a combination of livelihood improvements and biophysical catchment restorations to optimize socio-economic and ecological benefits.

Further, some specific criteria have influenced the choice of these categories. For instance, drought conditions were the leading categorization criteria in the NAKL catchment. According to ground-truthing information in the NAKL, the categorization was divided into two environment vulnerability levels, i.e., high drought-prone areas in proximity to Akagera National Park and those with low drought conditions. Erosion risk issues were also considered in particular areas as identified by the CROM tool within each catchment. This mainly covers Kirehe and Kayonza districts. Areas with the highest drought vulnerability level include Ndego, Kabare, and Mwiri sectors in Kayonza, Karangazi, and Rwimiyaga sectors in Nyagatare, and finally, Rwimbogo and Kabarore sectors in Gatsibo district. Table 1 below demonstrates the number of administrative entities and sampled households at sectors. The number of households surveyed in each administrative entity depended on districts and sectors' coverage areas.

Table 1: The study area: population size and area covered by Akagera Lower (NAKL) catchment

District covered	Estimates of total households (Census 2012)	Area (ha) covered by catchment	Weight (%) based on area covered by the catchment	Sample households
Nyagatare	105 365	96 650	22.58	56
Gatsibo	96 320	113 461	26.5	90
Kayonza	80 517	162 760	38.02	117
Ngoma	79 647	3 306	0.77	21
Kirehe	77 879	51 921	12.13	41
Total	439 728	428 097	100	325

Source: NISR (2012): Fourth Population and Housing Census (4PHC) – 2012, **ArcMap GIS**

Stage 2: The second stage consisted of distributing the sample size according to the coverage area of the sectors within the catchments. In the NAKL, the sample size distribution followed drought-prone vulnerability levels, which are also consistent with neighboring or not to Akagera National Park in the Eastern province, Rwanda.

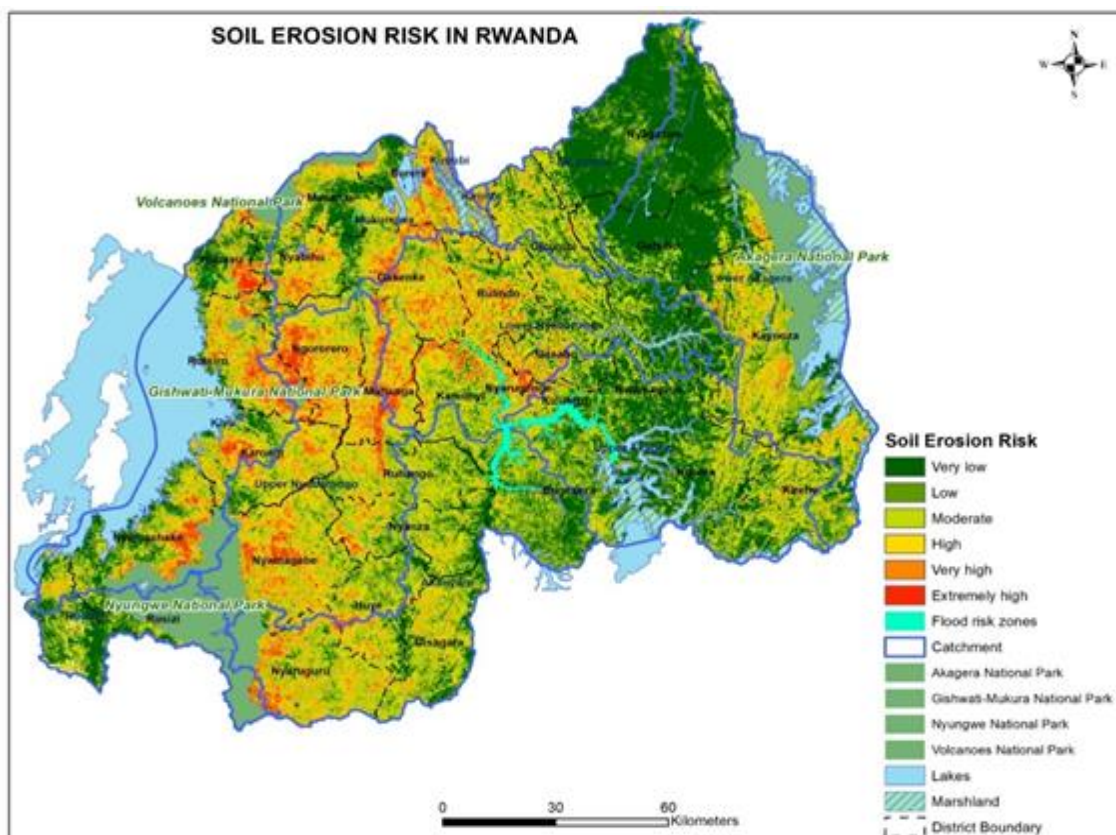


Figure 3: Erosion risk maps in Rwanda from CROM-DSS (RWB, 2018)

Stage 3: The third stage consisted of proposing sustainable catchment restoration interventions appropriate to Akagera lower catchments based on the financial and economic cost-benefit analyses combined by identifying sustainable livelihood options.

2.2 Sampling techniques

A sample population was obtained from the administrative entities located within the studied catchment (see Table 2). The sample size is computed based on estimates of total households within districts. The names of districts and sectors that are covered by the surface of the NAKL catchment have been identified and are presented in Table 2:

Table 2: Study area and population in Akagera Lower catchments

DISTR ICT	SECTOR	Survey respondents	DISTR ICT	SECTOR	Survey respondents
G A	GATSIBO	18	K A	KABARE	20

NYAGATARE	KABARORE	16	KIREHE	KABARONDO	24
	REMERA	18		MURUNDI	19
	RUGARAMA	16		MWIRI	15
	RWIMBOGO	21		NDEGO	20
	KARANGAZI	19		RWINKWAVU	19
	KATABAGEMU	19		MPANGA	9
	MATIMBA	19		NASHO	11
NGOMA	KIBUNGO	10		NYAMUGARI	12
	REMERA	10		NYARUBUYE	10
		Total			325

Based on the total number of households, we followed Krejcie and Morgan (1970) to determine the sample size:

$$n = \frac{\chi^2 * N * p(1-p)}{(ME^2 * (N-1)) + \chi^2 * p(1-p)} \quad [1]$$

Where:

n : sample size,

χ^2 : Chi-square for the confidence interval (C.I) of 95% at 1 degree of freedom (3.841),

N : Population size (N: 439,728 HHs in NAKL),

p : Population proportion (assumed to be 0.50 as no additional information about the population characteristics was provided and since this would provide the maximum sample size),

ME: Desired Margin of Error (5%).

Therefore, the representative sample estimated a total of 325 households in Akagera Lower catchment.

2.3 Data collection techniques

As per the above methodology, data were collected through a desk review, quantitative survey (household surveys based on livelihood vulnerability assessment and landscape identification tools), qualitative survey (Focus Group Discussions (FGDs), Key Informant Interviews (KIIs), and spatial tools (ArcGIS) to characterize various landscape variability in the study catchment.

2.3.1. Desk Review

Before data collection, the research team from the Centre reviewed the relevant documents to have a deep understanding of the significant features of the catchment. In addition, the study examined the existing policies, strategies, and catchment plans. In addition, the research team made a closer reference to catchment plans previously developed, such as Sebeya, Nyabarongo, and Muvumba, to learn further on the best practices and lessons learned to inform on the prospects of this assessment.

2.3.2. Qualitative Survey (FGDs and KIIs)

Qualitative information was collected through Focus Group Discussions (FGDs) and Key Informants Interviews (KIIs) before proceeding to an extensive household survey. We have used a bottom-up approach to better understand existing issues and possible solutions in the study area. At the start, community and local stakeholders living or working in the catchments were consulted using FGDs to comprehend the community's opinions and preferred intervention options. Local leaders were targeted to capture the historical perspective and the dynamics within the catchment. Key stakeholders and partners were also consulted during stakeholder consultation meetings in Akagera Lower (27-28 April 2021).

2.3.3. Quantitative survey or household survey

Primary data were collected following the study's objectives and scope detailed in section two (2) of this proposal. The household survey was undertaken in all districts covered by the catchment, and the target population was the community residing within the catchment. For this purpose, a structured questionnaire was developed and translated from English to Kinyarwanda. The questionnaire was pre-tested to validate its relevance and test its comprehensiveness (if questions are clearly stated and restated). A pre-test survey was organized to help the enumeration team to be familiar with the questionnaire. The enumeration team was deployed to locations other than those included in the sample administrative entities (villages). Before the pre-testing phase, the L4D research team shared the questionnaire with IUCN and RWB technical teams for validation and approval during the inception. The data collection through questionnaires was programmed and preloaded onto tablets using SurveyCTO to allow data quality checks. Before the data collection, 26 enumerators were recruited and trained on the scope of work and questionnaire. For inclusion and gender consideration, females were about 45% of total enumerators. After training, 20 enumerators and two supervisors were selected for field activities based on various assessments. A team of enumeration was trained and dispatched in the catchment for data collection. Each team had 10 enumerators and 1 supervisor. Two research assistants and 2 consultants conducted qualitative interviews (FGDs and KIIs). To ensure data quality, a STATA "Do-file" was designed for daily data quality. Each evening, enumerators received feedback on data collection progress and areas of improvement.

2.4 Analytical framework

In livelihood analysis, socio-economic situation (situation analysis) was assessed in the Akagera Lower catchment to understand the available resources and assets, opportunities and constraints, and goals of the communities. This assessment helped predict future effects of livelihood interventions and assisted the communities in dealing with future changes. It also provides a better understanding of the scale and distribution of costs and benefits of changes while seeking to maximize positive effects and minimize adverse effects resulting from observed changes in people's welfare. The livelihood analysis focused much

on descriptive analysis rather than inferential. Information considered is related to individual, household, and community levels and those about biophysical catchment resources.

2.4.1. Sustainable Livelihood Approach (SLA)

The conceptual framework proposed in Figure 4 has to combine both livelihood improvement and biophysical restoration analyses to sustain the catchment management while improving people’s livelihoods. In this respect, the DFID’s Sustainable Livelihood approach (SLA) was also followed (see Figure 5). It allows to establish the socio-economic conditions prevailing in the catchment in relationship to the five capital dimensions also known as assets: human capital, natural capital (e.g., access to land and water), financial capital (e.g., markets), social capital (e.g., community organizations and collective actions), and physical capital (e.g., road infrastructure). Further, the approach is used to the community's vulnerability as related to these assets or opportunities influencing their dynamic use. Some of the expected outcomes assessed through the SLA include more income, improved well-being, reduced vulnerability, improved food security, and more sustainable use of natural resources (Dearden et al. 2002).

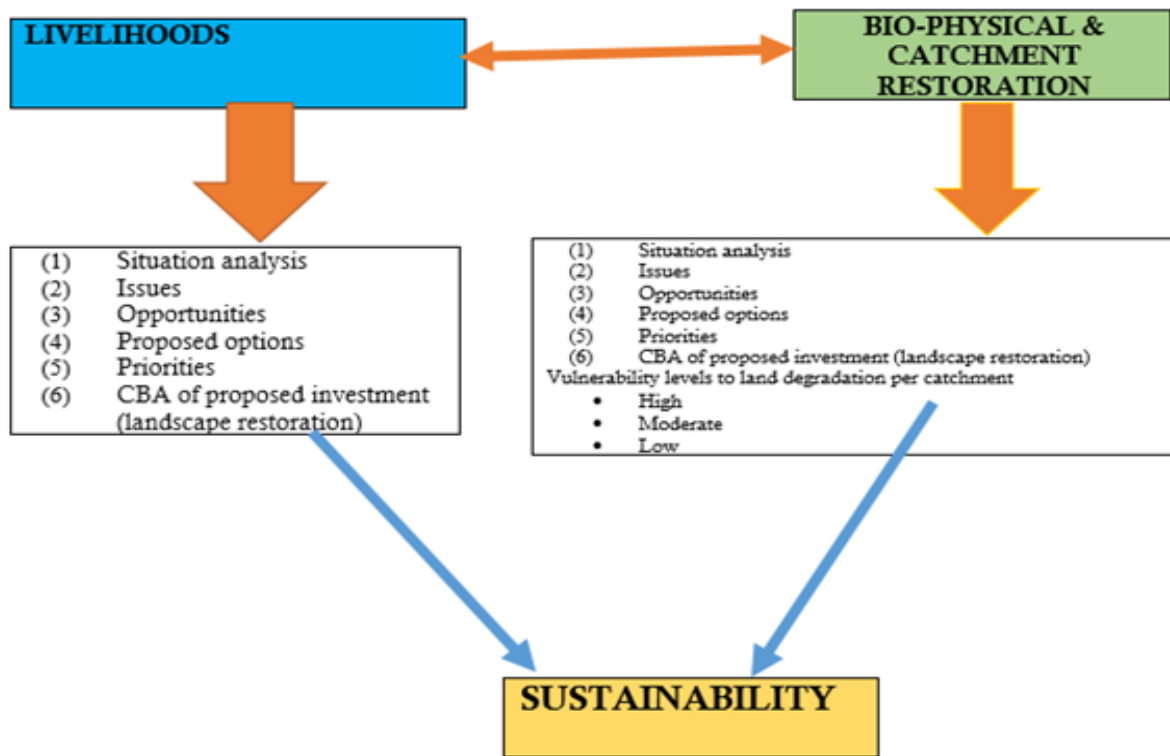


Figure 4: Proposed analytical framework integrating sustainable livelihoods management and landscape restoration (Authors)

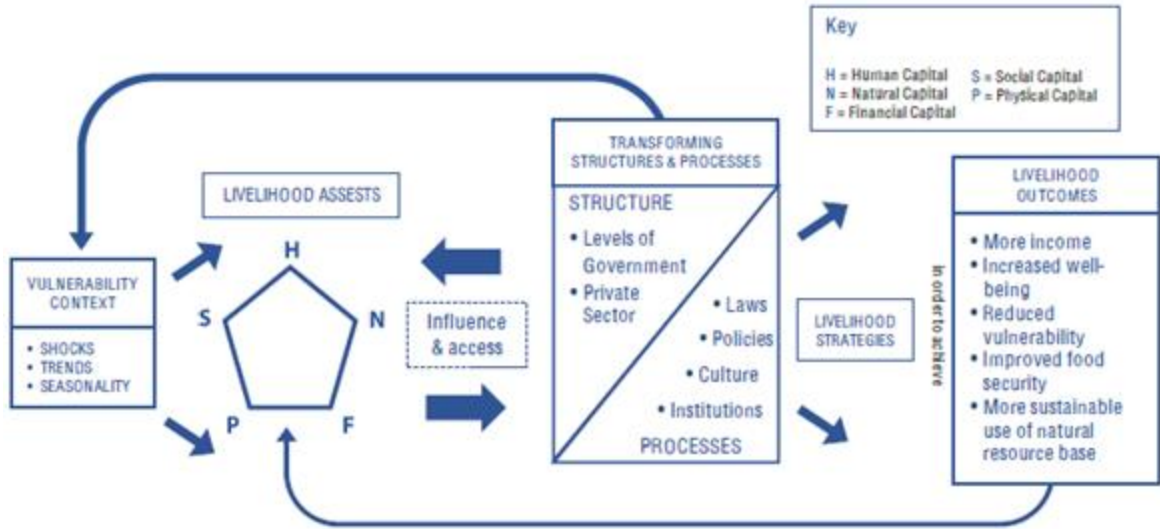


Figure 5: Sustainable Livelihood Framework, Source: DFID (2001)

2.4.2. Cost-benefit Analysis

In addition to the livelihood analysis, a cost-benefit analysis (CBA) was performed to determine the costs and benefits of priority catchment restoration interventions. This study emphasized two kinds of CBAs; financial CBA and economic CBA. Financial CBA relates to those costs and benefits for the funding party, whereas economic CBA relates to (avoided) costs and benefits to the broader (national) economy (Bizoza and de Graaff, 2012; Guenat et al., 2011). Financial CBA also considers the financial returns of each intervention. In other words, this CBA approach was used to help Rwanda Water Resources Board (RWB) and IUCN make decisions about what intervention could be more beneficial to the community irrespective of its financial returns.

The following equation specified CBA for this intervention:

$$NPV = \sum_{t=1}^n \frac{(b - c)_t}{(1 + r)^t}$$

Where: *b* stands for benefits and *c* for investment and recurrent costs. The superscript and subscript represent future and current time, respectively, while *r* stands for the discount rate at the time (*t*).

To come up with comparable costs and benefits among the different land restoration options, several steps are followed as described in the following box (1), and these were adapted for analysis in the context of this study:

Box 1: Steps to conduct an economic cost-benefit analysis (See Wainaina et al. 2020, Bizoza and de Graaff, 2012)

- *Specify the set of restoration transitions:* Define which degraded land will be restored and the activities that will be used to restore them.
- *Define the stakeholders who will be impacted by restoration:* it is vital to describe those actors likely to get involved.
- *Catalog the impacts and define how they will be measured:* Which impacts matter most to the stakeholders, who will be impacted by restoration, and what units of measurement are most helpful in measuring them?
- *Predict the impacts quantitatively over the time horizon of the project:* Use ecosystem service models, household surveys, stakeholder engagement, and other estimation methods to quantify the expected impacts of restoration activities.
- *Monetize all of the impacts:* Use appropriate direct and indirect methods to value the estimated impacts,
- *Discount benefits and costs to obtain present values:* Select appropriate discount rates to make streams of future benefits and expenses comparable at the present moment,
- *Calculate the Net Present Value (NPV) of each alternative:* Subtract the discounted stream of implementation, transaction, and opportunity costs from the discounted stream of benefits as shown in the equation.
- *Perform sensitivity analysis:* The results of the CBA depend on assumptions, and the sensitivity of the products to changes in the underlying assumptions should be evaluated.
- *Make policy recommendations:* From a Pareto-efficiency perspective, the restoration activities with the largest NPV should be recommended.

Valuation of Costs and Benefits in the CBA process

Estimation of Implementation Costs: the implementation costs considered comprise three main categories: the *first category* of costs of establishment of the landscape restoration option such as the construction of terraces, tree seedlings, irrigation infrastructure (including digging for water channeling and installation of pumps). *Category two* is about the opportunity costs. These represent foregone opportunities or products and services to enable landscape restoration. These include, for instance, foregone opportunities in individual farming in the marshlands towards collective farming in irrigated marshlands or hillsides. The *third category* involves transaction or monitoring costs. Landscape restoration requires enormous capital and operating expenses. It is highly recommended to appreciate the value of an investment by putting in place a mechanism to monitor the use and maintenance of established investment until the breakeven period. Transaction or monitoring costs are usually not considered in the project planning, making it challenging to ensure the sustainability of established infrastructures.

Estimation of the Benefit Values: as a result of implementing landscape restoration, one may observe both direct (i.e. change in the value of production) and indirect benefits (i.e. appreciation of the ecosystem by future generation). Thus, the values attached to each category of benefit may vary mainly based on how the computation of these is done (either through monetary or non-monetary values) and subject to the willingness to pay (WTP) for any resultant service or benefit.

Table 3: Benefit types and valuation process

Types of benefits	Valuation process
(1) Direct benefits or value:	These involve benefits from direct use of the service or restored land use. This may comprise direct use of an ecosystem.
(2) Indirect benefit (s):	These benefits are mainly associated with regulation services or post-investment services such as carbon sequestration, water treatment and regulation, soil erosion control, pollination, quality water, and air.
(3) Other optional benefits:	Other types of benefits related to landscape restoration include the value attached to future use of restored ecosystem or land uses like for medicinal purposes, satisfaction attached to future generations also known as bequest value, and the satisfaction linked to the existence of certain indigenous tree species, birds and animal, grasses, among others.

Looking at the above cost and benefits categorization, some of these costs and benefits are difficult to obtain or measure. For instance, it isn't easy to estimate the benefit attached to future use of restored ecosystem as it is also not easy to estimate comprehensively the costs of ecosystem restoration. We have used the market prices where possible and proxy values/prices for categories of costs and benefits for which their values are difficult to obtain using the market price.

3. Results on Socio-Economic Situation in Akagera Lower Catchment

This section presents results from the integrated situation analysis. This entails both the socio-economic and biophysical conditions driving people's livelihoods in the Akagera Lower Catchment.

3.1 Socio-Economic Profile of Akagera Lower catchment

The description of the current socio-economic conditions of the NAKL catchment is based on information obtained from secondary sources, stakeholders' consultations, focus group discussions, and a household survey conducted during this study's period.

3.1.1. Social-demographic characteristics of the catchment

NAKL catchment covers entirely or partially 5 administrative districts of Eastern Province, Rwanda: Kayonza, Ngoma, Kirehe, Gatsibo, and Nyagatare. The catchment's dominant social characteristics include high population density, a relatively low literacy rate among the population aged above 15 years old, lower net attendance at secondary school, high stunting among children below 5 years old, and a low response to reproductive health – fewer married women use modern contraception measures. The lower

net attendance at secondary school means that majority of children have completed primary school. The total population under extreme poverty is between 8.5% and 20.1% for the entire catchment.

Findings from the survey confirm the same patterns: The population is still in its active age (35-49 years old), majority of respondents have completed upper primary school (51.6%), the majority of respondents are married (64.3%) followed by those who live with partners (18.8%) and widowed (10.8%), and only 0.6% have divorced. When asked about the main reasons for settlement in the catchment, three dominant reasons for land occupancy were highlighted: purchased land (47.4%), family land from the ancestors (28.3%), and resettled by the government (16%), especially returnees from other neighboring countries. They have occupied a proportion of Akagera National Park surrounded by lakes and rivers in the 1997s. The land in the catchment is known to be productive for agriculture and livestock, explaining more purchases by individuals for their farming activities.

The above social characteristics have implications for landscape degradation. Increased population density coupled with a lower rate of secondary school attendance induces more reliance on natural resources, especially land, as they continue to be employed in the agriculture sector, the dominant employer sector of the economy (see table 4). Other social indicators are promising, such as access to health insurance and access to safe drinking water. The population in the catchment is dominantly constituted by women (around 52%) compared to men (48%).

Table 4: Summary of Social characteristics in NAKL Catchment

District	Total population	Literacy /Education (%)	Data (%)	Health (%)	Data (%)	Poverty level (%)	Data (%)
Kayonza	375,846 - Female: 51.6% - Male: 48.4%	- Literacy rate (population aged 15 above)	72.2	- Health insurance coverage	----	- Population under poverty level	26.7
		- Enrollment in Primary School	80.5	- Stunting of children under 5 years	42.0	- Population under Extreme poverty	8.5
		- Net Attendance Rate in secondary	18.0	- Access to safe drinking water	88.1		
		- Promotion rate in primary:	75.4	- Reproductive health: married women age 15-49 using modern contraception	47.0		
Ngoma	338,562 - Female: 52% - Male: 48%	- Literacy rate (population aged 15 above)	54.1	- Health insurance coverage	78.1	- Population under poverty level	37.8
		- Enrollment in Primary School:	87.6	- Stunting of children under 5 years	41.0	- Population under Extreme poverty:	14.0
		- Net Attendance Rate in secondary	22.8	- Access to safe drinking water	82.6		
		- Promotion rate in primary	77.9	- Reproductive health: married women age 15-49 using modern contraception	47.0		
Kirehe	340,368 - Female: 52% - Male: 48%	- Literacy rate (population aged 15 above)	68.9	- Health insurance coverage:	----	- Population under poverty level	44.6
		- Enrollment in Primary School	85.3	- Stunting of children under 5 years	29.0	- Population under Extreme poverty:	18.5
		- Net Attendance Rate in secondary	18.1	- Access to safe drinking water	84.3		
		- Promotion rate in primary	73.5	- Reproductive health: married women age 15-49 using modern contraception	50.0		
Gatsibo	433,020 - Female: 52% - Male: 48%	- Literacy rate (population aged 15 above)	71.3	- Health insurance coverage	79.0	- Population under poverty level:	42.1
		- Enrollment in Primary School	87.6	- Stunting of children under 5 years	32.0	- Population under Extreme poverty:	18.8
		- Net Attendance Rate in secondary	16.2	- Access to safe drinking water	79.1		
		- Promotion rate in primary	77.5	- Reproductive health: married women age 15-49 using modern contraception	45.0		
Nyagatare	465,855 - Female: 51% - Male: 49%	- Literacy rate (population aged 15 above)	69.1	- Health insurance coverage	85.0	- Population under poverty level	44.8
		- Enrollment in Primary School	78.4	- Stunting of children under 5 years	37.0	- Population under Extreme poverty:	20.1
		- Net Attendance Rate in secondary	19.1	- Access to safe drinking water	80.4		
		- Promotion rate in primary	83.4	- Reproductive health: married women age 15-49 using modern contraception	48.0		
- Repetition rate in primary	12.1						





Table 5: Socio-demographic characteristics of respondents located in Akagera lower catchment

Variables	Response options	Number	Percent
Gender	Female	129	39.7
	Male	196	60.3
Age category	18-34	58	17.9
	35-49	142	43.7
	50-64	98	30.2
	65+	27	8.3
Formal education	Yes	283	87.1
	No	42	12.9
Level of education	Lower primary	32	11.3
	Upper primary	146	51.6
	Lower secondary	58	20.5
	Upper secondary	40	14.1
	Vocational	0	0
	College diploma/ University	7	2.5
	Married	209	64.3
Marital status	Living with partner	61	18.8
	Married but separated	11	3.4
	Married but divorced	2	0.6
	Widowed	35	10.8
	Single (never married)	7	2.2
	I (my family) was resettled here by government authorities	52	16.0
Reasons for resettlement	I (my family) purchased land	154	47.4
	I (my family) leased/ rented land	11	3.4
	It was my (family's) ancestral land	92	28.3
	Internal migration (within the country) for economic and social reasons	3	0.9
	External migration (from neighboring countries)	11	3.4
	Other (describe)	2	0.6

Source: Field data (2021)

3.1.2. Economic Characteristics of the NAKL Catchment

Rain-fed agriculture is the dominant economic activity in the NAKL catchment. More than 80% of the active population is involved in agriculture as the main economic activity. During the survey, respondents have identified selling crops (53.4%) and livestock products (20.2%) as the primary sources of income in the catchment. Nevertheless, despite the agriculture sector being dominant, it remains mainly for subsistence farming with inadequate value addition of crops and livestock products, low levels of irrigation and mechanization, insufficient agriculture and livestock facilities such as post-harvest handling facilities, and inadequate rainfall leading to drought, and prevalence of pests and diseases.

Table 6: Main sources of income in the NAKL Catchment

Main source of income	Frequency	Percent
Farming (sales of crops)	249	53.4
Casual jobs (farming, construction)	54	11.6
Livestock (sales of livestock)	94	20.2
Small business	25	5.4
Wages/salaries from formal/permanent job	15	3.2
Remittances	4	0.9
Transport	3	0.6
Masonry	5	1.1
Carpentry	2	0.4
Membership to eco-tourism cooperative supported by RDB	1	0.2
Bee keeping/ honey processing	1	0.2
Other (describe)	13	2.8

The survey substantiates that male respondents are slightly dominantly involved in the agriculture sector (selling agricultural and livestock products). On the contrary, women are more involved in small businesses (5.9%) and casual labor jobs (15.8%) as compared to their male counterparts with 5.1% and 9.2% participation rates, respectively (Figure 6).

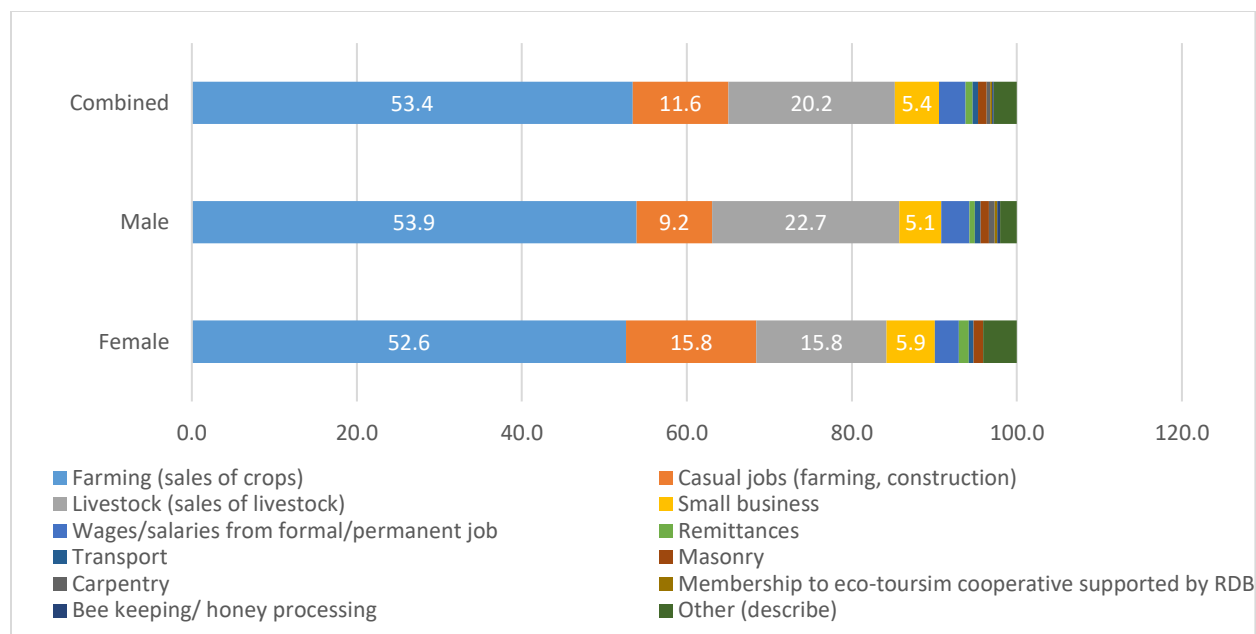


Figure 6: Main source of income of household head (respondents), by gender

Impact of COVID-19 on income earnings

The household economic analysis has also considered the potential impact of Covid-19 on people’s levels of income. It has considered the situation before and during the Covid-19 pandemic considering the different socio-demographic characteristics of respondents: gender, age, marital status, young people, and level of education. Results depicted in Table 7 shows an overall decline in income from both farm and non-farm activities. These findings suggest a double-edged burden of catchment development – that is, addressing structural challenges in economic development in addition to health-related challenges caused by Covid-19 related government restrictions against the spread of the pandemic.

Table 7: Summary of monthly income before and during COVID-19

Response options	Average income (RWF) before COVID-19		Average income (RWF) during COVID-19	
	Farming (crop and livestock) activities	Non-farming activities	Farming (crop and livestock) activities	Non-farming activities
Sex				
Male	64,795	58,388	52,867	43,844
Female	50,871	30,235	34,137	23,998
Age groups				
16-24	16,000	-	16,000	-
25-34	43,159	28,093	33,488	15,500
35-44	63,431	61,145	46,891	53,078
45-54	64,027	49,087	46,880	31,617

Response options	Average income (RWF) before COVID-19		Average income (RWF) during COVID-19	
	Farming (crop and livestock) activities	Non-farming activities	Farming (crop and livestock) activities	Non-farming activities
55-64	61,805	20,500	55,877	16,333
65+	57,096	16,614	44,105	11,750
Young/ Adult categories				
Young (16-30)	36,235	20,212	29,294	13,529
Adult (30+)	61,397	50,520	47,648	38,669
Marital status				
Married	63,643	56,625	51,328	43,172
Living with partner	47,302	31,929	40,395	26,893
Married but separated	18,167	23,667	17,500	15,160
Married but divorced	65,000	-	70,000	-
Widowed	54,833	14,240	24,019	13,075
Single (never married)	39,500	18,200	31,500	10,000
Level of education				
Lower primary	46,533	19,214	28,256	14,083
Upper primary	53,668	42,811	45,412	32,037
Lower secondary	51,658	57,650	42,535	39,018
Upper secondary	71,541	58,143	52,756	43,214
College diploma/ University	130,714	172,500	65,714	160,000

Other off-farm related activities are significantly less reliant as main sources of income as reported in Table 6 above where small businesses occupy around 5%, 3% for wages and salaries, and the rest of enterprises provided with less than 1% of employment opportunities and hence income sources. Clearly, other sectors of the economy such as industry and services are yet to be developed to create more off-farm income sources and reduce heavy dependence on agriculture. Several challenges to the development of these off-farm sectors have been identified (see Box 2).

Concerning financial inclusion, results from secondary sources indicate a high national level of financial inclusion (93%) equivalent to about 7 million adults (i.e., levels of access to financial products and services – both formal and informal) (AFR, 2020). The same AFR's FinScope indicates that 77% are formally served (they use formal services such as banks) while 78% use informal services (i.e., informal mechanisms). Around 80% use the informal mechanism or belong to the savings group to manage their financial needs. Specifically, to districts covered by the catchment, it takes almost the same time with other districts less than an hour on average to the destination of a financial institution or facility (Umurenge SACCO, MFIs, Bank branch, ATM, and Mobile Agent) (AFR, 2020).

Box 2: Summary of Socio-economic issues facing the NAKL Catchment

<p>Agriculture sector</p> <ul style="list-style-type: none">• Inadequate value addition to agriculture and livestock production• Subsistence agriculture with low levels of irrigation (only 1,722 Ha under irrigation) and mechanization (0.6%)• Insufficient agriculture and livestock facilities and infrastructure, including post-harvest handling facilities• Insufficient rainfall leading to drought Prevalence• Limited use of agriculture inputs such as improved seeds, fertilizers, pesticides,• Low level of livestock productivity due to subsistence farming practices• Limited agriculture processing industries,• Some wetlands/marshlands not developed,• Crop diseases such as Bacteria xythomonas wilt disease (Kirabiranya), which affected banana production. <p>Private Sector Development & Youth Employment sector</p> <ul style="list-style-type: none">• Insufficient markets, udukiro, and selling points;• Undeveloped infrastructure to boost the tourism sector, e.g., insufficient hotels and guest houses• Lack of skilled workforce• Less population in urban areas• High cost of mining equipment• Limited integration of tourism activities (cultural and religious tourism) in the District development plans and local development priorities;• Limited specific youth and women development programs for job distribution• Low involvement of the private sector in implementing planned projects that are business-oriented such as Industries, markets, Hotels, etc. <p>Transport sector:</p>	<p>Financial Sector</p> <ul style="list-style-type: none">• Limited use of financial services and business financing facilities• High interest rates for loans offered by financial institutions• Limited capital and funds for investment, especially among the youth• Limited access to agriculture finance• Low savings culture hence affecting domestic investment capacities• Insufficient skilled and specialized professionals in financial mobilization in rural areas;• Existence of several informal financial groups in the district• Low penetration of financial institutions, particularly in rural areas <p>Social Protection Sector</p> <ul style="list-style-type: none">• High stunting rate among children (37%)• Natural calamities hinder graduation from poverty by destroying people's property and sometimes their lives.• Limited finances to construct houses for vulnerable people• Limited financial resources to scale up pro-poor programs, e.g., distribution of small livestock• High number of households in need of social protection support• Dependency mindset among some people that receive support from government <p>Health Sector</p> <ul style="list-style-type: none">• Insufficient health personnel
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- Limited coverage of **tarmac, feeder roads, and car parks** (due to resource constraints)
- **Poor condition** of certain feeder roads and bridges
- Insufficient public **street lighting**
- Undeveloped **airstrip**
- **Limited financial resources for constructing and rehabilitating transport** infrastructure

Energy sector

- Insufficient **electricity** networks
- Insufficient **alternative energy** sources
- **High cost** of utilities (energy)
- **Low voltage** power supply lines for industries
- **Unaffordable electrical materials** and equipment to connect households (cash power and cables)
- According to EICV5, 85.9% of the households in the district use biomass (firewood) for cooking. This is a threat to the environment and should therefore be checked.
- In addition, EICV 5 also shows that 18.1% of residents in the district use electricity for lighting. This needs to be substantially increased over the NST 1 period.
- Insufficient budget for construction of **electric lines** in sectors of Gasange, Kageyo, and Nyagihanga sectors
- **Lack of electricity access** to some productive areas of the District such as cells.

Water and Sanitation sector

- Insufficient **water connection** (or supply), storage, and production in Matimba, Musheru, Rwimiyaga, Karangazi, and Rwempasha Sectors
- Low **private investments** in water production and supply
- Insufficient **waste collection and recycling** systems within the district
- **Limited usage** (operational) of Rutaraka fecal sludge plant
- Little **innovation and modern technology** used to recycle used water like lake muhazi;
- Limited **coordination among the stakeholders** in the sector (Population and other end users-schools, hospitals, etc.)
- Insufficient **clean and safe water** in all sectors and other sanitation facilities in **public institutions**.
- Limited financial capacity for extension and rehabilitation of water pipelines.

Urbanization and Rural Settlement Sector

- Lack of **detailed and updated Master plans** for Nyagatare City and five emerging centers (Karangazi, Mimuri, Rukomo, Rwimiyaga, and Kagitumba)

- **Unconnected health facilities** (healthy centers or posts) to water, electricity, and internet
- **Insufficient health infrastructure** (health posts and health centers),
- Limited **modern health equipment**,
- Poor service delivery, Lack of **specialized services** in the Hospital,
- **Limited pharmacies at the District** level, especially Private ones
- **The stunting prevalence** is still high at 42%, this needs to be reduced to match national targets
- **Inadequate geographical accessibility** of health services renders poor service delivery, and some patients remain unattended.
- Fewer visits to the health facilities for treatment. According to EICV4, 58% of the households surveyed say they don't visit health facilities when they are sick due **to lack of money**.
- Lack of specialized medical equipment (**like ambulances**), particularly in Ngarama and Kiziguro provincial hospitals.

Education Sector

- Insufficient **equipment and classrooms** in schools (i.e., 70 students per classroom)
- Poor and insufficient **school laboratories, libraries, and smart** classrooms
- Insufficient **teachers' accommodation**
- Insufficient schools and teachers for people **with disabilities**
- Limited **VTCs, TSS, and polytechnics**
- Lack of **adequate higher learning** institutions and universities
- **Low performance** of students in some schools
- **High number of student** per teacher ratio
- **Inadequate budget** for construction/ rehabilitation of school infrastructures such as classrooms, laboratories, desks, etc.)

Governance and Decentralization Sector

- **Poor condition** of and **insufficient government entities'** infrastructure
- Insufficient public administrative **office equipment**
- **Human resource** skills gaps
- Some offices of cells are **not yet constructed**
- **Drug abuse**, especially among the youth
- **Poor service delivery** in some sectors

- Lack of **green Local Urban Development Plans**
- Unexploited **open spaces** (Including recreational and Leisure centers/Facilities)
- Limited **skills and expertise** for green city development
- lack of **adequate, affordable housing** units and real estate development
- **Low urban population** as a result of limited economic pull factors in urban areas
- Lack of sufficient capacity to acquire **water tanks to harvest and store rainwater**. This has resulted in streams of rain water runoffs from people's houses and the creation of gullies, especially on steep hill slopes
- **Isolated habitats** in the District and their implication on other sectors
- Limited **public cemetery**;
- Limited **landfills and public latrines**
- **Low pace of implementation** of Master plan
- **Insufficient budget** to construct urban infrastructures such as water supply in Kabarore, Kiramuruzi, and Ngarama towns, and construction of roads (Murrum and tarmac roads).

ICT Sector

- Insufficient ICT **infrastructure and equipment** in public and private institutions (schools, hospitals, hotels, etc.)
- **Limited online services**
- **High cost** of ICT infrastructure and ICT services
- **Insufficient ICT literacy** in the district
In Ngoma District, **the use of computers is minimal**. According to EICV4, 96.9% don't know how to use a computer. It means that only 3.1% are confident about using a computer;

Environment and Natural Resources sector

- **Deforestation** due to overdependence on firewood and charcoal for cooking and timber or wood
- **Environmental degradation** (drought, water scarcity, termites) and limited **knowledge** on environmental protection
- Lack of **touristic activities** and developed sites
- Prevalence of **natural disasters**
- **Limited funds** for environmental protection
- **Lack of safety measures/** facilities for miners who use traditional methods of excavation/exploitation,
- **Large area of land** with un planted forest and Agro forestry covers, only 12.7% of the land reserved for afforestation, has so far been planted with trees;
- **Lack of safety measures** for miners who use traditional methods of excavation/exploitation, *Financial Sector Development*
- Limited use of financial services and business financing facilities
- High interest rates offered by financial institutions
- Limited capital and funds for investment, especially among the youth

- **Bribery, injustice, and nepotism**
- High crime rate among the community.

Justice, Reconciliation, Law, and Order

- **Human trafficking** and other cross border crimes
- Low level of **dissemination of laws** and policies in place
- **Corruption tendencies** within public and private sector circles knowledge of local community regarding laws, rules, and policies
- High number of unexecuted judgments (e.g., from Gacaca courts)
- Low **awareness of citizens** about Laws and regulations

Sport and Culture Sector

- Limited number of sports, cultural and recreational **facilities** (i.e., stadium, pitches)
- Lack of **cultural villages** and developed historical tourism sites
- **Undeveloped** sports facilities like Mutara Rudahigwa football ground at Rwinkwavu.
- **Poor entertainment infrastructure**
- Insufficient **Youth centers**
- Little awareness among citizens about the importance of sports.

Public Financial Management Sector

- Low level of internal revenue collections

Table 8: Summary of Economic Characteristics

District	Population in Agriculture	Data (%)	Land ownership	Data (%)	Financial Inclusion	Employment	Data (%)	Cooperative Membership	Data (number)	Established Enterprises	Data (number)	
Kayonza	- Population in agriculture	-	- Inheritance	41.0	Percentage of Adult financial inclusion: 93%	- Labour force participation rate	54.4	- Number of cooperatives	197	- Formal enterprises	7,395	
	- Percentage of land under consolidation	10.1	- Purchased land	48.0		- Unemployment rate	7.5		- Farming cooperatives	102	- Informal enterprises:	2,465
	- Percentage of land protected against soil erosion	57.8	- Gift	24.0		- Shared cropping	33.0		- Non-farming cooperatives	95	- Micro enterprises:	3,420
	- Percentage of land under irrigation	14.9	- Free use/loan	14.0		- Lease	13.0				- Small enterprises:	2,300
											- Medium enterprises:	1,660
Ngoma	- Population in agriculture	92.3	- Inheritance		Percentage of Adult financial inclusion: 89%	- Labour force participation rate	49.5	- Number of cooperatives	-	- Formal enterprises	767	
	- Percentage of land under consolidation	32.0	- Purchased land			- Unemployment rate	12.0		- Farming cooperatives	-	- Informal enterprises:	3,694
	- Percentage of land protected against soil erosion	54.2	- Gift			- Shared cropping			- Non-farming cooperatives	-	- Micro enterprises:	3,698
	- Percentage of land under irrigation	1.7	- Free use/loan			- Lease					- Small enterprises:	275
											- Medium enterprises:	43
Kirehe	- Population in agriculture	--	Inheritance	34.0	Percentage of Adult financial inclusion: 87%	- Labour force participation rate	53.7	- Number of cooperatives	-	Formal enterprises:		
	- Percentage of land under consolidation	33.0	Purchased land	50.0		- Unemployment rate	10.4		- Farming cooperatives	-	Informal enterprises:	
	- Percentage of land protected against soil erosion	73.9	Gift	34.0		- Shared cropping			- Non-farming cooperatives	-	Micro enterprises:	3,765
	- Percentage of land under irrigation	5.8	Free use/loan	20.0		- Lease					Small enterprises:	254
			Shared cropping	28.0							Medium enterprises:	48
Gatsibo	- Population in agriculture	77.3	Inheritance	42.0	Percentage of Adult financial inclusion: 87%	- Labour force participation rate	49.0	- Number of cooperatives	-	Formal enterprises	187	
	- Percentage of land under consolidation	16.8	Purchased land	56.0		- Unemployment rate	7.8		- Farming cooperatives	-	Informal enterprises	4,292
			Gift	24.0							Micro-enterprises	4,099
			Free use/loan	16.0							Small enterprises	330
			Shared cropping	18.0							Medium enterprises	46
		Lease	22.0									

District	Population in Agriculture	Data (%)	Land ownership	Data (%)	Financial Inclusion	Employment	Data (%)	Cooperative Membership	Data (number)	Established Enterprises	Data (number)
Nyagatare	- Percentage of land protected against soil erosion	3.7						- Non-farming cooperatives	-	Large enterprises	4
	- Percentage of land under irrigation										
	- Population in agriculture	87.9	Inheritance	18.0	Percentage of Adult financial inclusion:	- Labour force participation Rate	59.3			Formal enterprises:	
	- Percentage of land under consolidation	7.9	Purchased land	55.0		- Unemployment rate		- Number of cooperatives	-	Informal enterprises:	
	- Percentage of land protected against soil erosion	41.6	Gift	18.0			24.4	- Farming cooperatives	-	Micro enterprises:	5,549
	- Percentage of land under irrigation	4.1	Free use/loan Lease	14.0	93%			- Non-farming cooperatives	-	Small enterprises:	436
			Shared cropping	5.0						Medium enterprises:	50
				25.0						Large enterprises:	3

Source: DDS (2018-2024), NISR (2017), and NISR (2014)

3.2 Livelihood conditions in Akagera Lower Catchment

The study has also assessed the livelihood conditions in the NAKL catchment using data from the socio-economic survey. The assessment has considered five livelihood capitals or assets, namely natural capital, financial capital, social capital, human capital, and physical capital, as captured in Figure 7 below. The analysis describes identified livelihood issues and proposed solutions both in the short and long run.

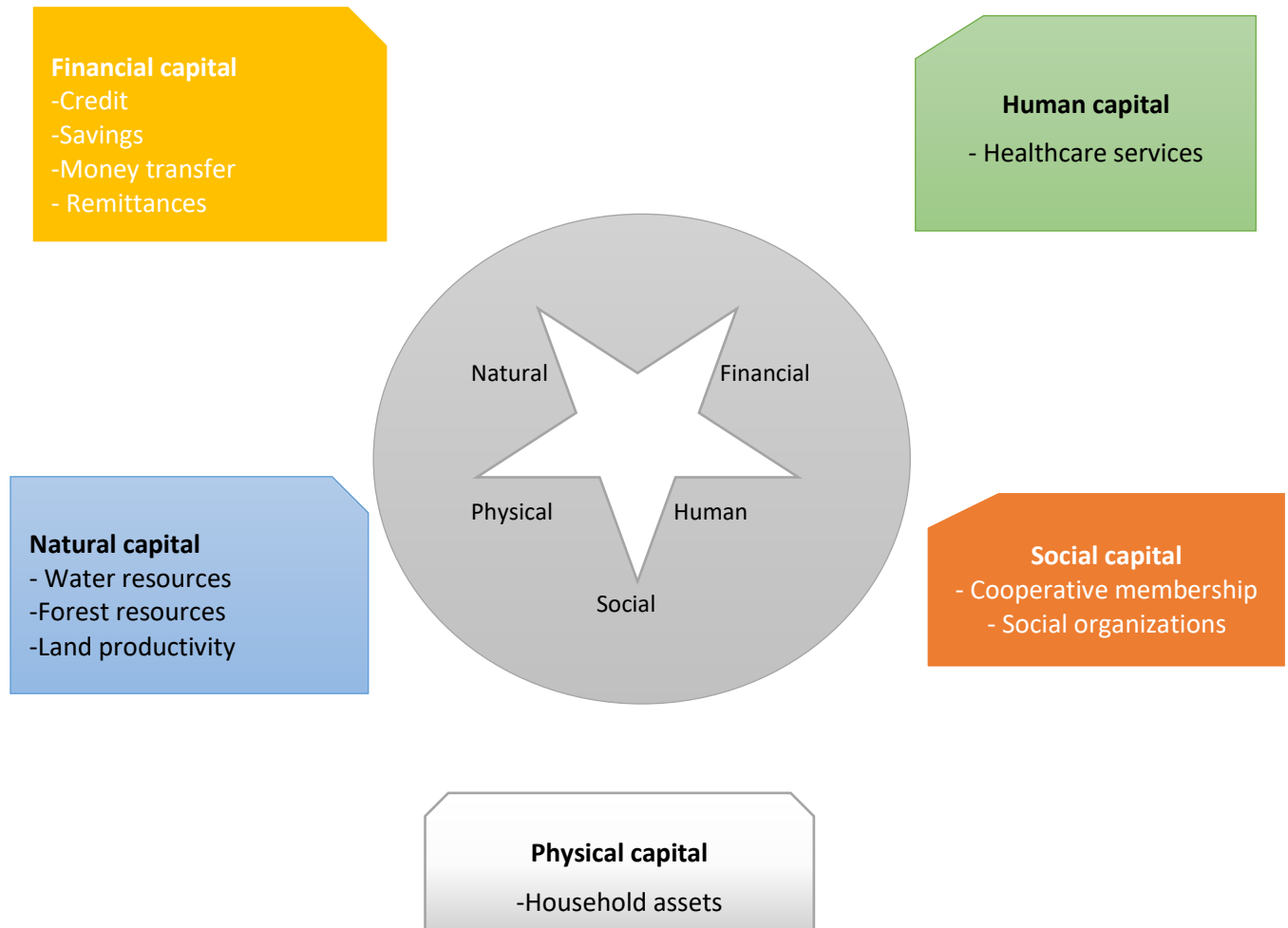


Figure 7: Five capitals of the sustainable livelihood framework

3.2.1. Natural Capital

The livelihood analysis on the natural capital has addressed the availability and use of main natural capitals such as water, land, and forest-related resources. The topography of the catchment area is generally characterized by hills with low slopes and deep valleys. Due to weather conditions, the catchment area is prone to natural hazards, including drought and soil erosion, in some areas with steep slopes. Lack of water due to drought continues to degrade (make it unfertile) arable land in the area and eventually make

it unproductive. The result is a decline in crop and livestock productivity and concerns about food availability and security concerns.

Issue # 1: There is a water shortage for home consumption, agriculture, and livestock. Water shortage has been identified as one of the major issues facing improved livelihood conditions. The majority of respondents use public taps and taps on the property (41.5% and 12.6%, respectively) as their primary source of water for home consumption. Others still fetch water from unprotected well, springs, streams/rivers/lakes and dams, water (Figure 8). The nearest water source is within the homestead; 44.3% of respondent’s households are within 500 m of the primary source of water. Installation of more public taps would address this issue of water shortage for consumption. Due to low precipitation in the Eastern province and limited rainwater harvesting facilities, farmers struggle with insufficient water to use for irrigation and livestock.

Proposed solution: Construction of a robust irrigation system to support farmers finding water in sunny season and construction of stretched dams to collect and store water for both farming and livestock

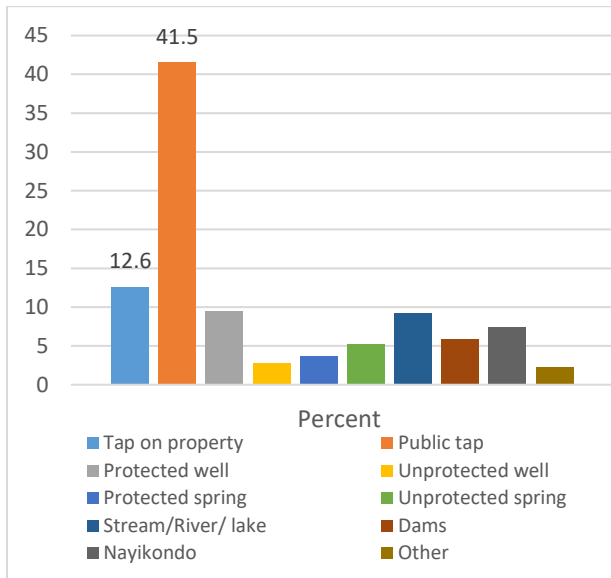


Figure 8: Primary source of drinking water

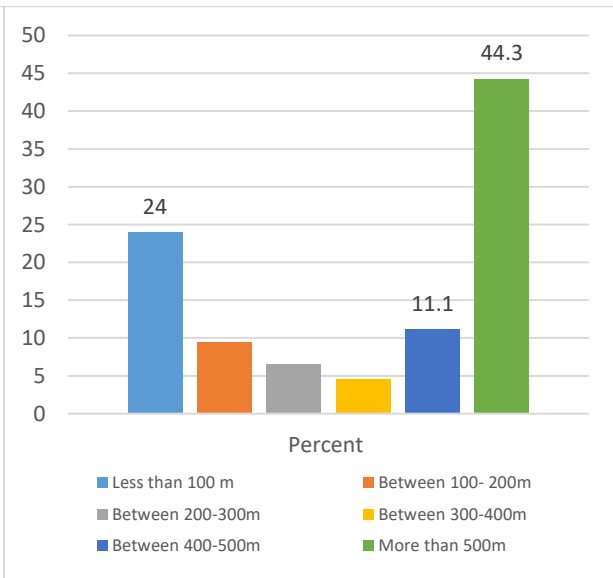


Figure 9: Distance to the nearest source of drinking water

Issue # 2: Citizens in the NAKL Catchment face the challenge of insufficient access to alternative energy sources for cooking, resulting in intensive use of forestry resources, mainly for firewood. Before the aftermath of the 1994 Genocide against Tutsis in Rwanda, a large proportion of the NAKL catchment was occupied by the Akagera National Park, characterized by a savannah with a mixed woodland-grassland ecosystem. After the resettlement of some families in the region, cutting trees for firewood and charcoal has increasingly been a significant issue facing the park and the entire catchment. Government initiatives in the past have encouraged people to plant more trees for wood and agro-forestry to avoid more desertification and improve soil fertility. However, the issue remains critical as far as obtaining alternative sources of energy is concerned. About 87% of respondents still rely on firewood and hence cutting trees and the main source of energy.

Proposed solution: Establish more tree nurseries nearby different villages to facilitate more tree plantation and forestation.

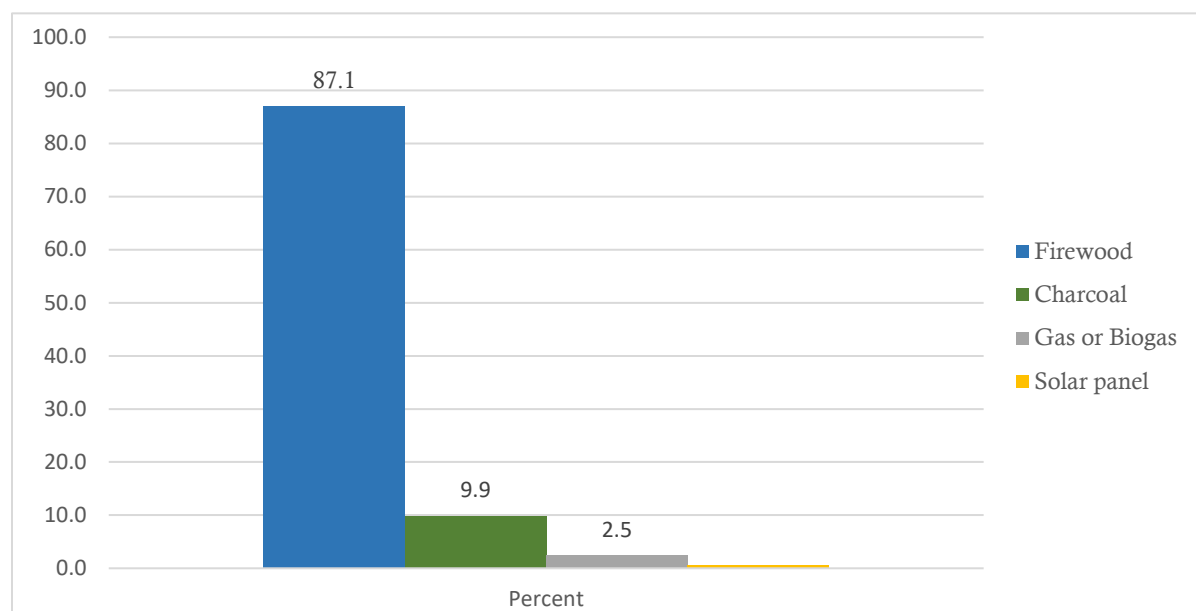


Figure 10: Source of energy for cooking

Issue # 3: Land ownership is not an issue; instead, its efficient management and use are the main issues facing the NAKL catchment population. Per capita land size in the Eastern Province where the NAKL catchment is relatively greater than the national average (0.6 ha) (MINAGRI, 2018). On average, each household owns two plots with a plot size ranging from 100 m² to 60,910 m². But the majority (45.1%) own one plot. The average plot size recorded is 9,602 m². Households allocate their lands mainly for agriculture and livestock farming activities individually or combined for some farmers. However, challenges remain about the household's ability to manage the lands, address soil erosion, and increase its fertility for improved yield. Findings show that more than 85% of the plots cultivated are located in the hillside and fewer in the marshlands. Hillside plots are prone to soil erosion and drought, calling farmers to use soil and water management options, including terracing, agroforestry, irrigation, and other modern farming practices. But due to their inability, very few farmers can use these measures without government or development support.

Table 9: Summary of the number of plots and total land size owned by sampled households

Catchments	Observation	Mean	Std. Dev.	Min	Max
Number of plots					
Akagera lower	288	2.1	1.4	1	10
The total size of land (m2)					
All plots owned	323	9,602.1	10,289.8	100	60,910
Plot 1	283	4,252.6	3,437.7	70	17,600
Plot 2	154	2,859.6	3,027.1	70	12,500
Plot 3	68	2,680.0	3,001.5	100	15,000

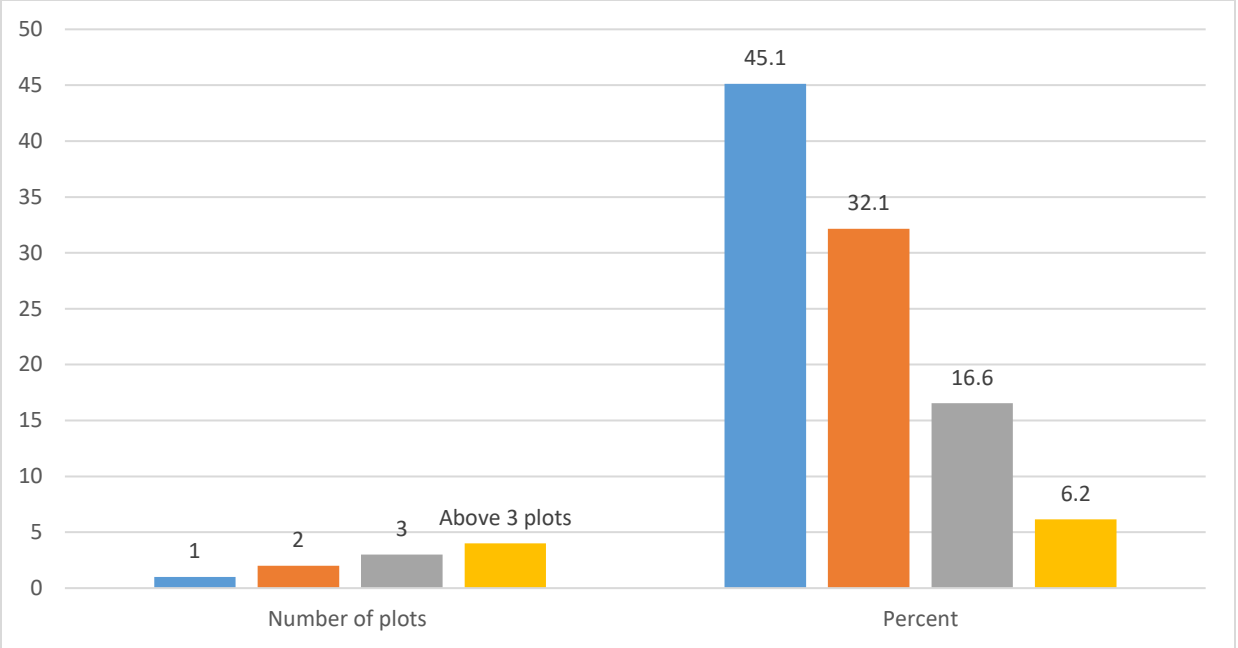


Figure 11: Number of cultivated plots per household

Issue #4: Markets for agricultural products are imperfect and distant, leading to low agricultural income. Findings from this study have confirmed maize, beans, and banana to be the dominant cultivated crops in the NAKL catchment. A big share of produced maize is sold, followed by beans to earn agricultural income. But survey respondents have claimed for lower commodity prices and distant markets. They mainly rely on local markets and cannot sell in other national markets to benefit from positive marginal prices (table 10).

Table 10: Average quantity produced and sold by farmers from NAKL

Crops	Variables	Average quantity	Proportion (%) of sales
Beans	Production	336.8	73.5
	Selling	247.7	
Maize	Production	1,553.3	77.6
	Selling	1,205.3	

3.2.2. Financial Capital

Issue # 5: Women are less financially included as compared to men: Financial capital is an essential livelihood asset considered in the sustainable livelihood approach (SLA). National-level data indicate a high level of financial inclusion, as already highlighted in section 3.1.2 above, with a 93% level of inclusion. In this catchment, the trend echoes the national one where 75.7% of the respondents substantiate to be financially included. From a gender perspective, women are less financially included, 68.9% less than 80.1% of men. The majority of respondents rely on financial products and services by SACCOs (58.4%) and less on commercial banks (17.9%) and revolving savings/loan schemes (15.8%). Clearly, men access bank loans than women, and these are used to finance mainly farming activities and livestock rearing, repair or building of houses, and payment of school fees for their children. **Lack of collateral and high interest rate are reported to be the main issues** constraining access to financial loans (table 11).

Table 11: Access to financial services, reasons for taking a loan, and issues related to access financial services

Variables	Response options	Men	Women	Combined
Access to financial services	Yes	80.1	68.9	75.7
	No	19.9	31.0	24.3
Type of financial institution	SACCO	61.6	56.8	58.4
	Cooperative (e.g farming, motorcyclist, etc)	4.0	4.9	4.6
	Revolving savings/loan scheme	16.8	15.2	15.8
	Micro finances	1.6	4.1	3.3
	Commercial Bank	16.0	18.9	17.9
Access to financial services	Credit	58.6	51.7	56.1
	Saving	90.4	92.1	91.1
	Money transfer	20.4	25.8	22.4
Reasons for requesting for loan	Food	3.7	1.9	2.6
	Health care	1.9	1.9	1.9
	Education (school fees)	12.9	16.7	15.4
	Repair or building house	24.1	20.6	21.8
	Family events (Parties, grieves)	3.7	1.9	2.6
	Farming and livestock	40.7	36.3	37.8
	Funding/ build more non-farm businesses	11.1	15.7	14.1
	Other	1.9	4.9	3.9
Issues related to access to finance	None	38.7	36.4	37.3
	Lack of enough land for collateral	20.7	20.3	20.4
	Jobless	11.6	9.5	10.3
	Absence of commercial bank in the area	9.7	8.3	8.8
	High interest rate	14.8	17.8	16.6
	Other issues	4.5	7.9	6.6

3.2.3. Social Capital

Issue # 6: most of the activities performed through cooperatives are related to farming than other off-farm activities. Social capital is often measured through soft and hard institutions. Soft institutions include dimensions like trust, mutual support, and collective action like Umuganda. Hard institutions have law, policy, and cooperative or organizational membership (North, 1990). Accordingly, community-based organizations, cooperatives, and associations are an effective vehicle that the state can use to shape its relationship with community members like farmers to implement landscape restoration interventions. The relationships formed within the farmer organizations in turn nurture collective action and mutual assistance (Bizoza, 2011). The survey asked about membership to cooperatives or any form of saving and lending group; 44.9% of respondents are members of cooperatives. Out of these cooperative members, 72.9% are members of any saving and lending group mainly operating in their respective villages. Agriculture-related activities are the most performed through these cooperatives and less on other non-farm activities (63%) followed by savings and lending-related activities (27.4%)- this is mainly due to the structure of prevailing economic activities. These cooperative memberships are essential to capitalize on, especially for collective or community-led landscape restorations in the catchment.

Table 12: Cooperative membership and main activity of cooperatives

Response options	Number	Percent
Member of any cooperative		
Yes	146	44.9
No	179	55.1
Member of any saving or lending group		
Yes	237	72.9
No	88	27.1
Cooperative's main activity		
Farming	42	57.5
Livestock	4	5.5
Milk collection & processing	3	4.1
Masonry	2	2.7
Water user's association	1	1.4
Tailoring	0	0.0
Hair dressing	0	0.0
Service provision	1	1.4
Trading	0	0.0
Saving and lending	20	27.4

3.2.4. Human capital

Qualified and healthy human capital is an important livelihood asset. The socio-economic survey asked about the respondents' ability to access health care services both for men and women. Findings postulate that 83.7% of respondents have tried and can access healthcare services. This is equally reported between men and women respondents. This is mainly explained by the fact that the majority of households are insured through "Mutuelle de Sante," a community-based health insurance somewhat equally reported by both women (95.5%) and men (90.3%). Community health insurance has been a top priority for the government through different enforcement mechanisms such as the performance contract (known as Imihigo)- health insurance coverage is a recurrent top priority in various districts, including those covered by the NAKL catchment.

Table 13: Access to healthcare services and reasons for not need of any healthcare services

Variables	Response options	Men	Women	Combined
Access healthcare services	Yes, we tried and were able to access healthcare services	83.7	83.7	83.7
	Yes, we tried but were not able to access healthcare services	1.0	0.0	0.6
	Yes, we tried and were able to access some, but some we couldn't	6.6	5.4	6.2
	No, we didn't need any healthcare services	8.7	10.9	9.5
Why didn't you need any healthcare services?	Health centre/ post located far from homestead	0.0	0.0	0.0
	Do not have any health insurance	5.9	14.3	9.7
	Procuring medication from pharmacies	0.0	0.0	0.0
	Praying for healing	0.0	0.0	0.0
	Herbists	5.9	0.00	3.2
	I didn't get sick	88.2	85.7	87.1

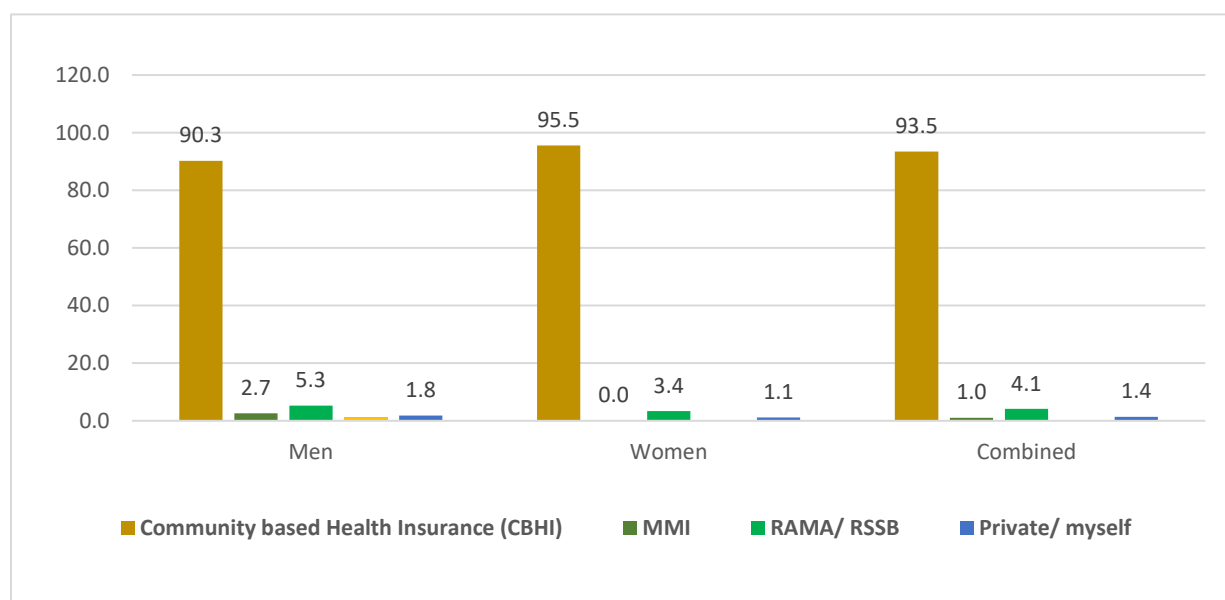


Figure 12: Health insurance coverage

3.2.5. Physical Capital

The assessment of physical assets is vital to determine the level of asset ownership. Findings from the survey indicate that more than 90% of households own assets such as cell phones, hoe, house, and mattresses. Except for radio, owned by about 60% of households, other assets like bicycles, comfortable chairs, TV sets, motorcycles, wheelbarrows, and sewing machines are owned by less than 50% of households.

Table 14: Asset ownership in Akagera lower catchment

Asset	Number of respondents	% of households with asset	Average number of assets owned
Phones	316	97.2	2.1
Hoe	308	94.8	2.6
House	305	93.9	1.3
Mattress	302	92.9	2.4
Radio	193	59.4	1.1
Bicycle	146	44.9	1.1
Comfortable chairs	105	32.3	5.9
TV Set	79	24.3	1
Motorcycle	30	9.2	1
Wheelbarrow	22	6.8	1.2
Sewing Machine	13	4.0	1

3.2.6. Households' Food Security and Seasonal Food availability

Improved food security is one of the desired livelihood outcomes. The analysis of food security status in the catchment reveals that 51.1% have sufficient food than 48.9% who reported insufficient food availability. Low production or productivity has been reported as the main reason for insufficient seasonal food availability (79.6%); most respondents are capable of securing two meals per day. This low productivity reported has some links with landscape degradation, especially agricultural lands, calling for improved management and restoration (see details in the next section on landscape restoration options).

Table 15: Food availability, number of meals taken by day

Response options	Number	Percent	Response options	Number	Percent
Food availability			Period of which households experienced food shortage		
Yes, sufficient	166	51.1	Before 2000	1	0.6
No, insufficient	159	48.9	2000-2009	28	16.9
Reasons for insufficient food			2010-2019	83	50.0
Low production/ productivity	117	79.6	During 2020	54	32.5
Lack of financial means to buy food	23	15.7	Number of meals per day: Adult		
Limited access to food market	7	4.8	1	72	22.2
Food shortage experience			2	210	64.6
Yes	174	53.5	3	43	13.2
No	151	46.5	Number of meals per day: aged 5 to 17 years		
Number of meals per day: UNDER-5 Children			1	39	13.3
1	11	5.2	2	180	61.4
2	98	46.2	3	71	24.2
3	86	40.6	More than 3 meals	3	1.0
More than 3 meals	17	8.0			

4. Results on Economic and Financial CBA of Landscape Restoration options

The second objective of this study is to conduct an economic and financial cost-benefit analysis of proposed landscape restorations based on the biophysical analysis done in the context of this socio-economic assessment. Two levels of assessment were done to inform on the choice of the landscape restoration. Firstly, a desk review-based assessment was conducted to identify landscape restorations proposed in the national and district level strategic plans plus the identification of major ongoing projects in the districts covered by NAKL catchment. Secondly, landscape restorations were identified through primary data collection, namely the stakeholder's workshop, Focus group Discussions, and the household survey. Results from this analysis are presented to inform more detailed feasibility studies in the context of the catchment management plan.

4.1. Landscape Restoration Options proposed in the National and District Strategic Plans

The study has also assessed the different landscape restoration options proposed in the relevant national strategic and planning documents, namely the National Transformation Strategy (NST1), Sector Strategic Plan for the Ministry of Environment, the Agriculture Transformation Strategy (PSTA4), National Strategy for Climate Change and Low Carbon Development, and concerned District Development Plans (DDSs).

- National Strategy for Transformation (NST1) (2018-2024): in its first pillar of economic transformation, specifically in its sixtieth and seventieth pillars, provides key interventions relevant to landscape restoration (see Pages: 8-10). These include:
 - (1) Work with the private sector to increase the surface area under consolidated and irrigated land (scaling both marshlands and small-scale technologies for irrigation);
 - (2) Promotion of new models of irrigation scheme management (e.g., strengthening farmers' and water users' associations and piloting and scaling up public-private partnerships models);
 - (3) Increase the land area covered by radical and progressive terraces and ensure their optimal use;
 - (4) Strengthen forest management and their sustainable exploitation,
 - (5) Reduce the number of households depending on firewood as a source of energy for cooking through the promotion of the use of alternative fuels such as cooking gas and biogas;
 - (6) Development of a project to manage water flows from the volcano region and other rivers to mitigate disasters and improve water resource management;
 - (7) Improve integrated water resource management, water catchment areas are supposed to be effectively managed and protected to mitigate disasters in partnerships with communities.
 - (8) Strengthen land administration and management to ensure optimal allocation and use of land.
- Sector Strategic Plan – Ministry of Environment SSP-MoE (2018-2024): This strategy is designed to implement some relevant provisions in the SNST1 and the goals of Vision 2050. The SSP-MoE strategy emphasizes integrated water resources management focusing on water use efficiency in all sectors within catchment context; sustainable management of forest and biomass resources through increased forest and agroforestry coverage; improved functioning of ecosystems and conservation by rehabilitating the degraded areas; and promote land use planning based on suitability or capability.
- National Agriculture Policy and its strategy PSTA-4 (2018-2024): in its second priority area on productivity and resilience, the PSTA4 provides actions aimed at promoting sustainable land husbandry and climate-smart practices and water use efficient irrigation systems through innovative irrigation technologies. These actions are proposed to address challenges linked to sustainable

agricultural land management practices, protect resources and enhance the productive capacity of land and soil. This is done by reducing soil erosion, improving soil water infiltration, and holding capacity, enhance nutrient supply, and increasing soil biodiversity. Further, proposed interventions are expected to address issues associated with weather variability affects productivity in Rwanda; inter-annual variability and periodic shocks have a major impact on the agriculture sector.

- National Strategy for Climate Change and Low Carbon Development (2009): this strategy established the national mitigation and adaptation strategies to climate change and low carbon development in Rwanda by promoting low-carbon technologies of integrated soil fertility management, irrigation infrastructure, and agroforestry.
- Irrigation Master Plan and Rwanda National Water Resources Master Plan: These plans provide additional information of potential areas in water resource development in the context of nine catchments (including irrigation, water dams, rainwater harvestings, and groundwater exploration).
- District Development Strategies (DDSs) (2018-2024). District Development Strategies (DDS) have been developed to implement priority areas and interventions provided in NST1 and SSPs as decentralized plans implemented at the District level.

The study has further identified ongoing initiatives at the macro or catchment level with a greater likelihood to support the proposed landscape restoration options in the NAKL catchment. They contribute to the landscape restoration in the catchment while at the same time improving people's livelihoods. The following are some of the major interventions identified. These need further exploration in the context of the development of the catchment management plan:

- (1) Kayonza Irrigation and Integrated Watershed Management Project (KIIWP)/MINAGRI project: this focuses on the development of appropriate irrigation system at small and large scales within five years, 35 infrastructures (valley tanks and boreholes) for rain-fed areas, 15 new valley tanks, and 20 boreholes, 370 ha of radical terraces, 165 ha of soil bunds, and 65 ha of ditches and grass trips;
- (2) Government Financing subsidy system (50%) supports the construction of radical terraces for the increased area of land protected against soil erosion as well as small- and large-scale irrigation for Strengthening resilience to droughts, expecting to cover 5000 ha by investment-ready pipeline and 2,275 ha of other schemes.
- (3) Large scale irrigation schemes in Mwili, Ndego, Kabare, and Rwinkwavu
- (4) Promotion of Integrated craft production centers
- (5) Large scale plantation of forest and agroforest trees
- (6) Construction of Small and Medium Enterprises (SME) Park
- (7) Establishment stone crushing plant
- (8) Tourism inventory
- (9) Construction of IDD green model villages
- (10) Promotion of agro-processing industries
- (11) Construction of social and economic infrastructures such as markets, roads, schools, and hospitals, which contribute to the creation of off-farm jobs.

4.2. Proposed landscape restoration options and Budgetary implications

Before the Cost-Benefit Analysis (CBA), different landscape restoration options in the Akagera Lower Catchment were proposed during the FGDs, stakeholders’ consultations, and household surveys conducted in the context of this study. Later these were considered in the socio-economic survey and ranked based on their suitability and likelihood of being implemented in the catchment. The following table 16 describes the frequencies of perceived potential adoption of each option by survey respondents mainly constituted by farmers with support from government or development partners. Rainwater harvesting (74.8%) and irrigation (68%) were the most ranked by survey respondents as alternative options to address landscape degradation in the catchment. Some of these measures have been introduced in some parts of the catchment but at a lower scale.

Table 16: Identified landscape restoration options in NAKL Catchment

Land use type/Ecosystem type	Landscape restoration options	Frequency (%)
Water Usage/ Management	Irrigation	68
	Rainwater harvesting	74.8
	Dam sheet/water ponds	49.5
	Boreholes	54.2

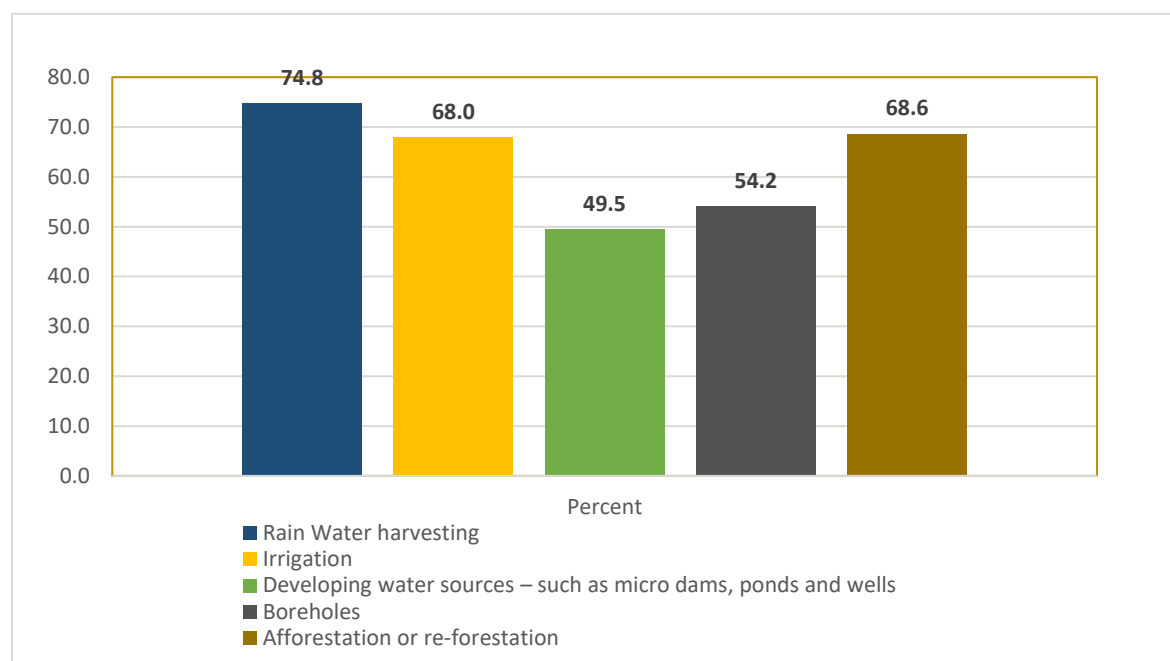


Figure 13: Landscape restoration options in Akagera Lower Catchment

Based on the above proposals, the budget estimates for each proposed catchment restoration option were computed using unit costs provided in earlier studies. However, since these estimates are based on secondary data, there is room for their adaptation based on adjusted numbers of the coverage areas for each catchment option and the unit price considering the dynamics in market prices. Further, it was not possible to have better estimates of the areas appropriate for each land husbandry technology – these

are supposed to be generated from a biophysical mapping of the catchment, which is beyond the scope of this socio-economic assessment.

Table 17: Budget estimation of possible landscape restoration options in NAKL

Identified Issues	Landscape restoration Solutions	Unit	Quantity	Unit Price (FRW 1)	Total cost (Frw)	Stakeholders	
Drought, Source of wood energy, Floods, Water scarcity for home consumption, agriculture, livestock, Erosion, Termites	A. Water resource management						
	[A1] Irrigation system (Small scale)	Ha	2949	5,000,000	14,745,000,000	District, MINAGRI/KIMP project, RAB, RWB, NGOs, Farmers	
	[A2] Large scale irrigation (with pivot)	Ha	85845	250,010,198	21,462,125,447,310	District, MINAGRI/KIMP project, RAB, RWB, NGOs, Farmers	
	[A3] Water reservoirs with Damsheet	Ha	914	15,909,040	14,540,862,560	District, MINAGRI/KIMP project, RAB, RWB, NGOs, Farmers	
	[A4] Boreholes	Nbr	3000	278,271	834,813,000	District, MINAGRI/KIMP project, RAB, RWB, NGOs, Farmers	
	Sub-total					21,492,246,122,870	
	B. Land husbandry						
	[B1] Radical terraces	Ha	No information of the catchment	2,358,420	These are to be determined once the surface areas covered by each of the proposed land husbandry measures are available or known. These are expected to be provided by a biophysical mapping of the catchment.		
	[B2] Progressive terraces/Hedgerows	Ha		633,600			
	[B3] Agroforestry	Ha		209,600			
[B4] Forestry	Ha	327,000					
[B5] Rainwater harvesting	Nbr	100,000					
[B6] Bamboos	Ha	209,600					

Notes: 1. The reference unit price was obtained from the Karangazi study

4.3. CBA of Landscape Restoration Options for Akagera Lower Catchment

The increase in demand for landscape restoration and limited resources available has expanded the need for economic and financial analysis of landscape restoration to help prioritize the investment of the resources in many parts of the world. Cost-Benefit Analysis (CBA) is a tool commonly used for economic analysis though its application varies across different contexts (Wainaina et al. 2020). Thus, this landscape restoration process involves both associated costs and benefits. This section presents results from CBA carried out for different landscape restoration options suitable for each catchment. The focus is mainly on financial cost-benefit analysis. This provides information in comparing the alternative options (considered as landscape restoration enterprises) though the actual effect or impact of the project is

hidden in the economic analysis. Elements of economic analysis are also considered to a certain extent during the interpretation or discussion of the results.

It was already indicated the both CBA and Economic Cost-Benefit Analyses have some similarities and differences. But, in both analyses, the net benefits of a project investment can be estimated from the difference between with-project and without-project situations (Wainaina et al. 2020). This implies the difference in the outcome variable (s) between beneficiaries of a given project or intervention (a “with” situation) and non-beneficiaries (a “without” situation). Therefore, both the benefits and costs are computed to appreciate the value of money or the effectiveness of a policy option. Therefore, a variation of the total cost of landscape restoration depends, among other factors, on the levels of land degradation and how difficult the restoration is.

For this CBA, two categories of costs are considered: (1) the investment cost for each of the top three identified restoration options, (2) operating costs for agriculture land-use type, and revenues resulting from cultivation of top three crops (2 selected from a list of crops for subsistence) and one commercial crop (from a list of commercial crops). The analysis treats each landscape restoration option as an individual project or intervention. But this does not preclude the option of collective investment at the community level upon the investment option available.

The CBA analysis in Akagera lower catchment has focused mainly on irrigation as the main landscape restoration option reported by this study’s findings from different data collection techniques as above highlighted. The analysis has further compared the current status against the experiment using different types of irrigation to serve as a benchmark for this analysis. Results are presented in the following Table 18. Results substantiate that farming practices must be well adapted for irrigation to be profitable at the farmer level by cultivating high-yielding crops. Government or development partners are called upon to finance the costs of establishing the irrigation schemes, which often are beyond the financial capacity of the majority of farmers.

- The duration of appraisal considered is 20 years, mostly recommended to appraise similar Soil and Water management technologies or investments (de Graaff, 2005). Similarly, the discount rate considered is 8%, an average saving interest rate with commercial banks. It is used as a discounting factor.
- Operating costs are seasonal and were based on survey data collected in the socio-economic survey to inform on operating costs per ha. These comprise costs per Ha of seed, fertilizers, and labor allocated to the cultivation of bean and maize.
- Looking at the Benefit Cost Ratio (BCR) criteria of evaluation, the current farming of beans and maze is profitable, farmers can cover their seasonal costs with their seasonal gross income from the selling of the produce.

Table 18: Valuation of costs and revenues for the Financial CBA

Variables	Beans [Farming in the Hillside]	Maize [Farming in the Hillside]
Plot size (ha)	0.34	0.46
Investment (Costs/ ha)		
Large and small scale irrigation		
Agroforestry systems		
Water reservoir with damsheet and water boreholes		
Land husbandry options		
Annual Gross Revenue / ha		
Yield (Kg)	729.8	1,384.30
Value	391,838	365,660
Seasonal Operating Costs (per ha)		
Seed (Kg)	108.6	24.9
Seed(Frw)	76,068	57,318
<i>Inorganic fertilizers</i>		
NPK (Kg per ha)	89.7	---
DAP (Kg per ha)	91.7	95.1
UREA (Kg per ha)	46.2	47.4
Fertilizers (NPK Urea, DAP) without government subsidy		
NPK (Frw per ha)	63,695	--
DAP (Frw per ha)	67,755	70,246
UREA (Frw per ha)	29,527	30,303
Manure (Kg per ha)	9,497.20	6,956.80
Manure (Frw per ha)	---	---
Compost (Kg per ha)	9,495.80	10,251.00
Compost (Kg per ha)	---	---
Labour (Man-days)	80	75
Labour (Frw)	96,082	89,884
Total Operating Costs	333,127	247,751
Gross Margin (per ha)	58,711	117,909
Benefit-Cost Ratio (BCR)	1.2	1.5

In the following Table 19, the CBA analysis is performed using the Net Present Value (NPV) criteria for two alternative options: one with large-scale irrigation, which constitutes the first scenario, and the second one, which is the small-scale irrigation being the second scenario. The NPV of an alternative equals the difference between the present value of the benefits and the present value of the costs. Both these values result from prediction. Using this criterion for both scenarios or choices, the NPV is negative, suggesting that Irrigation might not be a viable investment under current farming conditions. Heavy investment costs than the cash flows, the investment costs are beyond the capacity of individual farmers. But the scenario without these investment costs shows progressive farming activities.

Table 19: Financial Cost-Benefit Analysis in Akagera Lower

Scenario 1: Large Scale Irrigation			Scenario 2: Small Scale Irrigation		
Situation without Irrigation	Crop	Bean	Maize	Bean	Maize
	Appraisal period (years)			20	
	Capital Costs (Irrigation)				
	Whole life costs				
	Annual costs	333127	247,751	333127	247,751
	Annual revenues	391,838	365,660	391,838	365,660
	CBA at Public sector discount rate (8%)	8%		8%	
	Present value of the benefits	84,068.1	78,452	84,068.1	78,452
	Present value of Costs	71,472	53,154.53	71,472	53,154.53
	Benefit Cost Ratio (BCR)	1.2	1.5	1.2	1.5
	Present Value of Future Cash Flows	1,174,220	2,358,180	1,174,220	2,358,180
NPV (initial annual cost as investment) (N=67)	841,093	2,110,429	841,093	2,110,429	
Situation with Irrigation	Appraisal Period	20			
	Capital Costs (Irrigation)	20	Frw: 12,000,000	5,000,000	
	Whole life costs				
	Annual costs	333127	247,751	333127	247,751
	Annual revenues	391,838	365,660	391,838	365,660
	CBA at Public sector discount rate	8%		8%	
	Present value of the benefits	84,068.1	78,452	84,068.1	78,452
	Present value of Costs	71,472	53,154.53	71,472	53,154.53
	Benefit Cost Ratio (BCR)	1.2	1.5	1.2	1.5
	Present Value of Future Cash Flows	1,174,220	2,358,180	1,174,220	2,358,180
	NPV (Capital Investment) (N=67)	8,657,560-	9,713,121-	-	1,463,115.52

From an economic perspective, these results are the costs that the government or development partners will accept to finance to ensure that other economic and ecosystem benefits are obtained. Previous studies in Rwanda have already confirmed that soil and water management investment using irrigation has greater chances to reduce poverty in diversifying rural economies. For instance, the study by Nabahungu and Visser (2011) found that the contribution of wetland cultivation was 74% (US\$ 1901) of

the total cultivation gross margin per household per year in Cyabayaga and 24% (US\$ 84) in Rugeramigozi, respectively. These effects from wetlands cannot be materialized without investment in irrigation. Irrigation helps to increase yield due to its effect on drought, but this should be combined with high-yielding crops to ensure better returns in the medium to long run. This gives some confidence that the development of irrigation schemes in Rwanda will address issues linked to sufficient food production and effective natural resources management. Going forward, a community level or catchment level feasibility study is recommended to account for all landscape restoration options and other bio-physical assessments beyond this socio-economic assessment.

4.4. Analysis of financing opportunities of the landscape restoration options

A deepened analysis has further proposed the different landscape restoration options been gathered from consultations at field conditions and were supported by a household survey and scientific knowledge. The study listed the following landscape restoration options:

Box 3: Proposed landscape restoration options in Akagera Lower catchment

- Promotion of rainwater harvesting at household level and livestock through Nkunganire system
- Supply of potable water to villages in the catchment to stop using dirty water from dams;
- Look for other alternatives to minimize overexploitation of natural resources
- Deep study for the development of boreholes (Nayikondo) to supply water mainly for home consumption;
- Promote irrigation through water storage dam and borehole facilities nearby farms for agriculture, livestock, and domestic purposes;
- Promotion of Bee-keeping activities as another alternative source of income;
- Improvement of milk and crop (maize) value chains to avoid monopoly of the buyers.
- Promotion of land husbandry activities resistant to drought conditions including fodder, agroforestry, crops, trees, and other mechanical infrastructures;
- Preventions of the spread of termite in the agricultural lands;
- Propose a strategic plan to cope with drought and park buffer zone conditions

The above described proposed solutions and their financing models/opportunities have been reported in this study to overcome the described catchment related challenges of drought, Source of wood energy, floods, Water scarcity for home consumption, agriculture, and livestock, soil erosion, termites attack, and other climate change impacts.

The main identified landscape restoration options for catchment management plan are small and large scale irrigation, construction of water reservoirs (livestock, home, agriculture purposes), construction of boreholes, and land husbandry interventions (agroforestry, erosion control system, and afforestation).

Financing models should encompass the involvement of policy institutions including RWB and RAB to lead the proposed interventions. Joint Action Development Forum (JADF) at the district level can help to monitor the financing models to check if they follow the developed catchment management plan within each administrative entity. The District has to play the role of owning the developed infrastructures and make sure that the implemented works are aligned with district development strategy, national catchment management plan, and policies.

Option # 1: Small and large scale irrigations for Strengthening resilience to droughts:

Several stakeholder actors have been ranked by farmers for the level of involvement in the irrigation system as follows: District, Kayonza Irrigation and Integrated Watershed Management Project (KIIWP)/MINAGRI project, RAB, local NGOs, and farmers. Among others in the NAKL, the ongoing project KIIWP (Kirehe Irrigation and Integrated Watershed) in RAB is the existing potential stakeholder, contributing to the development of appropriate irrigation systems at small and large scales within five years. This project is expecting to cover 5000 ha by investment-ready pipeline and 2,275 ha of other schemes.

Another existing financing opportunities comprise the Government subsidy (50%) system, adopting Small Scale Irrigation Technology (SSIT) program from RAB/MINAGRI, aiming to build resilience to climate change, increasing production, and creating jobs for people especially youth and women targeting the development of 24,000 hectares by 2024 (PSTA-4). Every year, the program covers about 3000 ha, mostly in the Eastern province. For instance, 1752 ha were targeted for SSIT last year (2020/2021) in the districts within NAKL (Ngoma, Gatsibo, Kayonza, Kirehe, and Nyagatare).

Other potential stakeholders that can support the irrigation system are projects initiated by local NGOs and other organizations in the framework of JADF (Joint Action District Development Forum) at the district level. The implication of RWB as the leading institution in catchment management plans should be inevitable as well as farmers' participation for sustainability purposes.

Option # 2: Water reservoir with damsheets and water boreholes:

KIIWP project will also provide 35 infrastructures (valley tanks and boreholes) for rain-fed areas. 15 new valley tanks will be constructed and 20 boreholes will be installed. Potential supports can also be provided by local NGOs, WASAC, and other district local partners, mainly related to Water for Livestock Users Organisations. RWB's role is always paramount to control water use efficiency for different purposes.

Option # 3: Land husbandry options:

These include radical terraces, progressive terraces, agroforestry/forestry, rainwater harvesting, and riverbank protection with bamboos. To follow up with the catchment management plan, a land husbandry master plan at the catchment scale is required to know how many land areas are affected per each intervention. The existing financial opportunities comprise the MINAGRI subsidy system (50%) to support the construction of radical terraces for an increased area of land protected against soil erosion and crop productivity on an annual basis. For instance, 20 ha were targeted for radical terraces last year in Kirehe within NAKL.

KIIWP project is also supporting 370 ha of radical terraces, 165 ha of soil bunds, and 65 ha of ditches and grass strips. RAB, REMA, RWB and their partners/stakeholders are the potential financing opportunities to support land husbandry interventions in the NAKL catchment.

Potential stakeholders to be involved in the NAKL catchment management plan include RWB, REMA, RAB, ICRAF, and other JADF members (NGOs, organizations, cooperatives,...).

4.5. National strategic financing model to support sustainable Catchment management of Akagera Lower

In the context of analysis of the financing opportunities, the MOE and its agencies are the potential institutions to contribute to landscape restoration in the context of climate-smart catchment management plan. Particularly, the Rwanda Green Fund – known as FONERWA¹ provides strategic financing to accelerate Rwanda’s commitment to building a strong climate resilient and green economy. FONERWA serves as a “one-stop shop” to mobilize and channel domestic and international resources into climate and environmental projects. The Funding proposals are approved based on a careful evaluation to ensure their return on investment contributes to the country’s climate resilience. Climate finance, whether local, national, or international, recognizes the importance of financial assistance from countries with more resources to those that are less endowed and more vulnerable to mitigate the carbon emissions and adapt to adverse effects of climate change.

In this context, financing opportunity is claimed from the Updated Nationally Determined Contribution (NDCs)² for Rwanda approved in May 2020, and that serves as a blueprint for advancing targeted and measurable climate action in key sectors.

This framework guides coordinated efforts for both government agencies as well as international organizations, NGOs, civil society, and community-based organizations to address environment degraded challenges.

Financing analysis in expanding soil conservation and land husbandry programs in 100% of the priority area by 2030 (IUCN, 2020). The past related investment was about Frw 40 billion between 2014/15 and 2017/18.

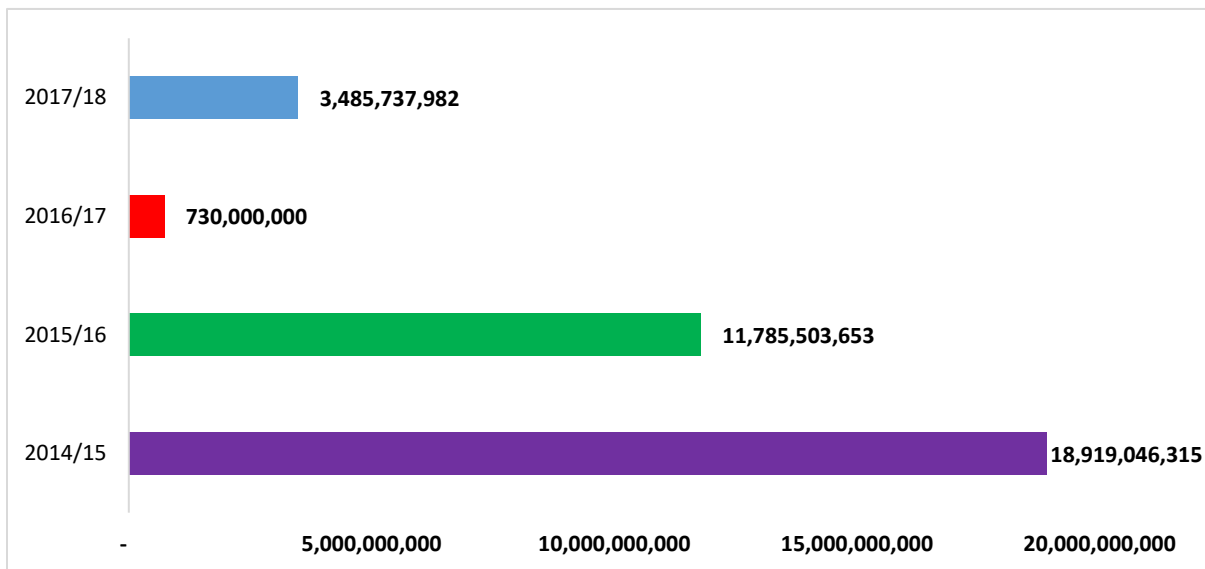


Figure 14: Past Investment in soil conservation and land husbandry (Source: Analysis of national budgets, 2014/15-2019/20)

For irrigation and water management, GoR intends to increase investment in irrigated agriculture to increase production, harness freshwater resources while ensuring food security to its population.

¹ The French acronym, FONERWA, was coined in 2005 under Organic Law no.4/2005 and means fund for environment and natural resources for Rwanda. Through the FONERWA Law, it has taken on the additional meaning of environment and climate change fund for Rwanda.

² Republic of Rwanda, 2020. Revised Nationally Determined Contribution

Irrigation Master Plan proposed a water catchment approach in the irrigation options. Figure 15 below clarifies the positive trend in the financial investment of about Frw 125.7 billion between 2014/15 and 2017/18, despite fluctuations that were observed in 2016/17.

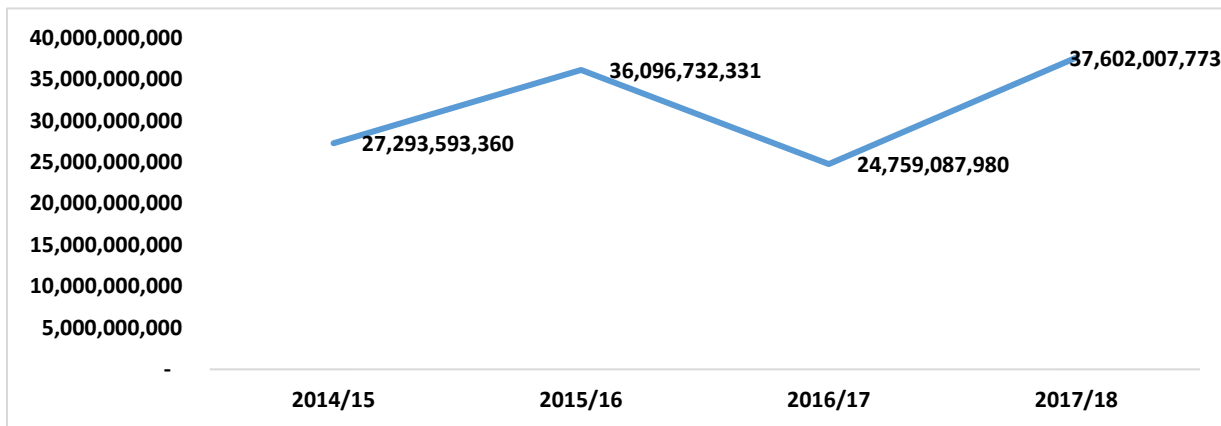


Figure 15: Investment in irrigation (Source: Analysis of national budgets, 2014/15-2019/20)

Forestry and agroforestry investments within five years are highlighted to respond to the needs in climate change protection and wood energy. The findings show that Frw 25.2 billion has been invested in forestry-related interventions (Figure 16). The investment in agroforestry in the fiscal year 2020/21 was estimated at Frw 810,240,895, mainly through trees planting, forestry planting management, and agroforestry, etc.

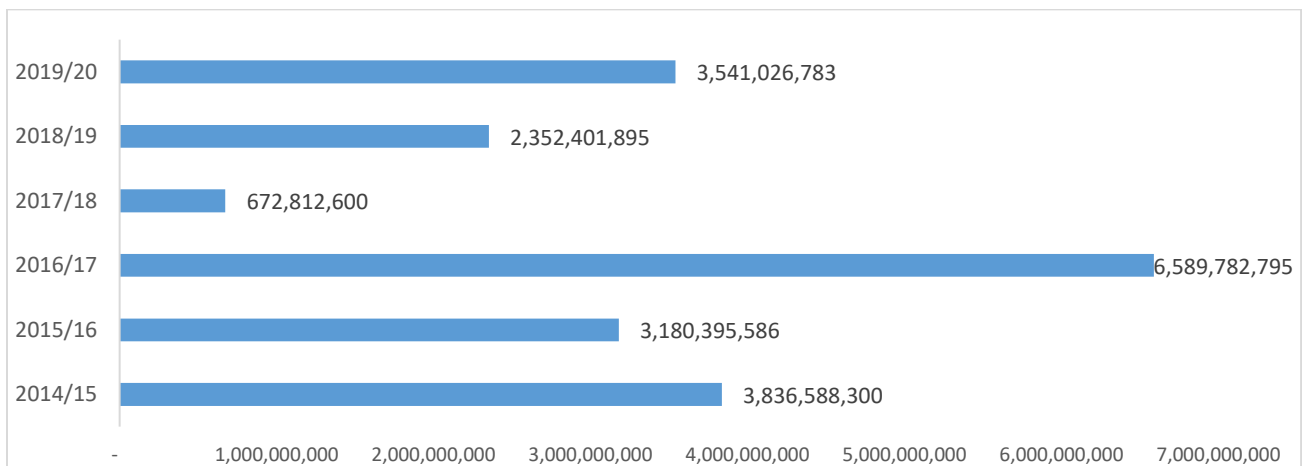


Figure 16: Investment in agroforestry (Source: Analysis of national budgets, 2014/15-2019/20)

For improving forest management, investment is required to maximize the productivity of degraded forest plantations, increasing biomass supply without converting additional land. The analysis of investment highlights about Frw 6.9 billion in the improvement of forestry management for degraded forestry resources over the past few years (Figure 17). The GoR should recommend the investment opportunities through public-private partnerships to sustainably managing all forestry plantations through multi-year contracts with forests operators (in cooperatives). Reforestation and afforestation of designated and degraded areas have been an important priority intervention in the year 2020/21 with an estimated Frw 5,039,770,316.

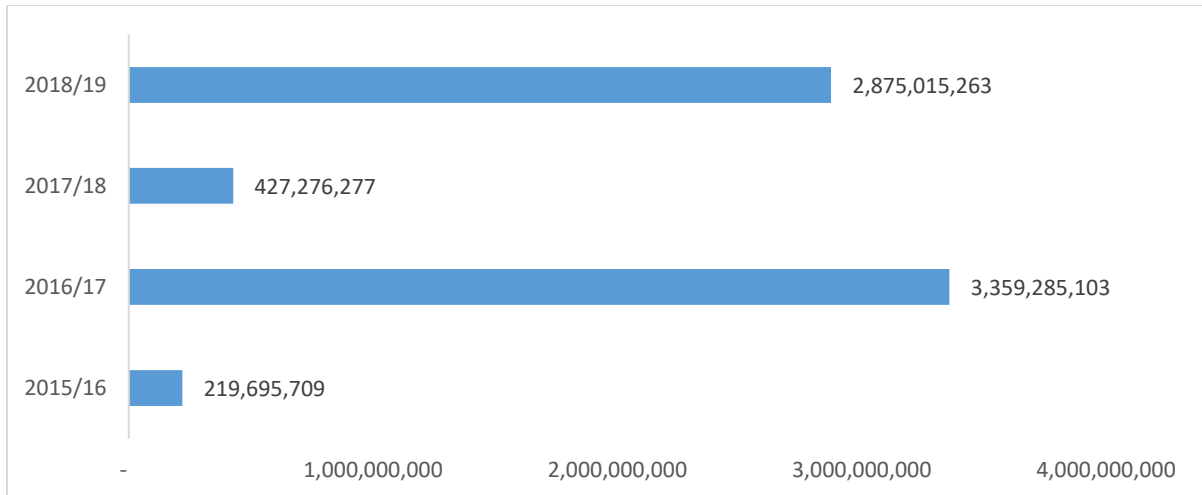
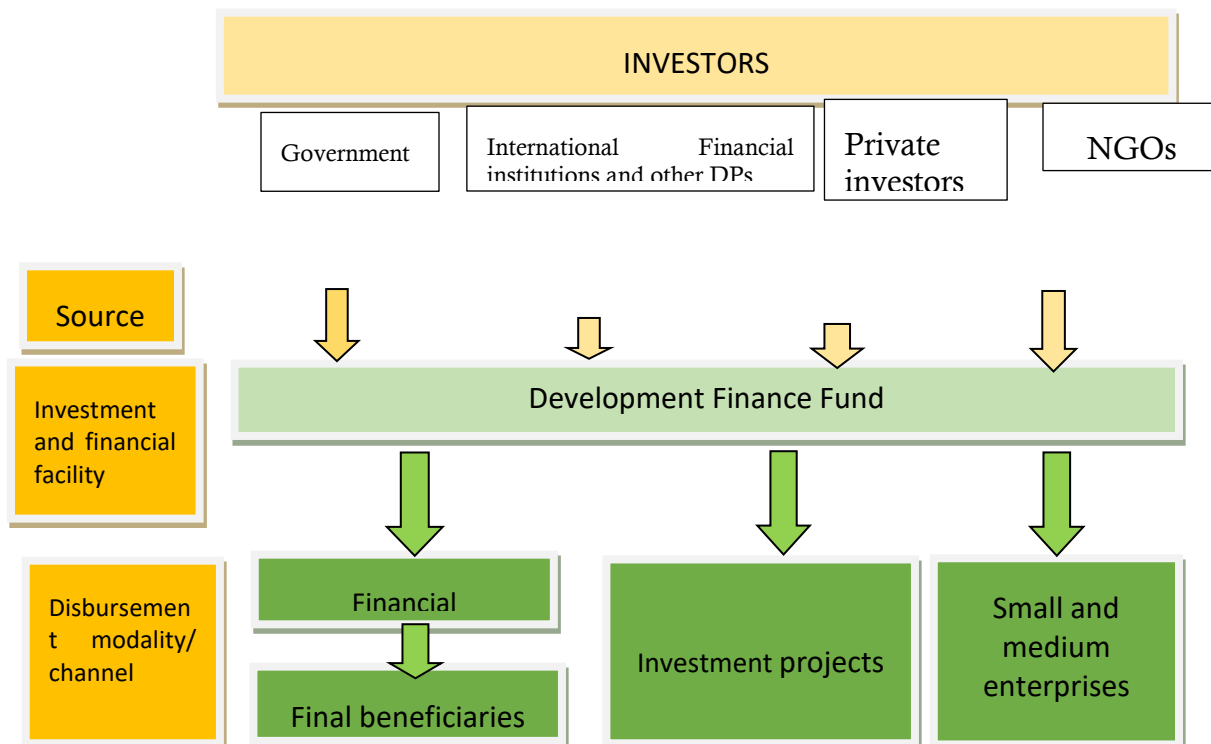


Figure 17: Investment in Forest Management for degraded forest resources (Source: Analysis of national budgets, 2014/15-2019/20)

An indicative financing model can be suggested here to support the investment in landscape restoration programs. This requires raising awareness to get the role of the private sector and NGOs in financing interventions while decreasing the role of the government progressively. Funding Sources at the National level is summarized in the Table 20 below.



Source: Adapted from the World Bank, Making climate finance work in agriculture, discussion paper. Can be found on the link: <http://documents1.worldbank.org/curated/en/986961467721999165/pdf/ACS19080-REVISED-OUO-9-Making-Climate-Finance-Work-in-Agriculture-Final-Version.pdf>.

Table 20: Potential funders

Development partners	Agriculture (irrigation, husbandry,...)	land	Land and forestry (under environment and natural resources)
Bilateral	Belgium, China, India, Japan, Korea, USA, UK, Sweden	South	Germany, Netherlands, Sweden, UK
Multilateral	EC, EIB, World Bank, BMGF		Green Climate Fund, World Bank
UN organizations	FAO, IFAD, WFP		UNDP, UNECA, UN Environment, IFAD

5. Livelihood opportunities, Interventions, and Stakeholders

This section addresses the third component of the overall objective: to provide innovative suggestions on prioritizing proposals, combining livelihood improvements and biophysical catchment restorations for optimizing economic and ecological benefits.

5.1. Overview of livelihoods issues

Understanding the challenges and issues facing landscape restoration is crucial to develop sustainable catchment management plans. The study has assessed perceived issues and challenges in the two catchments through the consultations held in the form of stakeholders' meetings and focus group discussions and complemented by findings from the socio-economic survey. This exercise has also helped to confirm the identified livelihood issues to identify livelihood opportunities for interventions linked to landscape restoration.

Table 21: Ranking of issues in Akagera lower Catchment

Issue identified along with the Five SLA's Capitals	Consultation meeting		Focus Group Discussion				Total points	Percentage (%)
	Stakeholders' Workshop	FG1	FG2	FG3	F	G		
Natural capital-related								
Drought	1	1	1	1	1	5	100	
Water scarcity	1	1	1	1	1	5	100	
Floods	1	0	1	1	1	4	80	
Erosion (wind and soil)	1	1	1	0	1	4	80	
Deforestation	1	1	1	1	1	5	100	
Agriculture and settlements activities that do not follow erosion control measures	1	0	1	0	1	3	60	
Depletion of the soil nutrients	0	1	1	1	1	4	80	
Presence of termites (Imiswa) in the soil	0	1	1	1	1	4	80	
Loss of Biodiversity	0	1	1	1	1	4	80	
Sedimentation	0	1	1	0	0	2	40	
Water pollution due to agriculture	0	0	1	0	0	1	20	
Water quality	1	1	1	1	1	5	100	
Mining activities	1	1	0	0	0	2	40	
Financial Capital related								
Poor coordination and collaboration between government and private entities	1	1	1	1	1	5	100	
Lack of collateral while requesting for bank loans	0	1	1	1	1	4	80	
High interest rate for bank loans	0	1	1	1	1	4	80	
Complicated and high cost of the procedure of loans requesting	0	1	1	1	1	4	80	
Long distance to some financial institutions	0	1	1	1	1	4	80	
Lack of market of the agricultural products	0	1	1	1	1	4	80	
Lack of off-farm opportunities/ over reliance on farming	0	1	1	1	1	4	80	
Human capital related								
Lack of knowledge in appropriate land use policies	1	0	0	0	1	2	40	

Issue identified along with the Five SLA's Capitals	Consultation meeting	Focus Group Discussion					Total points	Percentage (%)
	Stakeholders' Workshop	FG1	FG2	FG3	F G 4			
Poor agricultural infrastructure and agricultural practices	1	1	1	1	1	5	100	
Poor implementation of existing plans	0	1	1	1	1	4	80	
Poor planning	0	1	1	1	1	4	80	
<i>Social Capital</i>								
Conflicts between farmers and livestock growers due to the water dams' usage	0	1	1	1	1	4	80	
Unprotected Riverbanks of water bodies	0	0	1	0	0	1	20	
Buffer zones encroachment	0	0	1	0	0	1	20	
Population pressure	1	1	1	0	1	4	80	
Unplanned Settlement	1	1	0	0	1	3	60	
<i>Physical Capital related</i>								
Limited water storage facilities	1	1	1	1	1	5	100	
Infrastructures that are not friendly to protection of watershed (houses, roads),	0	1	0	1	1	3	60	
Insufficient health posts/ centers	0	0	1	1	1	3	60	
Mining activities	1	1	0	0	0	2	40	
Climate change	0	1	1	1	1	4	80	
Over grazing practices	1	0	0	0	0	1	20	

5.2. Livelihood opportunities, proposed interventions, and key stakeholders

This sub-section presents key livelihood opportunities identified and examples of interventions or enterprises that can be implemented to promote both livelihood improvements and biophysical catchment restorations to optimize both socio-economic and ecological benefits. Proposed livelihood opportunities are obtained from the different issues identified along with the five capitals of the sustainable livelihood approach and have the potential for landscape restoration in the NAKL catchment. Proposed interventions indicate possible enterprises and will need more detailed feasibility studies towards a sustainable catchment management plan.

Table 22: Suggested interventions for improved livelihood conditions and catchment restoration in Akagera Lower Catchment

Livelihood opportunities identified along with the Five SLA's Capitals from issues/challenges	Examples of Interventions for improved livelihood conditions and Landscape restoration: Livelihood Strategies (LS)	Key Stakeholders
Natural capital		
Opportunity # 1: Agriculture and livestock remain the dominant sources of income and hence livelihoods.	<ul style="list-style-type: none"> ▪ Increase the number of agro-dealers and bring them closer to the local farmers ▪ Sensitize local farmers about the use of agricultural inputs ▪ Provision of livestock (cows, pigs, goats) to generate manure for increasing agriculture production and human nutrition 	<i>District, RAB, BDF, MINICOM, MIGEPROF, MYICT, KIIWP, ICRAF, RFA, RWB, Community members</i>
	<ul style="list-style-type: none"> ▪ Development of off-farm opportunities of employment in areas of carpentry, masonry, and creation of eco-tourism businesses through eco-tourism cooperatives. ▪ Capacitate communities in the NAKL Catchment for the development of small businesses, especially for women and youth both in on and off-farm sectors. 	<i>District, RDB, AKAGERA Part-RDB, KIIWP project, Community members</i>
Opportunity# 2: There is a water shortage for home consumption, agriculture, and livestock.	<ul style="list-style-type: none"> ▪ Installation of more public taps to address this issue of water shortage for consumption. ▪ More investment in small and large scale irrigation and water management to address water shortage for agriculture ▪ More investment in rainwater harvesting facilities ▪ Construction of water reservoirs with dam sheets ▪ Construction of water boreholes and water facilities. 	<i>District, RAB, RWB, WASAC, IUCN, KIIWP, HINGA WEZE PROJECT, EKN, WB, Community members</i>
Opportunity#3: Citizens in the NAKL Catchment face the challenge of insufficient access to alternative energy sources for cooking, resulting in intensive use of forestry resources, mainly for firewood.	<ul style="list-style-type: none"> ▪ Promotion of alternative energy sources such as biogas for cooking to reduce reliance on firewood in the long run. ▪ Afforestation- more plantation of trees and agroforestry trees (short-run) ▪ Promotion of solar energy for lighting 	<i>District, REMA, REG, ICRAF, RWB, Community members</i>
Issue/Opportunity#4: Inefficient use and management of agricultural land by citizens in the Catchment.	<ul style="list-style-type: none"> ▪ Increase adoption of agriculture technologies and best practices ▪ Agroforestry systems to be promoted for increasing organic fertilizer supply ▪ Enforce cultivation of crops based on soil suitability guidelines 	<i>District, RAB, TUBURA, HINGA WEZE, Community members</i>
Issue/Opportunity#5: Lack of markets for agricultural products; markets for farm products are imperfect and distant, leading to low agricultural income.	<ul style="list-style-type: none"> ▪ Facilitation of access to markets through cooperatives ▪ Introduction of E-commerce, especially for commercial crops. ▪ Investment in post-harvest handling facilities (i.e., cold rooms for vegetables and other horticulture crops. 	<i>District, MINAGRI, RDB, MINICOM, NAEB, Community members</i>
Financial capital		
Opportunity # 6: Women are more financially excluded as compared to men	<ul style="list-style-type: none"> ▪ Design and implement innovative financial products adapted to women through BDF and other financial institutions 	<i>District, BDF, DUTERIMBERE, BRD, GMO,</i>

Livelihood opportunities identified along with the Five SLA's Capitals from issues/challenges	Examples of Interventions for improved livelihood conditions and Landscape restoration: Livelihood Strategies (LS)	Key Stakeholders
Natural capital		
Opportunity # 7: Lack of collateral while requesting bank loans, high interest for bank loans, lengthy procedures in loan requesting.	<ul style="list-style-type: none"> ▪ Design loan subsidy products adapted to categories of investors in agriculture. ▪ Design financial products aligned to the nature of agriculture and small businesses. ▪ Financial products with a competitive interest rate for investment in agriculture and natural resource management. 	<i>District, BDF, DUTERIMBERE, BRD, BNR,</i>
Social Capital		
Opportunity# 8. Most activities performed through cooperatives are related to farming than other off-farm activities.	<ul style="list-style-type: none"> ▪ Create more cooperatives involved in off-farm activities or encouraging diversification of their activities. ▪ Construction of "Udukiriro" with preliminary equipment. 	<i>District, RCA, MINICOM, Community members</i>
Opportunity# 10. Conflicts between farmers and livestock growers due to the water dams' usage, Buffer Zone encroachment, and unprotected riverbanks of water bodies.	<ul style="list-style-type: none"> ▪ Create and capacitate Associations to manage water facilities liked Water User Associations. ▪ Enforce regulation for buffer zone and innovative ways of using buffer zone for economic activities without compromising the protected area like food tree plantation. ▪ Protection of riverbanks using agroforestry trees or bamboos – these will also serve for business purposes. 	<i>RWB, REMA, RDB, GABIRO-AGRIBUSINESS, Community members</i>
Human Capital		
Opportunity# 9. Knowledge gaps on appropriate land-use policies and plans, agricultural and environmental practices.	<ul style="list-style-type: none"> ▪ Education and capacity building interventions ▪ Knowledge dissemination ▪ Capacity building in business planning, including those related to the environment. ▪ ICT Literacy 	<i>DISTRICT, MOE, RWB, RAB, MINAGRI, REMA, MYICT, Community members</i>
Physical		
Opportunity # 10. Limited feeder roads, Inappropriate mining activities, and watershed infrastructure.	<ul style="list-style-type: none"> ▪ Construction of feeder roads to enhance market linkages ▪ Development of environmentally friendly mining activities. 	<i>District, MININFRA, LODA, Rwanda Mines, Petroleum and Gas Board (RMB), Community members</i>

5.3. Summary of key issues and landscape restoration responses

Driving forces – Pressures – States – Impacts – Responses (DPSIR) framework is built on information obtained from different sources of information, namely stakeholders’ consultation workshop, Focus Group Discussions (FGDs) with opinion leaders, Key informant interviews, and robust Household Survey. Findings have revealed several socio-economic and environment-related issues, pressures, states, and impacts. The responses to mitigate negative impacts identified in the NMUK catchment were proposed.

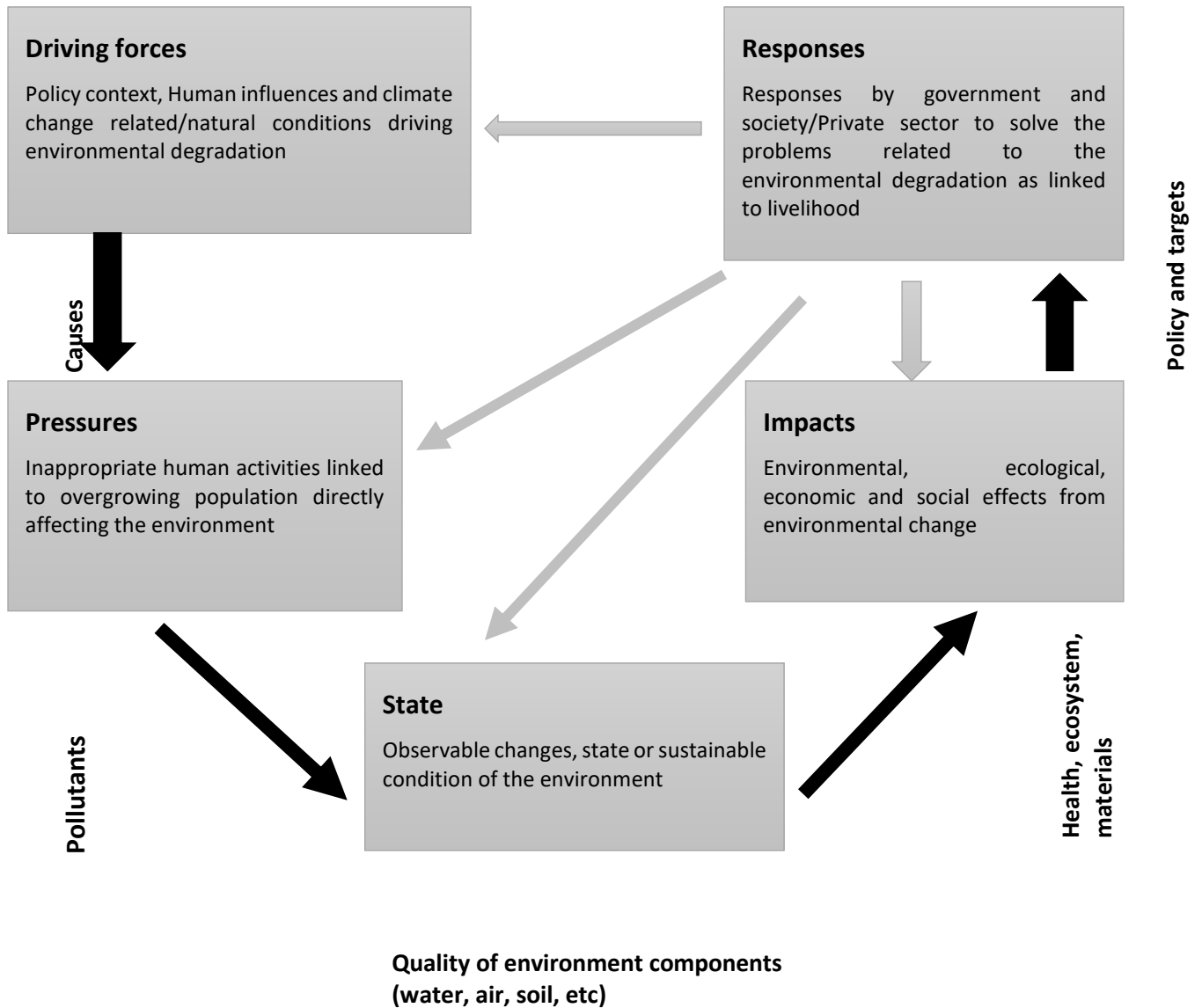






Figure 18: DPSIR Framework

DPSIR framework is explained as follows;

- **Drivers:** Drivers refer to fundamental processes in society, which drive human activities having a direct impact on the environment. The leading driving forces behind socio-economic and environmental issues in the NAKL catchment include high population growth and density, limited value addition to agriculture and livestock production, drought linked to low levels of irrigation practices, poverty due to low levels of income, steep topography inducing natural hazards (erosion), among others.
- **Pressures:** Driving forces mentioned above lead to human activities that give rise to pressure on the environment and natural resource management. These human activities exert pressure on the environment for the sake of production and responding to livelihood needs. Deforestation due to overdependence on firewood and charcoal for cooking and timber or wood, subsistence agriculture with low levels of irrigation, inefficient use of water conflicting agriculture, and livestock production, are among the main stresses that human activities place on the environment.
- **States:** The states referred to as environmental change, which could be both natural and human-induced. One form of change, such as climate change and variability (i.e., extreme events) may lead to other forms of change such as biodiversity loss, drought, loss of soil fertility, and other forms of land degradation, etc.
- **Impacts:** Environmental change may positively or negatively influence human wellbeing. The impacts may be environmental, social, and economic, contributing to the vulnerability of people in the catchment. Some of these impacts include low levels of crop and livestock productivity, a high level of stunting among children, environmental degradation (drought, water scarcity, termites), and limited knowledge on environmental protection, among others.
- **Responses:** Responses by society or policymakers are referred to as the result of undesired impacts and can affect any part of the chain between driving forces and impacts. Responses address issues of vulnerability of both people and the environment and provide opportunities for enhancing human well-being as reflected in Table 23 below.


Table 23: Details of drivers, pressures, states, impacts, and responses on Akagera Lower Catchment (NAKL)

Drivers	Pressure	State	Impact	Response
1. High population density and growth (high birth rates and inward migration)	Deforestation	Low tree cover, Wildlife migration, Degradation of grasslands	Environmental degradation (e.g: drought, water erosion, flooding, soil acidity, and the existence of termite mounds) and limited knowledge on environmental protection	1. Enhance family planning
	Soil degradation leading to agronomic drought and low resilience	Degraded wetlands and marshlands, Low productivity due to drought, termites and poor soil fertility	Prevalence of natural disasters- flooding, drought, loss of habitat	2. Promote off-farm jobs business centers like agakiriro to create more jobs for unemployed people, construct sufficient markets and selling points
	High demand for water and energy sources in the settlements incl. refugee settlements	Water shortage status for home, livestock, and agriculture consumption		3. Promotion of alternative energy sources such as biogas.
	High cost of off-grid electrification, specifically biogas and solar energy	Insufficient access to electricity		4. Increased use of alternative energy sources (solar energy)
	Land use change from pasture to crop lands	Low crop and livestock productivity due to subsistence farming practices,		5. Reinforce homegrown solutions "kitchen garden- akarima k'igikoni"

2. Limited financial resources		High-interest rates offered by financial institutions		Low access to finance for vulnerable people, women and youth		Increased poverty		1. Support to value chains	
		Limited capital and funds for investment, especially among the youth				High rates of school drop-out		2. Enhance access to finance for vulnerable people, women, and youth	
		Poor coordination and collaboration between government and private entities							3. Promote Private sector involvement in planning, implementation, management, including financing of landscape restoration
		High water prices		Poor water quality		Poor hygiene			4. Adapt the subsidy program, e.g. "Nkunganire" and VSLA's for the purchase and installation of rainwater harvest facilities
				Water shortage status for home, livestock, and agriculture consumption					5. More diversified bank and financial products adapted to farming businesses both in terms of collateral and the payment period.
									6. Multi stakeholder platforms at national and sub national levels
3. Unplanned land use incl. urbanization		Low pace of updating and implementing the land use plan		Inefficient land use, Land scarcity for agriculture and livestock production		Unequal distribution of land and other facilities, means and resources		1. Sensitize program for local communities, e.g FFS, Farmer Promoters, to plant trees (forestation) and use alternative energy	

							for cooking (e.g: biogas)	
		Inappropriate mining activities		High sediment loads (high turbidity)			2. Promote environmentally friendly mining activities (sustainable mining).	
		Low enforcement of environmental guidelines for mining		Inappropriate mining activities that lead to degradation of land			3. GAP (mulching, ISIM, soil and water conservation practices)	
		Overgrazing		Poor manure management practices		Reduction of productivity and biodiversity of land; Spread of invasive species of non-native plants and of weeds.		4. Zero grazing reinforcement
		Subsistence agriculture		Low level of mineral fertilizer use, Low crop and livestock productivity due to subsistence farming practices.		Increased poverty		5. Enforcement of new and existing guidelines for agric in riparian zones e.g. biological pest control
4. Climate change and variability, insufficient rainfall		Deforestation		Degraded wetlands and marshlands .		Prevalence of natural disasters- flooding, drought, loss of habitat		1. Expand water supplies
				Degradation of grasslands				2. Promote the establishment of nature-based enterprises (e.g. beekeeping, mushroom, medicinal plants,) necessary to

							increase household income
	→	Soil degradation leading to agronomic drought and low resilience	→	Low productivity due to drought, termites and poor soil fertility			→ 3. Promote new models of irrigation scheme management.
			→	Recurrent droughts			→ 4. Develop water storage facilities
	→	Disturbance of water cycle	→	Rainwater runoff from house tops and the creation of gullies, especially on steep hill slopes.	→	Increased risk of flooding; Higher rates of erosion on steep hill slopes and riverbanks.	→ 5. Protection of rivers & lakes banks
			→	Competition between water users			→ 6. Promote rainwater harvesting systems
			→	High rate of dry boreholes			→ 7. Rehabilitate degraded wetlands and marshlands
			→	High level of lake fluctuation (e.g. Ihema)			→ 8. Early and regular warning system about climate change-related chocks (natural hazards such as floods, landslides, etc.
			→	River dry out e.g. Kadiridimba			→ 9. Crossbreed local breeds with exotic breeds to enhance livestock productivity
			→	High rate of dry boreholes			→ 10. Physical removal of invasive species
			→	Invasive species proliferation (e.g. water hyacinth)			→ 11. Exploit existing irrigation potential

							12. Promote climate change mitigation through planting trees, increased forest cover, agroforestry, irrigation practices, among others
5. Human wildlife conflict		Deforestation		Low tree cover, Degradation of grasslands		Environmental degradation (e.g: drought, water erosion, flooding, soil acidity, and the existence of termite mounds) and limited knowledge on environmental protection	 1. Promote off-farm jobs business centers like agakiriro to create more jobs for unemployed people, construct sufficient markets and selling points
				Wild migration		Killing of wildlife and habitat disturbance.	 2. Source funds for environmental protection, more support for cooperatives involved in protecting the environment (e.g: national parks).
				Encroachment of national park		Crop damage	 3. Construction of strong fences against the attack of animals
		Land use change from pasture to crop lands		Low productivity due to drought, termites and poor soil fertility			 4. Develop ecotourism sites.

6. Conclusion

The assignment's main objective was to conduct a socio-economic and livelihoods assessment of communities living in Akagera Lower (NAKL) Catchment. Data used to validate the study's objectives were sourced from stakeholders' consultation workshop, Focus Group Discussions (FGDs) with opinion leaders, Key informant interviews, and a Household Survey. A structured survey was proportionately conducted among 325 households from five (5) districts (Nyagatare, Gatsibo, Kayonza, Ngoma, and Kirehe) covered by the NAKL catchment. The analysis of this assessment provided the socio-economic situation in the NAKL catchment, livelihoods conditions, economic and financial cost-benefit analysis of landscape restoration options, livelihoods opportunities, interventions, and key stakeholders.

At a macro level, secondary sources indicate that the dominant social characteristics in the NAKL catchment include high population density, a relatively low literacy rate among the population aged above 15 years old, high stunting among children below 5 years old, and a high population under poverty. While for economic characteristics, the high population in agriculture, lack of appropriate irrigation practices, high financial inclusion, access to land (mainly owned and purchased), and high employment rate, found to be dominant in the catchment. At the micro-level, agriculture and livestock remain the dominant sources of income and hence livelihoods. Public tap is the main source of drinking water and a larger proportion of households are characterized by over-reliance on forest resources, especially for firewood, and cooking purposes.

Similarly, livelihood assessment considered five (5) livelihood capitals or assets, namely natural, financial, social, human, and physical, and identified key livelihoods issues and proposed solutions were also assessed. Key issues identified include drought which leads to water shortage for home consumption, agriculture, and livestock, insufficient access to alternative energy sources for cooking which result in intensive use of forestry resources, inefficient use and management of agricultural land that leads to conflicts between farmers and livestock growers, lack of markets for agricultural products, lack of collateral while requesting bank loans and high-interest rate, among other issues. Some of the proposed solutions include tree plantation, agroforestry, soil fertility, and crop management, small and large scale irrigation to increase production and improve livelihood, promotion of alternative energy sources such as biogas, increase adoption of agriculture technologies, and best practices to efficiently use land, the introduction of E-commerce, especially for commercial crops, and designing of financial products aligned to the nature of agriculture and small businesses to help those without collateral.

For the NAKL catchment, the financial CBA analysis focused mainly on large and small-scale irrigation as the main landscape restoration option reported by the study's findings. The assessment also considered financial models/ opportunities of other landscape restoration options necessary to address the described catchment-related issues. These include water reservoirs with dam sheets and water boreholes and land husbandry options such as radical terraces, progressive terraces, agroforestry/forestry, rainwater harvesting, and riverbank protection with bamboos. In line with livelihood opportunities identified along with the five sustainable livelihoods approach's capitals from key livelihoods issues, the assessment suggested interventions for improved livelihood conditions and landscape restoration (landscape strategies) as well as relevant key stakeholders likely to implement the proposed landscape strategies. More importantly, the assessment summarized key landscape issues with their respective landscape restoration responses using the DPSIR framework.

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Annexes

Annex 1: Household Survey Questionnaire

Consent form

Hello, my name is (INTERVIEWER'S NAME) and I am part of research team from International Union for Conservation of Nature (IUCN) and Rwanda Water Board (RWB) which is conducting a socio-economic and livelihoods assessment in Mukungwa and Akagera Lower Catchments. The purpose of this assessment is to understand the available resources and assets, opportunities and constraints and goals of the communities; and to conduct livelihood analysis in the two catchments with considerations of households' food security and seasonal food availability.

You have been randomly selected to participate in this assessment and your feedback and cooperation will be highly appreciated. The findings of the survey will be used to inform interventions aimed at improving livelihoods of local communities. In order to make the survey as inclusive as possible, selected respondent will be asked a set of questions and all responses will be kept strictly confidential.

We appreciate your voluntary participation, and we believe that your opinions will provide us with the highly valuable information.

Do you agree to participate in this survey?

1. Yes (Continue)
2. No (try to convince the respondent before conclusively ending the survey)

Thank you for your participation!

IDENTIFICATION

Household code	_ _ _
Catchment [1] Akagera [2] Mukungwa	_
District	
Sector	
Cell	
Village	
Interviewer name	
Respondent name	
Respondent contact number	
Date of interview	_ _ /04/2021
Starting time	
Ending time	
Add GPS coordinates	

SECTION 1: SOCIO-DEMOGRAPHIC CHARACTERISTICS OF THE RESPONDENTS

Q1.1. What is your sex? [1] Male [2] Female	_
Q1.2 What is your age? (in years)	_
Q1.3. Who heads your household? [1] Male [2] Female	
Q1.4. What is your position in this household? [1] Household head [2] Spouse [3] Son/ daughter [4] Other (describe)	
Q1.5. How many people currently live in your household? [1] Total household size [2] Number of males (aged 16 and above) [3] Number of females (aged 16 and above)	_T_ _M_ _F_
Q1.5. Have you attended any formal education? [1] Yes [2] No	_
Q1.6. If [YES], what is the highest level of education completed? [1] Lower primary [2] Upper primary [3] Lower secondary	_

<p>[4] Upper secondary [5] Vocational [6] College diploma/ University</p> <p>Indicate total years of formal education ___ </p>	
<p>Q1.7. What is your marital status?</p> <p>[1] Married [2] Living with partner [3] Married but separated [4] Married but divorced [5] Widowed [6] Single (never married) [7] Other (describe)</p>	<p> _ </p>
<p>Q1.8. When did you come to live here? Please indicate the year?</p>	<p> ___ Y ___ </p>
<p>Q1.9. How did you come to live here?</p> <p>[1] I (my family) was resettled here by government authorities [2] I (my family) purchased land [3] I (my family) leased/ rented land [4] It was my (family's) ancestral land ----→ Go to Q1.11 [5] Internal migration (within the country) for economic and social reasons [6] External migration (from neighbouring countries) [7] Other (describe)</p>	<p> _ </p>
<p>Q1.10. From which area (district and sector) did you come to resettle/ live here?</p> <p>[1] Country [2] District _____ [3] Sector _____</p>	<p> _ </p>
<p>Q1.11. For those who migrated internally, What were the reasons for resettling in this area? (multiple response)</p> <p>[1] Looking for agricultural land/ paid agricultural activities [2] Looking for grazing land [3] Family conflict [4] Better infrastructure access [5] Civil war [6] Climate change related shocks (land degradation, soil erosion) [7] Other reasons (describe)</p>	

SECTION 2: ECONOMIC AND LIVELIHOODS CHARACTERISTICS

SOURCE OF INCOME AND EXPENSES		
Q2.1. What is your sources of income? Activities do you employ in? (Choose all that apply) [1] Farming (sales of crops) [2] Casual jobs (farming, construction) [3] Livestock (sales of livestock and livestock related products) [4] Small business [5] Wages/salaries from formal/permanent job [6] Remittances [7] Transport [8] Masonry [9] Carpentry [10] Tailoring [11] Membership to eco-tourism cooperative supported by RDB [12] Bee keeping/ honey processing [13] Other (describe)	_	
Q2.2. Since when have you been employed in this activity? And how much do you earn from it on monthly basis (before and during COVID-19)	<i>Year</i>	<i>Income (Frw) before and during COVID-19</i>
Farming (sales of crops)		
Casual jobs (farming, construction)		
Livestock (sales of livestock)		
Small business		
Wages/salaries from formal/permanent job		
Remittances		
Transport		
Masonry		
Carpentry		
Tailoring		
Membership to eco-tourism cooperative supported by RDB		
Bee keeping/ honey processing		
Other (describe)		
Q2.3. In the past 12 months, Have you sold any of the following livestock and/ or their products? (Choose all that apply)	<i>1= Yes 2= No</i>	<i>Amount (Frw)</i>
Male Cow		
Female cow		
Chicken		
Goat		
Sheep		
Rabbit		
Pig		

Other (describe)		
Q2.4. What are the areas of expenditure does your household spend money? [1] Household groceries (meal and drinks) [2] Agricultural inputs [3] Education (school fees) [4] Rents (house and land) [5] Health services [6] Transfer to relatives or friends [7] Cosmetics [8] Clothes [9] Other (describe)		_
FOOD SECURITY		
Q2.5. Is food available in this area sufficient? [1] Yes, sufficient [2] No, insufficient		
Q2.6. If option [2] in Q2.5, Could you please explain why? [1] Low production/ productivity [2] Lack of financial means to buy food [3] Limited access to food market [4] Other (describe)		
Q2.7. Is there any period that you experienced food shortage? [1] Yes [0] No If YES, could you please recall that period? (Year)?		
Q2.8. How many meals do adult and child household members take per day?		Number of meals
18 years and above (adult)		
5 to 17 years old		
Under 5 children in your household		
LIVING CONDITIONS AND ASSETS		
Q2.9. Does your household has access to sufficient potable water? [1] Yes, sufficient [2] No, insufficient		_
Q2.10. What is the primary source of drinking and cooking water for your household? [1] Tap on property [2] Public tap [3] Protected well [4] Unprotected well [5] Protected spring [6] Unprotected spring [7] Stream/River/ lake [8] Dams [9] Other (describe)		_
Q2.11. What is the distance from home to the nearest source of water? [1] Less than 100 m [2] Between 100- 200m		

[3] Between 200-300m [4] Between 300-400m [5] Between 400-500m [6] More than 500m											
Q2.12. How have you got the house that you (or your family instead of you?) live in? [1] Own constructed [2] Bought [3] Borrowed [4] Rented [5] Gift/ support from government or other partners [6] Granted by parents [7] Other (describe)	_										
Q2.13. Could you please estimate the value of your house? Value _____ Rwf	_										
Q2.14. If [RENTED] could you please estimate the rental cost? Value _____ Rwf	_										
Q2.15. What is are the housing conditions?											
<table border="1"> <thead> <tr> <th>Characteristics</th> <th>Conditions**</th> </tr> </thead> <tbody> <tr> <td>Roof</td> <td></td> </tr> <tr> <td>Floor</td> <td></td> </tr> <tr> <td>Wall</td> <td></td> </tr> <tr> <td>Fence</td> <td></td> </tr> </tbody> </table> <p>** Codes: [1] Blue tent, [2] Thatch (Grass); [3] Iron sheet, [4] wood, [5] Cement Concrete, [6] Cement, [8] Bamboo, [9] soil, [10] Barbed wire, [11] tile, [12] concrete bricks, [13] Other (describe)</p>	Characteristics	Conditions**	Roof		Floor		Wall		Fence		
Characteristics	Conditions**										
Roof											
Floor											
Wall											
Fence											
Q2.16. Does your HH use any of the following source of energy for cooking? (choose all that apply) [1] Firewood [2] Charcoal [3] Gas or Biogas [4] Solar panel [5] Other (describe)	_										
Q2.17. Does your HH use any of the following source of energy for lighting? (choose all that apply) [1] Oil lamp [2] Candle [3] Electricity [4] Solar panel [5] Other (describe)	_										
Q2.18. Does your household own any of the following asset?	[1] Yes [2] No										
House	Number										
Phones											
Comfortable chairs											
Mattress											

Radio		
TV Set		
Bicycle		
Motorcycle		
Sewing Machine		
Hoe		
Wheelbarrow		
Other (describe)		
Q2.19. Do people living in this area face any of the following challenges? [1] Yes [2] No [1] Inadequacy of food [2] Poor infrastructure (roads) [3] Poor health services [4] Limited access to clean water [5] Issues related to safety and security [6] Environment degradation/ landscape deterioration [7] Other (describe)		__
COOPERATIVE MEMBERSHIP AND ACCESS TO FINANCE		
Q2.20a. Are you a member of any cooperative?		[1] Yes [2] No → go to Q2.22
Q2.20b. Are you a member of any saving or lending group?		[1] Yes [2] No → go to Q2.22
Q2.21. What is the cooperative's/group's main activity?		
1= Farming	__	7= Tailoring
2= Livestock	__	8= Hair dressing
3= Milk collection & processing	__	9= Hand craft
4= Carpentry	__	10= Welding
5= Masonry	__	11= Shoe making
6= Water user's association	__	12= ICT
		13= Honey processing
		14= Transport
		15= Service provision
		16= Trading
		17= Saving and lending
		18= Other (describe)
Q2.22. Does your cooperative (in which you are embedded in) composed of men, women and youth? [1] Yes [2] No, Why no mixed? (<i>EXPLAIN</i>) If [YES] How many members for each category? Number of men __ Number of women __ Number of youth __		__
Q2.23a. Does anyone in your household use financial services? [1] Yes [2] No		__
Q2.23b. Which type of financial institution mostly used? (select one) [1] SACCO [2] Cooperative (e.g farming, motorcyclist, etc) [3] Revolving savings/loan scheme [4] Micro finances [5] Commercial Bank [6] Other (describe)		__

<p>Q2.24. Have you accessed to any of the following financial services from your bank? ([1] Yes [2] No ---→ Go to Q2.25)</p> <p>[1] Credit [2] Saving [3] Money transfer [4] Other (describe)</p>	__
<p>Q2.25. If you had access to a loan, for what reasons did you request for? (choose all that apply)</p> <p>[1] Food [2] Health care [3] Education (school fees) [4] Repair or building house [5] Family events (Parties, grieves) [6] Farming and livestock [7] Funding/ build more non-farm businesses [8] Other (describe)</p>	__
<p>Q2.26. What are the main issues related to access financial services?</p> <p>[1] None [2] Lack of enough land for collateral [3] Jobless [4] Absence of commercial bank in the area [5] High interest rate [6] Other (describe)</p>	__
ACCESS TO HEALTHCARE SERVICES	
<p>Q2.27. In the last 12 months, Have you or any other household member tried to access healthcare services. Were you able to access them?</p> <p>[1] Yes, we tried and were able to access healthcare facilities [2] Yes, we tried but were not able to access healthcare facilities [3] Yes, we tried and were able to access some, but some we couldn't [4] No, we didn't need any healthcare services</p>	__
<p>Q2.28. If you were able to access healthcare services, how do you pay for your medical expenses?</p> <p>[1] Community based Health Insurance (CBHI) [2] MMI [3] RAMA/ RSSB [4] FARG [5] Private/ myself [6] Other means (describe)</p>	__
<p>Q2.29. If [4] in Q2.27, why didn't you need any healthcare services?</p> <p>[1] Health centre/ post located far from homestead [2] Do not have any health insurance [3] Procuring medication from pharmacies [4] Praying for healing [5] Herbists [6] I didn't get sick [7] Other reason (describe)</p>	__

SECTION 3: AGRICULTURE AND LIVESTOCK PRODUCTION

Q3.1. How many plots (for farming and livestock) does your household own? (Number of plots)

Q3.2. What is the total size (in m²) of land (Homestead, cultivated land and non-cultivated land) used by this household? (in m²) (Check from land title)----
→ Take photo

Q3.3. What is the total size (in m²) of land (only cultivated land) used by this household? (in m²) (Check from land title if available)

Q3.4. Plot characteristics (In this table you are required to provide information related to 5 main plots protected or non-protected by any of the **soil and water management measures**)

number of plots cultivated	1. Plot size (m ²)	2. How did you acquire this plot (land tenure)? [1] Inherited [2] Purchased [3] Borrowed [4] Rented [5] Government land [6] Other (describe)	3. Plot location [1] Hillside [2] Marshland	4. On average, what is the distance (m) from home to this plot?	5. Main crop cultivated per plot (See crop codes)	6. Have you used any of the following agricultural inputs used during season 2021A [1] Yes [0] No If [YES], How much quantity (KG) have applied per plot? (See inputs codes)	7. If [NO], why didn't you apply agricultural inputs on this plot? [1] Inputs are not available [2] Inputs are expensive [3] Not interested in using inputs [4] Land cultivated is not suitable for inputs [5] Other (describe)	8. Could estimate total labor per Are?		9. Could you please estimate quantity produced (KG) for this crop on this plot during 2021A?	10. Have you had access to the market for crop produced during the last season A 2021? [1] Yes [0] No → go to 11 If [YES], How much (in Kg) have you sold to the market?	11. Could you please tell the off-season market price (RWF) per Kg?	12. Have used any of the following soil and water management (SWM) measures on this particular plot? [1] Yes [0] No --→ go to 13 (if Yes, See SWM codes) (Choose all that apply)	13. What are the farming practices (FP) have you adopted in the past 12 months (See FP codes) (Choose all that apply)
								Labor	days					
Plot 1	__			__										
Plot 2	__			__										
Plot 3	__			__										

Crop codes: [1] Maize, [2] Beans, [3] Sweet potato, [4] Cassava, [5] Irish potato, [6] Banana, [7] Vegetables (tomatoes, Onions, etc.), [8] Fruits, [9] Sorghum, [10] Peas, [11] other (describe)

Inputs codes: [1] NPK, [2] DAP, [3] UREA, [4] Lime, [5] Manure, [6] Pesticides, [7] Improved seeds, [8] Compost, [9] Other (describe)

SWM codes: [1] Bench terraces, [2] Progressive terraces, [3] Agro-forestry, [4] Dams/ Rainwater harvesting/ Retention reservoirs, [5] Anti-erosive ditches, [6] Cover cropping and Mulching, [7] Irrigation, [9] rotational cropping/ grazing, [10] Other measures (describe)

FP codes: [1] Agro-forestry, [2] Intercrop with plants used for plant cover, [3] Having trees or grasses protecting terraces, [4] Radical terraces, [5] Progressive terraces, [6] Mulching, [7] Use of inorganic fertilizers, [8] Use of improved seeds, [9] None, [10] Other (describe)

Q3.5. Do you raise any of the following livestock? If [YES] how many do you raise?	[1] Yes [2] No → go to section 4	Number
Male Cow		
Female cow		
Chicken		
Goat		
Sheep		
Rabbit		
Pig		
Other (describe)		
Q3.6. Do you have access to enough feeds for your livestock in this area? [1] Yes [2] No	_	
Q3.7. Where do you normally collect feeds for your livestock? [1] In my farm [2] From others farm (for free) [3] From others farm (pay for) [4] Local market or factory [5] Other place (describe)	_	
Q3.8. If [3] in Q3.7. How much do you pay on weekly basis? (Amount in Frw)	_	

SECTION 4: BIO-PHYSICAL CHARACTERISTICS

Q4.1. To what extent soil erosion is a problem in this area? ([1] Severe/ High, [2] Low, [3] Moderate)

Q4.2. To what extent drought is a problem in this area? ([1] Severe/ High, [2] Low, [3] Moderate)

Q4.3. What are the main landscape restoration, soil and water management options recommended in this catchment/ area?	1. From non-protected plot, which of the following options are you likely to use? <i>(Rank them in priority order)</i>		2. Based on your capacity (without any support), what of these options are you likely to use? <i>(Rank them in priority order)</i>		3. With support from government or other partners/ CSOs, what of these options are you likely to use? <i>(Rank them in priority order)</i>		4. If this option was adopted by the support from government or CSOs, are you able to maintain it?	5. If this option is adopted by yourself, could you estimate the required cost (RWF) for this option?
Landscape restoration options/ Mukungwa	[1] Yes [0] No → to next option	Ranks (1,2,3,4,5)	[1] Yes [0] No - → to next option	Ranks (1,2,3,4,5)	[1] Yes [0] No -- → to next option	Ranks (1,2,3,4,5)	[1] Yes [0] No -- → to next option	<i>(include labor and materials/ equipment costs)</i>
Radical terraces								
Progressive terraces								
Agroforestry systems								
Cover crops								
Crop rotation								
Intercropping								
Trenches or water channels								
Growing grasses on contour lines								
Tillage practice across to the slope direction								
Digging holes of water storage								
Other (describe)								
Soil and water management options/ Akagera Lower	[1] Yes [0] No → to	Ranks (1,2,3,4,5)	[1] Yes [0] No → to	Ranks (1,2,3,4,5)	[1] Yes [0] No → to next option	Ranks (1,2,3,4,5)	[1] Yes [0] No → to next option	

	next option		next option					
Improved agriculture and livestock systems								
Rain Water harvesting								
Irrigation								
Developing water sources – such as micro dams, ponds and wells								
Boreholes								
Afforestation or re-forestation								
Protecting water sources against contamination								
Other (describe)								
Ranking: [1] More important, [2] Important, [3] Moderate, [4] Less important, [5] Not important								

Annex 2: Checklist of questions for FGDs with local communities

Livelihoods capitals	Information types/ areas
Natural Assets	<ul style="list-style-type: none"> • Characteristics of existing natural resources (land or water) in the study area; • Links between the natural resource types (land or water) and people’s livelihoods- how do they contribute to people’s livelihoods or how their scarcity impacts people; • Issues related to natural resource management and livelihoods (security of land tenure and sufficient access to water by members of the community in the study area); • Human and non-human induced causes of natural resource degradation; • Ecological and economic effects of natural resource degradation • Understanding risk and vulnerability factors of land degradation (environmental, economic, and demography) that affect natural resources; • Technical interventions/ strategies required for landscape restoration and their associated costs and benefits as well; • Community based ranking of land restoration strategies, priorities, and explaining factors or motivation behind each proposal or choice.
Sources of income and access to finance	<ul style="list-style-type: none"> • Market access for crops and livestock; • Access to finance (availability of financial institutions, access to services such as savings and credit); • Issues related to access financial services; • Availability/ potential of non-farm job opportunities (both for women and men as well as the youth in the study area); • Challenges in accessing available financial and grant products under BDF.
Social Assets	<ul style="list-style-type: none"> • Membership to community-based organizations such as saving and lending groups, cooperatives, • Community roles in ensuring sustainable protection of natural resources and protected areas (parks, rivers, ets);
Human capital dimensions	<ul style="list-style-type: none"> • Knowledge about natural resource management; • Sanitary conditions and diseases; • Understanding risk and vulnerability factors (environmental, political and economic) that affect human assets. • Access to health services / facilities
Biophysical aspects	<ul style="list-style-type: none"> • Evolution of degradation of natural resources (land degradation and water scarcity) • Types and extent or levels of vulnerability (drought or soil erosion); • Physical degradation of natural resources (compaction, waterlogging); • Biological/ ecological deterioration (deforestation, biodiversity loss);

	<ul style="list-style-type: none">• Current conditions of infrastructure:<ul style="list-style-type: none">• Roads, availability of means of transport (cars, motorcycle, bicycle, etc)• Agricultural machinery (for planting, seeding, fertilizing, pest control, irrigation)• Schools, health centers and local markets• History and drivers of community's settlement and resettlement in the study area ;• Understanding risk and vulnerability factors (environmental, political and economic) that affect physical assets;• Problems/ issues related to environment, natural resources use and management and infrastructure;• Identification of possible solutions to address problems facing communities in the catchment;
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Annex 3: Check list for KILs with:

- a. District staff: Vice Mayor in charge of economic affairs, Director of Agriculture and Director of BDE;
- b. Other relevant stakeholders

Livelihoods capitals	Information types/ areas
Natural Assets	<ul style="list-style-type: none"> • Characteristics of existing natural resources (land or water) in the study area; • Links between the natural resource types (land or water) and people’s livelihoods- how do they contribute to people’s livelihoods or how their scarcity impacts people; • Issues related to natural resource management and livelihoods (security of land tenure and sufficient access to water by members of the community in the study area); • Understanding risk and vulnerability factors of land degradation (environmental, economic, and demography) that affect natural resources; • Technical interventions/ strategies required for landscape restoration and their associated costs and benefits as well; • Mapping or identification of relevant stakeholders for effective implementation of these interventions – identification of the potential role of community members and development partners; • Identification of other driving factors of efficient use of available natural resources.
Sources of income and access to finance	<ul style="list-style-type: none"> • Market access for crops and livestock; • Access to finance (availability of financial institutions, access to services such as savings and credit); • Issues related to access financial services; • Availability/ potential of non-farm job opportunities (both for women and men as well as the youth in the study area); • Challenges in accessing available financial and grant products under BDF.
Social Assets	<ul style="list-style-type: none"> • Membership to community-based organizations such as saving and lending groups, cooperatives, etc; • Identification of cooperatives involved in the management of natural resources (e.g. water user’s associations), • Status of social capital (e.g. collective action and trust as well mutual support in various development interventions), • Community roles in ensuring sustainable protection of natural resources and protected areas (parks, rivers, ets);
Human capital dimensions	<ul style="list-style-type: none"> • Capacity building after setting up livelihoods interventions; • Enterprise development;
Biophysical aspects	<ul style="list-style-type: none"> • Evolution of degradation of natural resources (land degradation and water scarcity) • Types and extent or levels of vulnerability (drought or soil erosion); • Chemical deterioration of natural resources (nutrient depletion, salinization, etc);

	<ul style="list-style-type: none">• Physical degradation of natural resources (compaction, waterlogging);• Biological/ ecological deterioration (deforestation, biodiversity loss);• Current conditions of infrastructure:<ul style="list-style-type: none">• Roads, availability of means of transport (cars, motorcycle, bicycle, etc)• Agricultural machinery (for planting, seeding, fertilizing, pest control, irrigation)• Schools, health centers and local markets• History and drivers of community's settlement and resettlement in the study area ;• Understanding risk and vulnerability factors (environmental, political and economic) that affect physical assets;• Problems/ issues related to environment, natural resources use and management and infrastructure;• Identification of possible solutions to address problems facing communities in the catchment;• The current status of land restoration by the government and development partners.• Stakeholders (government and development partners) contribution.
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Annex 4: Districts, sectors, and cells covered by Akagera Lower Catchment

DISTRICTS	SECTORS	CELLS
GATSIBO	RWIMBOGO	Kiburara, Munini, Nyamatete, Rwikiniro
	RUGARAMA	Remera, Matare, Matunguru, Gihuta, Bugarama, Kanyangese
	REMERA	Butiruka, Kigabiro, Nyagakombe, Rurenge
	NYAGIHANGA	Gitinda
	NGARAMA	Kigasha, Ngarama, Nyarubungo
	KIZIGURO	Ndatemwa, Mbogo, Agakomeye, Rubona
	KAGEYO	Busetsa, Nyagisozi, Kintu
	KABARORE	Simbwa, Kabeza, Marimba, Kabarore, Nyabikiri, Karengye
	GITOKI	Bukomane, Cyabusheshe, Karubungo, Mpondwa, Rubira
	GATSIBO	Gatsibo, Manishya, Mugeru, Nyabicwamba
	GITOKI	Nyamirama
KAYONZA	KABARE	Rubimba, Rubumba
	MURUNDI	Buhabwa
	RWINKWAVU	Gihinga, Mbarara, Mukoyoyo, Nkondo
	RUKARA	Rukara, Rwimishinya
	NYAMIRAMA	Musumba
	NDEGO	Byimana, Isangano, Karambi, Kiyovu
	MWIRI	Kageyo, Migera, Nyamugari, Nyawera
	MURUNDI	Karambi, Murundi, Ryamanyoni
	MURAMA	Bunyentongo, Muko, Murama, Nyakanazi, Rusave
	KABARONDO	Cyabajwa, Cyinzovu, Rusera
	KABARE	Cyarubare, Gitara, Kirehe
	GAHINI	Juru, Kahi, Kiyenzi, Urugarama
KIREHE	NYARUBUYE	Nyabitare, Nyarutunga
	NYAMUGARI	Bukora, Kagasa, Kazizi, Kiyenzi, Nyamugari
	NASHO	Cyambwe, Kagese, Ntaruka, Rubirizi, Rugoma
	MUSHIKIRI	Rugarama
	MPANGA	Bwiyorere, Kankobwa, Mpanga, Mushongi, Nasho, Nyakabungo, Rubaya
	MAHAMA	Kamombo, Munini, Mwoga, Saruhembe
	KIGARAMA	Kiremera, Nyankurazo
	KIGINA	Gatarama, Rwanteru
NGOMA	REMERA	Bugera, Kabuye, Nyamagana
	RUKIRA	Kibatsi
	KIBUNGO	Cyasamakamba, Gahima, Gatonde, Mahango
NYAGATARE	KARANGAZI	Musenyezi, Ndama, Nyagashanga, Nyamirama, Rubagabaga
	KATABAGEMU	Kaduha, Kigarama, Nyakigando, Rubira, Rutoma
	KARANGAZI	Kamate, Karama, Kizirakome, Mbare
	RWIMIYAGA	Gacundezi, Kabeza, Kirebe

DISTRICTS	SECTORS	CELLS
	MUSHERI	Ntoma
	RWIMIYAGA	Nyarupfubire, Nyendo, Rutungu, Rwimiyaga
	RWEMPASHA	Gasinga
	NYAGATARE	Gakirage, Kamagiri, Rutaraka, Ryabega
	MUSHERI	Kijojo
	MATIMBA	Bwera, Byimana, Cyembogo, Kagitumba, Kanyonza, Matimba, Rwentanga
	KARANGAZI	Rwenyemera, Rwisirabo

Source: Arc Map GIS

Annex 5: Kils participants

District	Names	Position	Phone Number
Kayonza	MUNGANYINKA Hope	Vice Mayor Economic Development	788841117
	MUHAYIMANA Cyprien	Director of Agriculture	788552099
	MUDENGE Jean Paul	Environmental Officer	788642401
	RUBWIRIZA Théogène	Executive Secretary of KAHU Cell	789119673
	KAMPARAMPAKA Innocent	Sector Agronomist/KABARE	788538238
	MWIZERWA Jean François Regis	Cooperative Officer/KABARE Sector	788656586
	KANUMA Aphrodis	Agronomist	788447950
	KAVARUGANDA Jean Pierre	Agronomist	785047961
Kirehe	NSENGIYUMVA Jean Damascene	Vice Mayor Economic Development	788480080
	NGGIRABAKUNZI Octavien	Environmental Officer	788698007
	NSENGIMANA Janvier	Director of Agriculture	788844583
	GATSINZI Amani	Executive Secretary of NYARUBUYE Sector	788625038
	NSENGIYUMVA Félicien	Headteacher/ES NYARUBUYE	788557508
	KUBWIMANA Désiré	Veternary/ NASHO Sector	783423538
Gatsibo	TWIZEYEMUNGU Juvin	WATSAN	788512964
	MANZI Théogène	Vice Mayor Economic Development	788838304
	HABIMANA Jean Claude	District Executive Officer	788557601
	NDYUHORANJE Sylvere	DFNRO	783181571
	MANYUNZWE Pierre Claver	Agronomist/ GATSIBO Sector	788404166
	RUTAYISIRE Jean Bosco	Good Governance	788789202
	NYIRAMUKESHA Rehema	President/ Cooperative	785406369
	NYIRANSENGIYUMVA Agnes	Conseil National des Fammes/GATSIBO Sector	783026185
NYAGATARE	KUBWA Sylver	Executive Secretary of KATABAGEMU Sector	784886950

District	Names	Position	Phone Number
	NZEYIMANA Etienne	Sector Agriculture Officer/KATABAGEMU	788451909
	Rurangwa Stephen	District V/Mayor ED	788855758
	Mutabaruka Fulgence	Director of Agriculture	788885432
	Munderere Alfred	Agronomist	788690703
	AKWASIBWE Elie	Executive Secretary	788482039

Annex 6: FGDs participants

District	Names	Gender	Phone Number
Kayonza	UWIMANA Charles	M	786073416
	MUGABOSENAMUNGU	M	788668478
	BAGANINEZA Samuel	M	783368323
	BISANGABAGABO Alexis	M	789305725
	UWIMANA Peace	F	783176557
	NAMUHUNGU John	M	787026824
	NIZEYIMANA Marie Jeanne	F	783379866
	MUKAMUGEMA Francine	F	782775479
	KIBAGIZA Donatha	F	783358672
	MUKAKAMALI Therese	F	788412983
	MUTETERI Petronile	F	788490227
	NYIRANDEGEYA Dative	F	789605952
	KAWESA Léa	F	788819192
	MINANI Fabien	M	788472069
	NIYONZIMA Jean Paul	M	781996290
	HARERIMANA Pascal	M	786989749
	HABIMANA Bonaventure	M	781217037
	NTANSHUTI François	M	783355727
	MVUTSENEZA Jean Pierre	M	788434636
	MUNYANEZA Bernard	M	788617695
	TWESIGE Jean Bosco	M	782607140
	GAHUTU Said	M	780339491
	NTAGANIIRA Denis	M	788514655
	NTAGUNGIRA Emmanuel	M	788546267
	MWUBAHAMANA Hamida	M	788815670
	HAGENIMANA Emmanuel	M	788230711
MVUYEKURE GERUASI	M	784920631	
NTAWUGAYIRYAJE Jean Pierre	M		
KIMONYO Vincent	M		

District	Names	Gender	Phone Number
	MUKANDUTIYE Olive	F	
	INGABIRE Annet	F	788452460
Ngoma	INGABIRE Odille	F	781517454
	NYIRANEZA	M	781385740
	MUKANYANDWI Betty	F	789221808
	UWAMAHORO Ernestine	F	787158960
	MUKASHYAKA Christine	F	785023692
	NIYIGENA Gilbert		788797958
	NDAGIJIMANA Damascene		780087455
	HABIMANA Aphrodis		788478166
	BUKEDUSENGE Daniel		787352799
	NDAYAMBAJE Epa		781117569
	HABUMUGISHA Emmanuel		788434935
	NDAYAMBAJE Eric		783015787
	Kirehe	KAMANA Théogène	M
MAHIRANE Bernard		M	788639419
RUTAYISIRE Emmanuel		M	788603836
NYIRIMIGABO François		M	784327495
KABATSI Abraham		M	788239312
HAKIZAMUNGU Welarse		M	783307360
MUKABUGINGO Speciose		F	788691326
DUSABE Heri		F	782055782
NEMEYABAHIZI Felicien		M	78873866
HARERIMANA		M	788609332
NDUWAYEZU Alphonse		M	785185779
HAKIZIMANA Justin		M	783085804
NKIRANUYE Gratien		M	785399152
CYANGABWOBA		M	782398951
KARANGWA		M	788537393
IYAMUREMYE		M	788230981
TWAGIRAYEZU		M	788568118
HABUMUGISHA Alphonse		M	786002999
UWAYEZU Valens		M	783834635
NSABIMANA Jean Bosco		M	783809241
NKWAKUZI		M	788678991
NSHIMIYIMANA Emmanuel	M	783320091	
NSABIMANA Deogratias	M	783243405	
Nyagatare	NDENZAHO Calixte	M	783161725
	NTAGANZWA Claude	M	788484251
	DUSHIMIRIMANA Albert	M	788901114

District	Names	Gender	Phone Number
	NSIGIWENIMANA Alexis	M	788939453
	MANIRAGUHA Ildephonse	M	784839903
	DUSENGIMANA Xaver	M	788227929
	YABUKESHA Viateur	M	788749836
	NSHIMIYIMANA Daniel	M	788279977
	NDAYAMBAJE Jean d'Amour	M	786663067
	BUNANI Jean Damascene	M	785479906
	UWIMANA Clotilde	F	786806496
	MUKESHIMANA Jeannine	F	780311643
	MUKAKIBIBI Marie Clementine	F	785638099
	MUTEZIMANA Jacqueline	F	784009921
	MUKAKARAKE Liberathe	F	725173058
	AKAYEZU UWASE Solange	F	785823176
	BUSINGE	F	786268920
	GAKWAYA William	M	788648505
	KANYAMURIZA Stanley	M	788543207
	KALISA Eugene	M	788757731
	MURENZI Geoffrey	M	788568440
KAYIRANGA Steven	M	788275708	
Gatsibo	UWAMARIYA Theresie	F	783302080
	NKURUNZIZA Emmanuel	M	788465731
	SINDAYIGAYA Simon	M	783973856
	MUNYANDINDA Emmanuel	M	781921193
	MUSABYIMANA Eveline	F	783237814
	RUTAYISIRE Jean Bosco	M	788789202
	NYIRAMUKESHA Rehema	F	785406369
	UWIMANA Agnes	F	784003412