



RWB
Rwanda Water
Resources Board

ANNUAL REPORT 2023-2024





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CHAIR'S MESSAGE

As we reflect on the progress made by the Rwanda Water Resources Board (RWB) in 2023/2024 FY, I am proud of RWB's continued efforts to ensure sustainable water resource management. Water is a vital asset to Rwanda's development, and our mandate to implement policies, laws, and strategies that safeguard these resources has never been more critical.

In 2023/2024 FY, RWB made significant strides in water resource protection, particularly through works in catchment protection, flood management, and erosion control. By focusing on research-driven strategies, RWB have enhanced the country's capacity to forecast water availability and demand, ensuring that Rwanda remains resilient in the face of environmental challenges.

RWB's investment in water storage infrastructure and the creation of efficient water allocation plans have played a pivotal role in supporting key sectors such as agriculture, industry, and domestic use. These initiatives

have not only boosted the country's economy but also strengthened the country's preparedness against the threats of floods and droughts.

As RWB continues to oversee infrastructure development ensuring that roads, bridges, dams, and settlements align with flood mitigation and water storage guidelines, RWB remain committed to preserving the quality and quantity of Rwanda's water resources. Collaboration with regional and international partners has been crucial in enhancing RWB's capabilities in water resource management.

Looking ahead, the Rwanda Water Resources Board will remain committed to its mission to sustainably manage Rwanda's water resources and it is determined to build on 2023/2024 FY achievements and continue protecting water resources for the prosperity of future generation.

SIR DAVID KING
CHAIR OF THE BOARD OF
DIRECTORS/RWB



DG'S MESSAGE

In 2023/2024 FY, Rwanda demonstrated remarkable progress in water resource management. The period was a defining period for the Rwanda Water Resources Board (RWB), as we made remarkable progress in ensuring the sustainable management of Rwanda's water resources. It is my privilege to reflect on the significant milestones we achieved, despite the challenges posed by climate change and increasing demand for water across various sectors.

Our efforts this year were focused on implementing national policies and strategies aligned with water resource management. Key initiatives included the protection of our catchments, the implementation of flood control measures, and the continued development of critical water storage infrastructures. Through these endeavors, we ensured a balance between water availability, quality, and demand, contributing to Rwanda's broader sustainable development goals.

The construction of flood control infrastructure, such as the retaining walls along the Sebeya River, and the progress on the Muvumba multipurpose dam project, have been pivotal in strengthening

our nation's resilience against natural disasters like floods and droughts. These efforts, combined with our enhanced water storage capabilities, provide a solid foundation for future economic growth, especially in agriculture, industry, and urban development.

In partnership with regional and international stakeholders, we have also made significant progress in expanding groundwater mapping, improving water quality monitoring, and enforcing efficient water use through permits. These initiatives have positioned Rwanda as a leader in sustainable water management, both regionally and globally.

Moving forward, the Rwanda Water Resources Board remains committed to its mission of safeguarding and enhancing Rwanda's water resources. We will continue to drive innovation, foster partnerships, and implement research-based strategies to ensure a water-secure future for all Rwandans.

DR. EMMANUEL RUKUNDO
DIRECTOR GENERAL/RWB



EXECUTIVE SUMMARY

In the fiscal year 2023/2024, Rwanda Water Resources Board (RWB) continued to achieve significant progress in water resource management. Guided by its mission, RWB implemented its strategic initiatives focusing on flood management, water storage infrastructure, the availability of sufficient, quality water resources and catchment restoration. These efforts contributed to Rwanda's national goals, particularly under Vision 2050, aiming for sustainable development through effective water management.

Key achievements include the establishment of additional catchment management committees, comprehensive catchment

restoration activities, and the development of flood control strategies across the Country. The RWB completed vital flood control infrastructure, including the construction of retaining walls along Sebeya River and flood control works in Musanze and Nyabihu districts. Water storage initiatives also progressed, highlighted by the advancement of the Muvumba multipurpose dam project, which integrates hydropower, irrigation, and flood mitigation.

RWB made notable progress in water quality and monitoring through its various divisions, particularly the Knowledge and Forecasting Hub, which expanded groundwater mapping

in the volcanic regions. The enforcement of water use permits saw remarkable success, with more than 1000 permits issued, contributing to improved water resource allocation and management.

The RWB also strengthened its governance and regional collaboration by participating in international forums and promoting sustainable water practices.

Looking forward, RWB remains committed to enhancing water resource management through research-driven strategies and cross-border cooperation, ensuring long-term sustainability and resilience against climate change impacts.

An aerial photograph of a rural landscape. In the foreground, a wide river flows through a lush green forest. The middle ground shows a large area of dense green trees. In the background, there are terraced agricultural fields, some of which are planted with crops like corn. A small village with several houses is visible on a hillside in the upper left. The overall scene is a mix of natural forest and human agriculture.

I. INTRODUCTION

INTRODUCTION

I.1. RWB'S OPERATIONAL FRAMEWORK

Rwanda Water Resources Board (RWB) is governed by the Presidential Order N° O25/O1 of 18/O3/2022 which determines RWB's mission, responsibilities, organization and functioning of Rwanda Water Resources Board.

RWB has legal personality and enjoys administrative and financial autonomy and is managed in accordance with relevant laws and falls within the category of non-commercial public institutions. The RWB's mandate is to ensure the availability of enough and well managed water resources for sustainable development.

RWB's mission is to implement national policies, laws, and strategies related to water resources, while advising the Government on water-related matters. It aims to establish research-based strategies for water availability, quality, and demand forecasting, protect catchments, and coordinate erosion control plans. Additionally, RWB focuses on developing strategies for flood management and water storage infrastructure, as well as water resources allocation and preservation of both quality and quantity.

RWB also ensures the efficient use of water resources by examining the design of roads, bridges, dams, and settlements to meet flood mitigation and water storage standards. It monitors the implementation of flood mitigation measures and collaborates with regional and international institutions with similar missions.

RWB was established with two critical goals to support Rwanda's Vision 2050: ensuring sufficient water resources for long-term economic growth and reducing the risks of flooding and landslides. These goals will be achieved through three key outputs: the

protection of high-risk flood zones, the reduction of soil erosion, and an increase in artificial water storage per capita.

I.2. GOVERNANCE

Rwanda Water Resources Board is managed by two organs; the Board of Directors and the executive organ. The Board of Directors of RWB is the supreme management and decision-making organ. It is vested with extensive powers to make decisions regarding administration, human resources and property of RWB in accordance with laws. In addition, the Board of Directors of RWB has the responsibility to approve the draft budget proposal of RWB and make a follow up on the budget execution; to submit a quarterly and annual report to the office of the Prime Minister; and to decide on all matters falling within the responsibilities of RWB. The executive organ of RWB is composed of the Director General and Deputy Director General. The Director General of RWB has the power of decision making in the administrative and financial management of RWB in accordance with relevant laws, he coordinates and directs the activities of RWB.

The Deputy Director General has the duties of assisting the Director General and replaces him in case of absence; and performs any other duty falling within the responsibilities of RWB as may be assigned by the Board of Directors. RWB structure was set up under the Official Gazette n° Special of O6/O6/2020 to coordinate all stakeholders in water resources and ensure the availability of enough and well managed water resources for sustainable development. As a sign of government commitment to water resources, RWB is under the oversight of the Office of the Prime Minister.

THE MANAGEMENT TEAM



Director General
DR. EMMANUEL
RUKUNDO



**Deputy Director
General**
NSABIMANA
EVARISTE



**Head of Knowledge
and Forecasting Hub
Department**
MUSANA BERNARD



**Water Permit Division
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VITAL MUNYANDINDA



**Catchment
Restoration and
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Pamela RUZIGANA



**Flood Management
and Water Storage
Division Manager**
DAVIS BUGINGO



**Water Monitoring
and Quality Control
Division Manager**
Duhuze Remy Norbert



**Ag. Corporate
Services Division
Manager**
Mathilde MUSABYE



SPIU Coordinator
Serugo KAMATARI
Claude

I.3 RWB DIVISIONS AND DEPARTMENT



I.3.1 Knowledge and Forecast Hub Department (KFH)

The Department is responsible for developing appropriate sets of modeling and forecasting for water supply and demand, flood management, and soil erosion risks. Its main functions include supporting RWB's short, mid, and long-term planning by providing water resources data, analytics, and insights, as well as formulating water resource strategies and master plans aligned with Rwanda's NSTI and Vision 2050. Additionally, the Department conducts hydro-economic analysis to inform key regulatory functions such as water pricing, allocation, use efficiency, and recycling, which help guide investments and partnerships.

Internally, the Department plays a crucial role across technical divisions by offering early modeling tools, managing knowledge systems, and reporting water sub-sector performance indicators and SDG6 methodologies. It identifies knowledge gaps, develops research activities to address these gaps, and provides key services like the flood early warning system, water portal, geoportal, and hydro-database to the community, investors, and researchers. Furthermore, the Department sets baselines and targets for surface and groundwater availability, demand, storage, and flood and soil erosion control.



I.3.2 Catchments Restoration and Erosion Control Division

The Catchments Restoration and Erosion Control Division is responsible to identify areas with high soil erosion risks using Catchment Restoration Opportunity Mapping (CROM-DSS), decides on adequate erosion prevention measures, and develop catchment management plans which involve a thorough analysis of the catchment situation and detail interventions to address root causes of water resources issues.

The main functions of the Division include coordinating the implementation of erosion control plans, coordinating catchment restoration data collection, and implementing catchment restoration measures. Additionally, it monitors the implementation of these catchment restoration activities using shapefiles. Through the CREC Division, RWB collaborates with various partner institutions to fulfill these responsibilities effectively.



I.3.3 Flood Management and Water Storage Development Division

The division is responsible for the establishment of flood management and water storage infrastructures to ensure that the rainfall available in the country and resulting runoff are well managed for the safety of the community and making the storages of water required for sustainable development.

The main functions of the Flood Management and Water Storage Development Division include establishing flood management strategies and developing water storage infrastructure. The division also examines the designs of roads, bridges, dams, and settlements to ensure they meet flood mitigation and water storage standards, and monitors the implementation of flood mitigation measures and water storage during the implementation of these infrastructure plans.



I.3.4 Water Permits Division

The rationale of water use permits is to manage water resources; to ensure equitable allocation; to protect the environment; and to enable cost recovery of water resources investment. The main functions of the Water Permits Division include developing criteria for issuing permits based on water balances and efficiency, assessing and issuing permits to different water resource users, and monitoring compliance with the requirements specified in the water use permits. The division also has the authority to suspend or revoke a water resource use permit if the holder fails to comply with legal provisions. Additionally, it reviews water resource usage charges and imposes administrative fines as stipulated by law.



I.3.5 Water Monitoring and Quality Control Division

The Water Monitoring and Quality Control Division is responsible to ensure that hydrological and hydrogeological data is collected and disseminated to stakeholders for use by different sectors. It is also in charge of water quality data collection and dissemination, and ensuring that water pollution is investigated and remedial measures are proposed where degradation occurs.



I.3.6 Corporate Services Division

The Division is responsible for coordinating public finance management activities by ensuring their compliance with the laws and regulations in place and human resource management to ensure the fulfillment of the mandate of the institution.



I.3.7 Single Project Implementation Unit (SPIU)

The Single Project Implementation Unit (SPIU) concept was adopted by the Government of Rwanda (GoR) in 2011 to coordinate the implementation of externally funded projects within public institutions. The main functions of the SPIU are to oversee the overall implementation of externally funded projects; support Rwanda Water Resources Board (RWB) to fulfill its mandate; and ensure that resources are mobilized.



RWB STRATEGIC ACHIEVEMENTS

II.1 PROGRESS AGAINST NSTI

The first National Strategy for Transformation (NST-1)/Seven Years Government Program (2017-2024) had set the priority for a green economy approach in its Economic Transformation pillar that promotes “Sustainable Management of Natural Resources and Environment to Transition Rwanda towards a Green Economy”.

RWB STRATEGIC INTERVENTIONS PROGRESS AGAINST NSTI TARGETS



Develop a project to manage water flows from the volcano region and other rivers to mitigate related disasters and improve water resource management. A detailed feasibility study will provide alternative options for managing the water flows productively.



- A project was developed to address issues related to floods in Northern province of Rwanda funded by the Ministry of Finance and Economic Planning in 2018. Furthermore, additional fund was secured from the Embassy of the Netherlands for the flood mitigation in the Sebeya River System and the following are key achievements:
- Demonstration of structure and natural based approaches for flood control (12 hotspots) in complex and critical catchment such as Sebeya and some of the Volcano's gullies and 9 retention ponds have been constructed,
- 14 concrete bridges reinforced; Sebeya Dam & Lateral Dyke constructed with capacity to retain 4.5 MCM of flood.
- 1305 m retaining wall completed to cope with extreme flood events along Sebeya River.
- Shift toward programmatic and catchment-based approach:
- Demonstration of structure and natural based approaches for flood control (12 hotspots) in complex and critical catchment such as Sebeya and Some of the Volcanoes gullies. Relocation of community at risk and mitigation of flood in some of Volcanoes areas hotspots

RWB STRATEGIC INTERVENTIONS PROGRESS AGAINST NSTI TARGETS



To further improve integrated water resource management, water catchment areas will be effectively managed and protected to mitigate disasters in partnership with communities



1,258.717 ha have been rehabilitated in different Catchment areas in partnership with the local community. 9 Catchments management committees established at Level 1

II.2 PROGRESS AGAINST ENR SECTOR TARGETS AND PRIORITIES

The ENR Sector ensures the protection and conservation of the environment and optimal and rational utilization of natural resources for sustainable national development.

The ENR sector operates under this statutory mandate in global, regional and national contexts that have direct or indirect impact on its functions. The objective of the ENR Sector Strategic Plan is to contribute to Rwanda's vision of sustainable

economic development by safeguarding the natural capital that underpins it.

Under its outcome 2, it was stated that the water sub-sector will optimize IWRM governance structures at catchment (committee), national and trans-boundary levels to ensure improved coordination for equitable, efficient and productive water allocation. The issue of ambient water quality will also be prioritized through

establishment of national standards, monitoring and enforcement.

High-quality and renewable water resources are a key enabling natural capital resource for Rwanda's growth goals, particularly NST-1 priorities for increasing land under irrigation and expanding hydropower electricity generation, among others.

The **table 1** below illustrates the progress made against ENR sector targets.

Table 1: Progress Against ENR Sector Targets and Priorities

ENR SECTOR IMPLEMENTATION STATUS INDICATORS PROGRESS	
ENR Sector indicator	Progress
% of flood control measures implemented in 13 selected critical gullies	flood control measures were implemented in 13 selected critical gullies at 76%
Number of hectares of degraded areas rehabilitated	1,258,717 ha (cumulative to 332,861 ha) have been rehabilitated in different Catchment areas in partnership with local community
Number of Catchments management committees established.	9 Catchments management committees were established
Number of water permits issued.	1002 Water permits were issued.
Artificial water storage per Capita	Artificial water storage per Capita increased at 5.8 m ³
Percentage of water bodies with "good" ambient water quality	Water bodies with ambient water have increased from 15% to 79%.
Number of hydrological surface and ground water monitoring stations maintained	140 hydrological surface and ground water monitoring stations were maintained with Establishment of Water Resources Monitoring Information systems with more than 59 real time stations (Surface and Groundwater)
Percentage of Muvumba multipurpose dam constructed	Muvumba multipurpose dam constructed at 6.14 %

II.3 PROGRESS AGAINST STRATEGIC PLAN

The fiscal year 2023-2024 has seen RWB progressive in the implementation of the 5 strategic objectives (SO) in reference to the RWB's strategic plan. Rwanda Water Resources Board (RWB) is mandated to ensure the availability of enough and well managed water resources for sustainable development. To realize its mandate, RWB designed a Strategic Plan (2021-2030) which is arranged in 5 strategic objectives, 11 strategic outcomes and 129 strategic actions. The following **table 2** highlights the progress made by RWB in implementing its strategic plan by 2023/2024 FY.

Table 2: Progress Against Strategic Plan

Strategic Objectives	Implementation Progress
1. Strengthening governance of water resources	In the area of governance, the FY have seen all the 9 level 1 catchments (hydrological units) equipped with the catchment committee following the Water Law (2018) and the Ministerial order establishing those committees. At central level the operationalization of the National consultative committee on water was also operational with the approval of the National Water Resources master plan (linked with SO3) and various learning activities of the multi-stakeholder platform. In the same line the University of Rwanda -College of Science and Technology (UR-CST) and RWB has continued working on the concept of center of excellence eyeing an approval by the academic senate in 2024. Partnership for effective water governance has continued through direct collaboration in various Task Forces (e.g. Task force for monitoring mining activities with quarterly reporting to RMB, RWB and other government partners in charge of regulation, and enforcement).
2. Preventing, reducing and controlling soil erosion	The effort of reducing soil erosion (SO2) has been given a high priority in NST1. A total of 332,861 ha (cumulating also contribution before NST1) in extremely high, very high, high and moderate risk areas for soil erosion have been rehabilitated (this account also for the 1,258,717 ha achieved by RWB in the FY 2023-2024 and more than 30,000 ha achieved by the institution own projects and earmarked transfer to Districts in the NST1 timeframe). The effort for erosion control is expected to be at least 3 times more important given the NST2 target (versus NST1), and 6 times higher than NST1 (considering the ambitious target of the RWB's strategic plan compared to NST1). Important investment frameworks are currently put in place to ensure significant progress in this field by 2030 (e.g. the Volcano Community Resilience project presented under the fund mobilization section).

3. Strengthening the availability of sufficient, quality water resources and water storage development for sustainable development of Rwanda

Under the SO3, the network of hydrological stations has increased to 100 surface stations and 54 ground water stations, and gradually upgraded as real-time stations (exceeding the 120 target of the ENR's SSP1). RWB aims at turning most of those station in to continuous monitoring (47% of stations of stations by June 2024) and real time (38% of stations by June 2024).

The large majority of new water uses (bigger ones) currently apply for water permit prior establishing their activities. In June 2024, A total of 1,002 Water resources users have been registered with a water permit by RWB.

4. Strengthening resilience to flooding and landslides through improving preparedness, prevention, adaptation, mitigation and response mechanisms

Under the strategic objective 4, anticipatory actions to reduce risk of flood and landslide have continued through the construction of flood control infrastructure and setting of automatic alert emails linked to the hydrological monitoring stations. New studies are in preparation with the target of increasing the resilience of more than 40% of households currently exposed to flood by 2030.

5. Strengthening RWB capacity and financial sustainability

RWB has increased significantly the fund mobilization capacity (SO5) as presented in detailed in the following sections. This last strategic plan is essential to unlock resources needed for the other strategic objectives and in particular strategic water storage development, soil erosion and catchment restoration costed for nearly 90% of the strategic plan investment needs. New challenges have also emerged like vandalism of solar panels (affecting operation of Water Monitoring and Quality control Division), increase of rainfall intensity requiring new mechanism for assessment, implementation and sustainability.

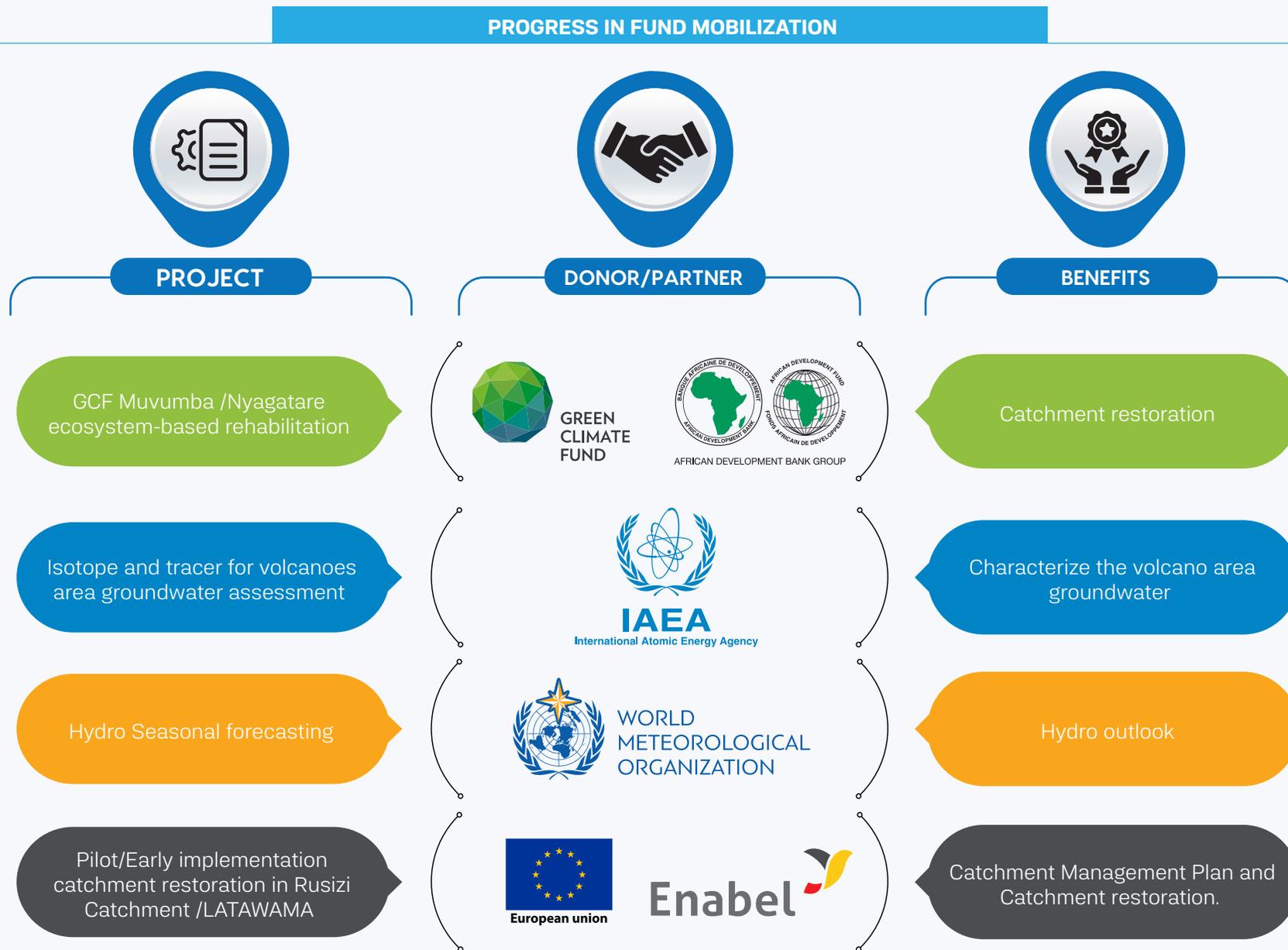
II.4 PROGRESS IN FUND MOBILIZATION

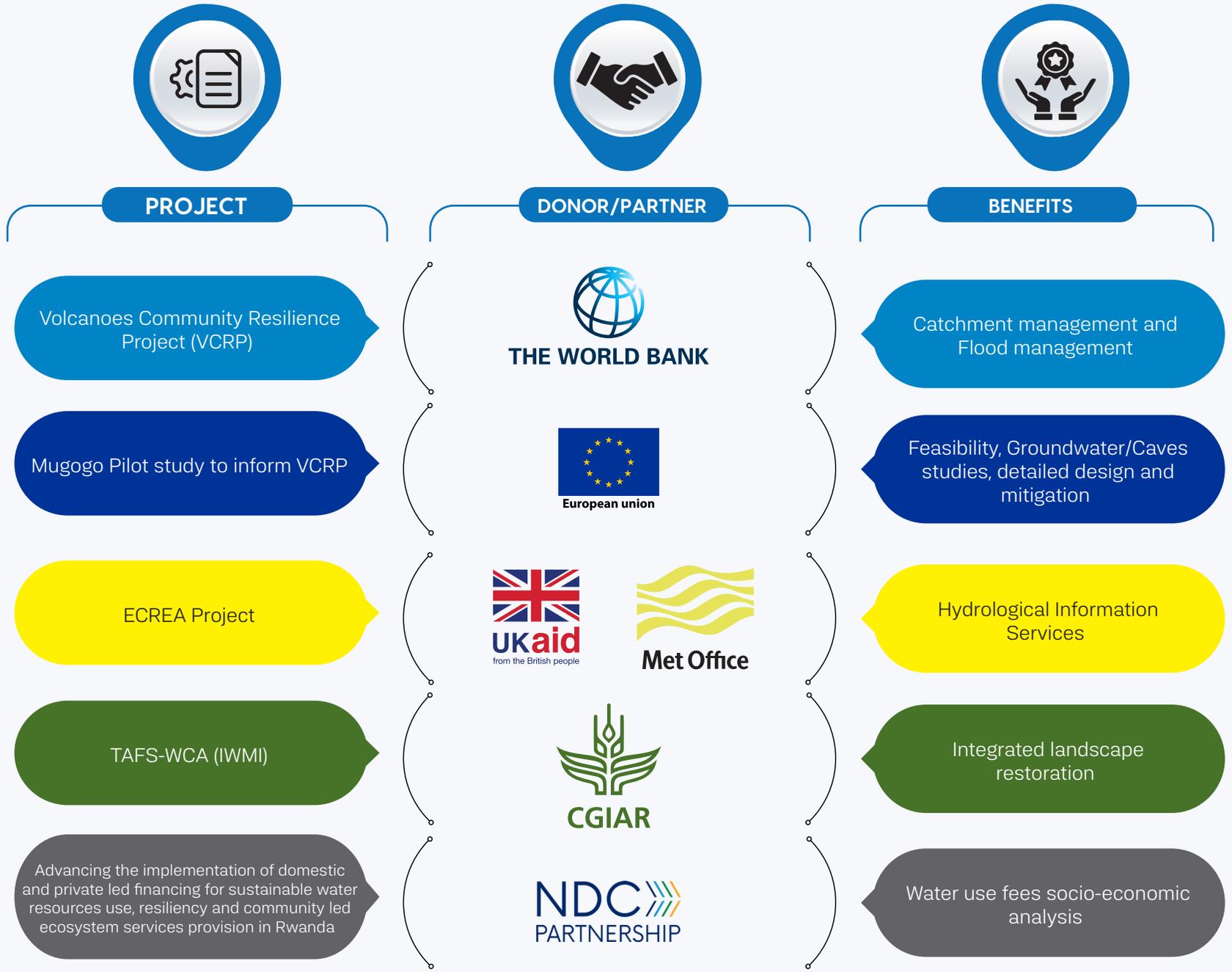
Strengthening capacity and financial sustainability is one of the key strategic objectives outlined in RWB 10-year strategic plan. RWB committed to securing long-term financial sustainability through diversified sources of finance and strategically mobilizing resources from various partners.

During the fiscal year 2023-2024, through development of project proposals and engagement of development partners, RWB has been able to successfully raise in total **281.8 billion Rwandan Francs** for supporting implementation of essential water resource management initiatives.

1 Environment and Natural Resources – Sector Strategic Plan (2018-2024)

The **table** below presents the list of projects for which funds were mobilized:





II.5 PROGRESS IN PARTNERSHIP AND COMMUNICATION

The Rwanda Water Resources Board is fully committed to actively collaborating with a wide range of stakeholders by providing regular updates on project advancements and exchanging best practices in water resources management. Throughout the fiscal year 2023-2024, the RWB employed a variety of tools and strategies to effectively communicate with our target audience.

II.5.1 Exhibition

Rwanda Water Resources Board participated in a five-day exhibition organized by Nyagatare District in partnership with different partners. The Nyagatare Joint Action Development Forum Open Day and Expo kicked off on 13th March 2024 and closed on 17th March 2024 at Nyagatare Stadium. Rwanda Water Resources Board was among the public institutions and other development partners who took the opportunity to engage with Nyagatare citizens.



The main objectives of RWB to attend this event included raising awareness of the Muvumba Multipurpose Water Resources Development Program, generating interest in the program and its benefits, gathering feedback on the program from beneficiaries, and promoting RWB's commitment to water resource development.

The RWB booth attracted a diverse audience. Visitors received detailed information about RWB's mission and gained a deeper understanding of the Muvumba Multipurpose Water Resources Development Project which is being implemented in Nyagatare district.

This project aims to improve water, energy, food, and nutrition security by harnessing water resources for irrigation, domestic, livestock use, and hydropower generation while ensuring the sustainability of the resources and building resilience against climate change and variability. Nyagatare District leadership commended RWB for its participation and acknowledged the institution's efforts in transforming lives through effective water resource management.

II.5.2 Awareness campaign

The Rwanda Water Resources Board (RWB) launched a series of documentary videos airing on Rwanda Television, aimed at raising awareness about various water resources management initiatives. This awareness campaign was initiated as part of the celebrations for World Water Day 2024, held under the theme "Leveraging Water for Prosperity."

The 12-week campaign aims to achieve several key objectives: increasing awareness about the importance of protecting water resource

infrastructures, promoting efficient water use to enhance productivity, raising awareness on catchment restoration, erosion control, and flood management, raising awareness on water laws and related regulations, and sharing best practices and experiences in various areas of water management and development. The TV program, titled "Uruhare rw'Amazi mu Iterambere" which translates to "Leveraging Water For Prosperity", aired every Wednesday at 7:30 PM. This initiative aimed to engage the public, educate viewers, and encourage sustainable practices in water resource management for a prosperous future.

II.6 CROSS CUTTING ISSUES (DIGITIZATION, GENDER, JOB CREATION, ENVIRONMENT AND CLIMATE CHANGE)

II.6.1 Gender equity mainstreaming & Job Creation

In line with the Government's commitment to mainstream gender in different sector strategies, Rwanda Water Resource Board has implemented several activities to promote gender during implementation of its projects and programs. All projects and programs being implemented have enhanced equal participation of women and men in the construction of flood control structures, erosion control and catchment restoration measures, etc. In this regard, females and male have been provided equal opportunity during work recruitment and been paid equally for equal work categories. In addition, prioritization in specific roles have been

made e.g. flaggers, cleaners, office assistants, casuals, and security guards.

To ensure female participation in decision making, the activities being implemented have considered gender in different committees such as grievance redress committee.

To enhance capacity building for females, RWB has provided equal opportunity for internship programs for both male and female youth. Gender-disaggregated sanitation facilities have been established at the campsite and other work sites, catering specifically to the needs of female employees. Additionally, provisions for proper disposal of sanitary waste have been made available across all work sites, ensuring a safe and dignified working environment for all employees. Both male and female students were given equal access to internship opportunities to further their skills and advance their careers. 34 academic interns (including 15 females) have been working as interns in the ongoing construction of Muvumba multipurpose dam project.

II.6.2 Environment and climate change

Since 1970, Rwanda’s average temperature has gone up by 1.40 °C and in some scenarios is projected to increase by 2°C by the 2030s. Precipitation is expected to increase by 5 to 10 percent by the 2030s relative to 1970, leading to higher frequency flooding and storms. There are also recurring floods and landslides in many parts of the country resulting from climate change and extreme hydrological events.

RWB has planned to apply climate change adaptation in the design and implementation of all flood storm water management, improve mechanisms for flood, and landslide preparedness response and prevention. Therefore, this will result into an increased resilience to flooding and landslides through improved preparedness, prevention, mitigation and adaptation.

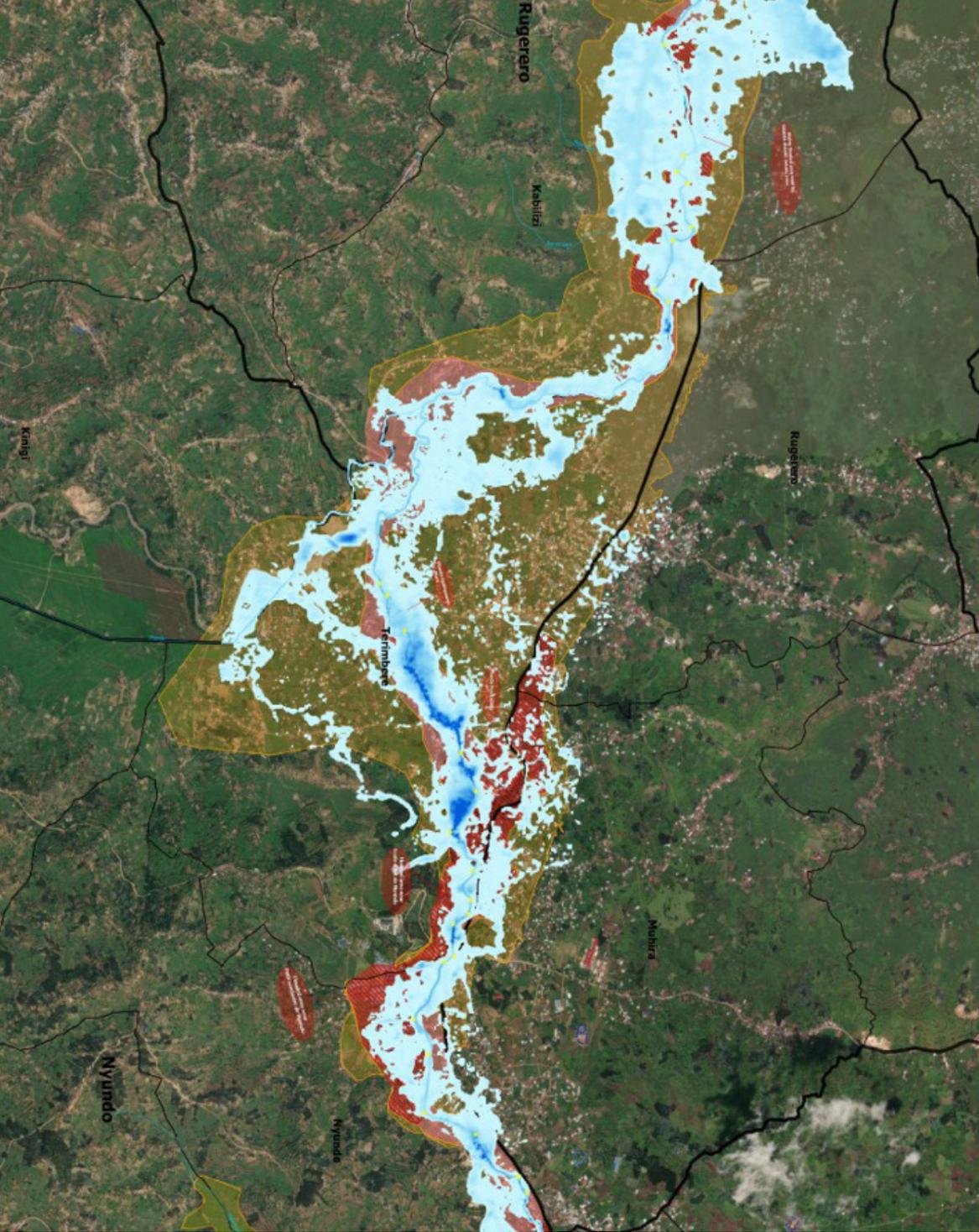
II.6.3 Digitization

RWB Digitization strategic plan theory of change is articulated as “Change or Improvement” in terms of strengthening governance of digital resources at all levels, ensuring the availability of enough and well managed water resources for sustainable development. The theory of change is presented with the issues, related key interventions, intermediate and long-term outcomes and expected impact. The following table highlights the strategic interventions as part of RWB Digitization plan, expected outcomes and the impact.

Strategic Interventions	Outcomes	Impact
Working with concerned institutions to hire additional digitalization staff and where possible to outsource experts through SPIU.	A specialized team of experts supporting the digitalization of RWB systems and processes.	
Strengthening RWB staff capacity, training processes & systems	Reinforced RWB skills capacity to improve organization performance through building the capacity of staff & processes and systems	Reduced delays in decision making due to
Mobilizing more financial resources through traditional and non- traditional sources of funding	Secured long-term sustainability through diversified sources of funding to cater to digitalization needs	availability of water resources information.
Development of a management information system integrating all existing and new systems to enhance interoperability.	The RWB-MIS shall bring seamless functioning of existing and proposed systems	



**III. RWB'S PROGRESS
& ACHIEVEMENTS
IN 2023/2024 FY**



III.1

Knowledge and Forecasting

III.1.1. Expanding groundwater mapping in Northern and Western Provinces

The Northern and Western of Rwanda known as volcanic region, is characterized by complex hydrological systems influenced by underground cave systems and subsurface water flows. This area is prone to flooding and landslides, making the local communities vulnerable to natural disasters and the adverse effects of climate change. To understand the complexity of the cave system and the availability of groundwater in the Northern and Western provinces, a geophysical survey was carried out in three districts namely Musanze, Nyabihu and Rubavu and a total of 26 km was achieved. **Table 3** shows the covered length in each district.

Table 3: The length of geophysical survey per district

District	Site surveyed	Total length covered (Km)
Musanze	Akadende	15.04
	Kinoni (Nyiragaju)	
	Mutobo Lower (Gitebe)	
	Mutobo Upper (Kabaya)	
Nyabihu	Nengo	10.01
	Bikwi	
	Kabyaza	
	Kinoni Upper (APARPE)	
Rubavu	Kumatiyo	1
	Nyabisazi	
Total		26.05

The results of the geophysical survey are a baseline to the water resources management both for flooding mitigation and water availability.

III.1.2 Knowledge Management

1. Cave system and source of water in volcanic region

To understand the cave system and source of water in the volcanic region, a tracing experiment to trace the outlets of the Mugogo Lowland Cave System using fluorescent dye was conducted. **Figure 1** indicates the location of tracer injection and pre-defined outlets.

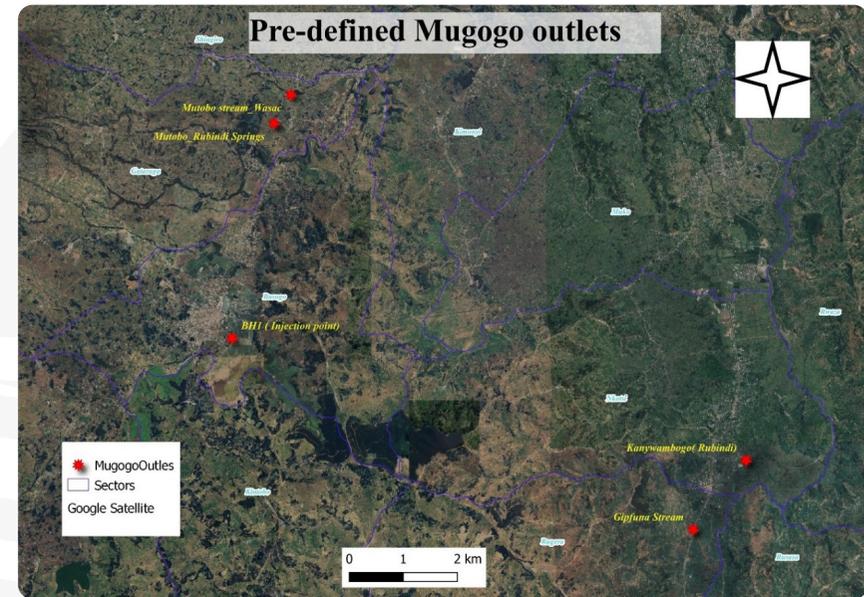


Figure 1: Location of tracer injection and pre-defined outlets of Mugogo caves system

Water samples were taken at predefined outlets of the Mugogo caves system before and after the fluorescent dye had been introduced and allowed to disperse within the cave system. The samples were taken from 25th March 2024 to the 19th May 2024 for laboratory analysis. The tracing experiment is complemented by investigating the relationship between surface and groundwater bodies in volcanic regions using isotope hydrology. This is to inform solutions of flood control that will use infiltration and understand the long-term impact of clogging of sinkholes and caves in the Volcanoes Region.

2. IWA Water Development Congress & Exhibition 2023 Participation



From 10th to 14th December 2023, RWB was honored with participation in IWA Water and Development Congress and Exhibition to witness and showcase Rwanda's innovative solutions shaping the future of water resource management. In this congress, RWB presented to the participants the study on groundwater mapping in the Eastern Province and Amayaga region in Rwanda, where RWB shared experiences & findings of groundwater mapping study undertaken in Eastern Province and Amayaga Region, the study was completed in 2023 under the support of UNICEF. The study provides reliable information on groundwater development, monitoring & planning of water supply systems.

3. Water Resources Modelling Hackathon

As part of Water week, the Rwanda Water Resources Board (RWB) has launched a

Water Resources Modelling Hackathon, a computer-based competition. This event invites undergraduate and master's students from universities and higher learning institutions in Rwanda that offer water-related courses.

The main goals of the competition were to:

- i. *Promote innovative solutions for sustainable water use and management in Rwanda and the broader region.*
- ii. *Enhance participants' modeling and data analysis skills, providing them with the tools to address real-world water-related challenges.*
- iii. *Highlight the importance of community involvement in water resource management.*
- iv. *Encourage innovation for resilience by having students develop solutions that improve the resilience of water systems against climate change and other environmental stressors.*
- v. *Advocate for data-driven and proactive decision-making in water resources management.*

A call for water modeling hackathon was launched on 3 April 2024 and Students from different universities both public and private applied to participate in the hackathon. Initially, 131 students applied to be part of a modeling competition and only 75 students were selected to advance to the next stage of the hackathon. The selection criteria were: Valid student card, being undergraduate or master's student registered in water related programs in Rwanda universities both public and private.

The hackathon received financial support from The Albertine Rift Conservation Society (ARCOS) Network and RWB awarded prizes to six winners from 75 students who participated in the hackathon, with the first-place winner receiving one million Rwandan francs, and the sixth-place winner receiving three hundred thousand Rwandan francs. The awarding ceremony took place on 30 July 2024 as **Figure 2** indicates.

4. Research and publications

In collaboration with the University of Parma, IPRC Musanze, and the Rwanda Water Resources Board (RWB), a summer school training program was organized through the Erasmus EnRHED project. This one-week training aimed to enhance the capability of participants to tackle and solve issues related to slope stability and



Figure 2: Water Resources modeling Hackathon awarding ceremony

flood management using specialized software. The training was attended by four RWB staff members, as well as participants from IPRC Musanze and other RWB partner institutions. With the EnRHED project now concluded, Rwandan universities and RWB are seeking funding opportunities to organize further summer school

sessions. RWB staff, along with colleagues from partner institutions, have also contributed to the publication of several research articles in the field of water resources management:

- i. *Review of the Flood Management Status in Rwanda – This study was conducted by PhD student Joseph Hahirwabasenga, in collaboration with professors from the University of Rwanda and Lund University, and Dr. Hussein Bizimana.*
- ii. *Forecasting Rainfall Patterns and Anomalies Under Climate Change in the City of Kigali – This research was led by Dr. Hussein Bizimana, with contributions from Abdusselam Altunkaynak (Istanbul Technical University), Robert Kalin (University of Strathclyde), Mbat Mathieu (Meteo-Rwanda), and Dr. Emmanuel Rukundo (RWB).*
- iii. *Isotopic Signature Tracing and Its Use in Cave Flow Analysis in the Volcano Region of Rwanda – This study involved Dr. Hussein Bizimana, Muhamed Qurtobi (CNESTEN-Morocco), and Robert Kalin (University of Strathclyde).*
- iv. *Hydro-chemistry Analysis, Aging, and Contamination Trends in the Volcanic Region of Rwanda – Researchers involved in this study included Dr. Hussein Bizimana, Muhamed Qurtobi (CNESTEN-Morocco), and Robert Kalin (University of Strathclyde).*
- v. *Downscaling Climate Change Projections in the Northwestern Part of the Country, Tracking Easterlies and Westerlies Fronts – This project was carried out by Dr. Hussein Bizimana and a team from the University of Rwanda's College of Science and Technology (UR CST), within the Water Resources Engineering Cluster.*

5. External access to RWB database

To allow partners to access water resources data, a dedicated server and port known as intermediate server are essential to overcome the obstacle

of VPN requirements when external clients access the main database/Aquarius server.

Therefore, the server hosting Aquarius was developed and serves as an intermediary that manages all incoming HTTP requests from clients, forwards them to Aquarius, retrieves the HTTP response, and then relays it back to the clients. **Figure 3** shows the schematic process of dedicated server and port as intermediate server.

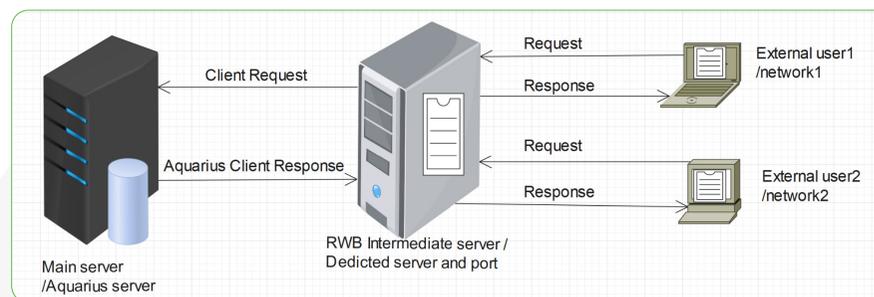


Figure 3: The schematic process of dedicated server and port as intermediate server

The API proxy server has been successfully implemented. The code to handle the HTTP requests from the clients was written and deployed to the production server, with the following domain <https://waterapi.rwb.rw> as base url. Different endpoints are coded and available for anyone who is using a network different to the one of RWB. Mainly, the list of endpoints is developed such as `/getLocationDescription`, `/getTimeSeriesData`, `/getTimeSeriesDescriptionList`, `/getTimeSeriesDescriptionListByUniqueId`, `/getTimeSeriesUniqueIdList` and `/getLocationData`.

Additionally, for enhancing the security, the proxy API server provides a static API security key which allows the access to the Proxy endpoints. At the end of this report, the sample codes in Python and PHP are provided for accessing the API on the proxy server.



III.2

Catchments Restoration & Erosion Control



In 2011, the Government of Rwanda approved a National Policy for Water Resources Management. The policy highlights the importance of catchment-based approach to management of water resources. RWB has made significant progress so far in terms of catchment management. Indeed, using CROM-DSS, RWB has identified areas with high soil erosion risks and recommended suitable catchment restoration measures across the country; Catchment Management Plans were developed and Catchment Management Committees established for all the 9 level 1 catchments. In addition, RWB is striving to mobilize resources for implementing the developed catchment management plans through different projects.

This section aims to present an overview of achievements regarding Catchment Restoration and Erosion Control. It focuses on managing and protecting the country's water resources while mitigating water-related hazards through establishment and operationalization of Catchment Management Committees and

the implementation of catchment restoration measures.

III.2.1 Establishment and operationalization of catchment management committees:

The catchment-based approach is widely recognized as essential to dealing comprehensively with water resources management issues. Therefore, institutional and management arrangements ought to be set up at catchment or basin scale. In Rwanda, Catchment Management Committees are established in accordance with article 10 of law No 49/2018 of 13/08/2018 determining the use and management of water resources. Subsequently, the Ministerial Order No 002/MoE/22 of 31/01/2022 governing the water management committees at the catchment level, defines responsibilities, composition, the

organization of the catchment committees and the logistical support to the committees. During 2023-2024 fiscal year, RWB has supported the establishment of three new Catchment Management Committees namely Mukungwa, Rusizi, and Akanyaru catchments. Adding to 6 Catchment Management Committees (Upper Nyabarongo, Lower Nyabarongo, Upper Akagera, Lower Akagera, Muvumba and Kivu) previously established, this marks the 100% completion of all level 1 catchments in Rwanda with management committees successfully established. During this activity two management organs of the catchment committee, (i) the Management Committee and (ii) the Technical Support Committee were considered. For each Management Committee, a Chairperson and a Deputy Chairperson were elected according to article 7 of the aforementioned ministerial order, while for each Technical Committee, a Coordinator and a Deputy Coordinator were elected in accordance with article 16 of the same ministerial order.

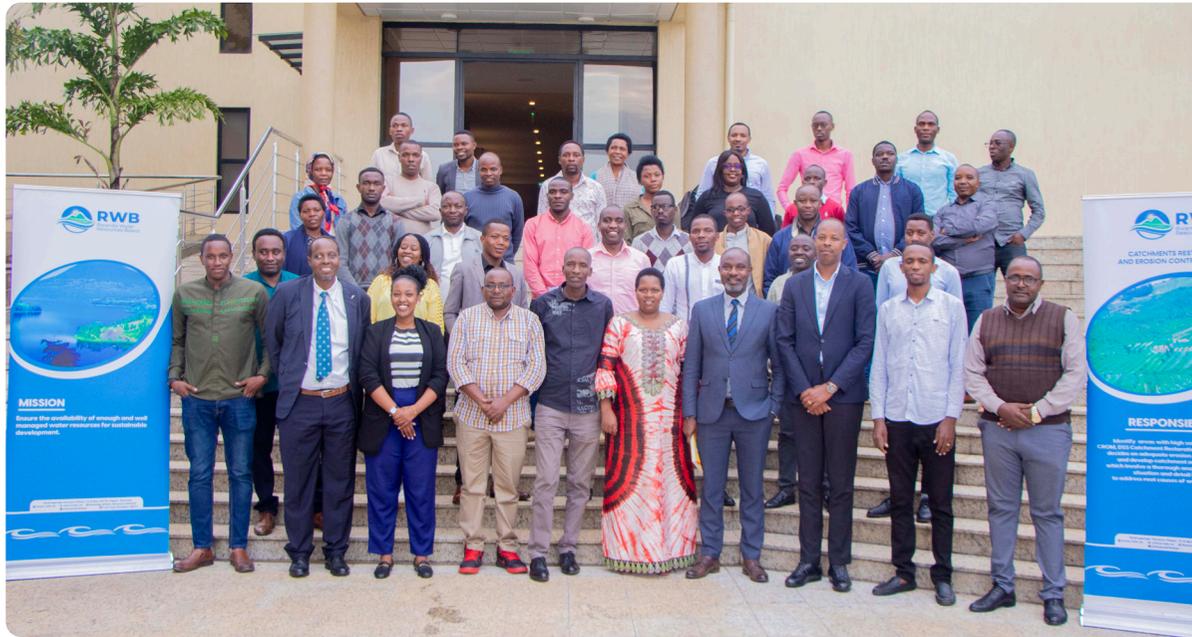


Figure 4: Elected Management Committee in Rusizi Catchment

III.2.2 Rehabilitation of degraded areas

The catchment restoration has been the central focus of efforts to build resilience against soil losses and flooding. This was done in recognition of the fact that the most significant challenge in

many catchments is soil erosion and sediment flow into water bodies, resulting in reduced groundwater recharge, loss of soil fertility, sedimentation of dams and water reservoirs as well as increased risk of floods.

Catchments Restoration and Erosion Control Decision Support System (CROM-DSS) is a tool

developed for the Rwanda Water Resources Board (RWB) to support decision-making related to catchment restoration and erosion control initiatives in Rwanda. The system integrates data, models, and analytical tools to assess the impact of various interventions on catchment restoration and erosion control. Based on CROM-DSS, different categories of soil erosion risk: moderate, high, very high and extremely high were mapped and associated with suitable catchment restoration measures. The measures include radical and progressive terraces, agroforestry, afforestation, hedgerows, rivers banks and lake shores protection as well as gully treatment.

During the 2023-2024, in terms of catchment restoration, RWB has successfully restored a total area of 1,258.7 ha of degraded lands. This has been an increase from the baseline of 225,343 ha restored at the beginning of the fiscal year. The rehabilitation efforts were carried out through various projects/programs: 992.3ha were rehabilitated through earmarked funds across 15 Districts including Huye, Nyamagabe, Muhanga, Kamonyi, Nyanza and Nyaruguru in Southern Province; Karongi, Nyabihu, Ngororero, Rutsiro and Nyamasheke Districts in Western Province; as well as Burera, Musanze, Rulindo and Gakenke Districts in Northern Province.

Figure 5: Examples of Rehabilitated area with Radical Terraces



Additionally, rehabilitation work was done for 169.45 ha under Giciye - Shyira - Karago - Mugogo - Satinsyi - Ndiza Sub-Catchments Project. The remaining 97ha were restored under a project for erosion and flood control in Nyamasheke District supported through Lake Tanganyika Water Management (LATAWAMA).

As presented in **figure 6** below, compared to other districts, Ngororero received a high coverage (26%) of restored degraded areas in 2023-2024 FY. This is mainly justified by its location in Vunga Corridor which was a priority for RWB in recent years following water related disasters (floods and landslides) that struck the region in May 2020 and therefore the presence of the ongoing Giciye-Shyira-Karago-Mugogo-Satinsyi-Ndiza Sub-Catchments Project.

As illustrated in **figure 7** progressive terraces and radical terraces are the most used restoration measures, representing 61.6% and 14.1% respectively. Indeed, according to the State of soil erosion in Rwanda (2022), it appeared that based on CROM-DSS, progressive terraces covered 47% of the total area needed for restoration, having a much higher proportion compared to other recommended erosion control measures.

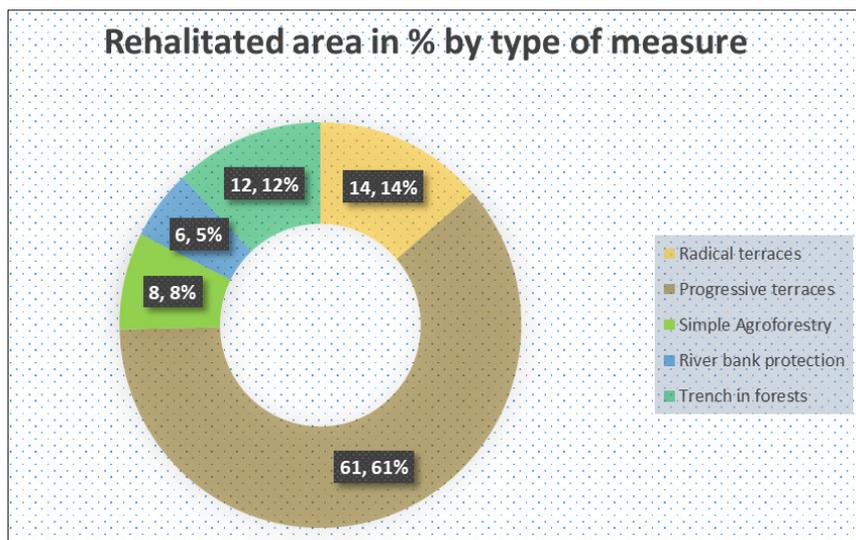


Figure 6: Rehabilitated area in % by District

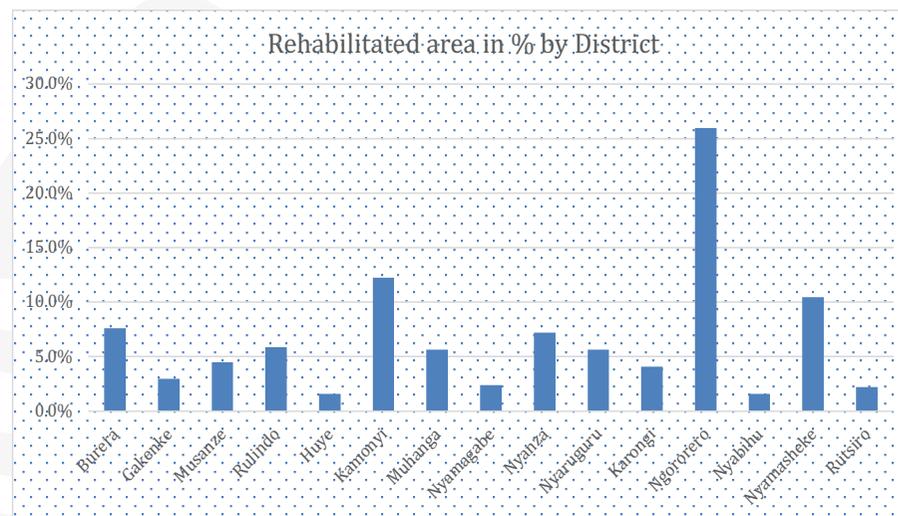


Figure 7: Rehabilitated area in % by of measures



III.3

Water Monitoring and Quality Control

Water resources are fundamental to every aspect of our daily lives as we use them for domestic purposes, recreation, and supporting economic development (industrial processes, agriculture, infrastructures, etc.). However, humankind's reliance and the fragility of this vital resource are too often taken for granted. It is generally only when something happens to our water supply, such as lack of water during droughts, or through overuse, when water quality becomes unsuitable for intended uses, or when crops and infrastructure are destroyed by unpredictable floods, and then only we notice. It is not always possible to predict the severity of floods and droughts, but we can do a lot to improve our understanding of our water resources.

Hydrological data can help us prepare and plan for extreme events by identifying where the risks are highest. Day to day hydrological data is used to better manage our water resources in ways that suit our economic and environmental needs by providing information on the availability and quality of water for all uses. Hydrological data is therefore important across a wide variety of sectors, whether it will be for use in total watershed management, disaster preparedness and mitigation, infrastructure and industry development, urban planning, water safety and supply, health, agriculture, mining, tourism, or environmental conservation.

III.3.1. Surface water quantity monitoring

During the fiscal year 2023/2024, RWB has organized field campaigns across different seasons: short dry, long rain, and long dry seasons. This method is crucial for capturing the full spectrum of water level and discharge variations throughout the year: i. Short dry season: Monitoring during this period helps understand water behavior during times of minimal precipitation and how water resources are affected by lower rainfall and higher evaporation rates, ii. Long Rain Season: During the extended rainy season, the focus is on how increased rainfall impacts water levels and discharge. This data is vital for flood risk assessment and management, and iii. Long Dry Season: Offers a view of water scarcity and its effects on surface water resources. This information is essential for managing water resources and planning for future droughts.

Analysis of data from these varied conditions, helps understand how factors like rainfall patterns and climate conditions influence water dynamics throughout the year. This seasonal perspective supports effective water

resource management, improved predictive modeling, and enhanced environmental protection strategies.

Water Level Monitoring: In Rwanda, water levels are measured using a combination of manual and automated instruments to ensure accurate and continuous data collection. The staff gauges, installed at all RWB gauging stations, serve as a crucial manual backup for data collection, ensuring no data loss in case of system failures. It also helps calibrate the automated instruments, making it an essential tool for maintaining accurate water level measurements.

In addition to these, RWB employs advanced technology such as telemetry pressure sensors and radar sensors for real-time water monitoring.

River flow measurement: River flow, also known as discharge, is the volume of water that flows through a measuring point or gauging station in a given period. It is expressed as a volume unit per unit of time. RWB uses the following instruments in river flow measurements:



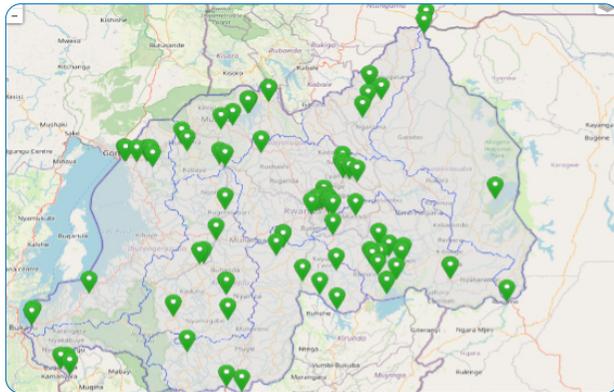
Figure 8: Ott MFPRO current meter & River ray ADCP

OTT MF PRO current meter used for measuring the discharge in shallow and medium streams and rivers.

The River Ray ADCP (Acoustic Doppler Current Profiler) is a next-generation instrument used for measuring water currents, velocity profiles, and other hydrodynamic parameters in various aquatic environments including big rivers like Nyabarongo, Rusizi, Akagera and Akanyaru Rivers. This economic system comes with the River Ray ADCP, a custom-designed boat, user-friendly software, and convenient wireless communication.

Sites for data collection

The figure below indicates the 50 sites assessed during the water monitoring campaign :



← Figure 9: Map of the water monitoring network



Figure 10: Field Laptop Communicating with ADCP sensors on Giswi River (Left) & Yanze River gauge (Right)

Results

The table below details the water levels and discharges recorded at the 50 monitoring sites:

Table 4: water levels and discharges recorded at 50 monitoring sites

N°	Name of the site	Water level (m)	Discharge (m ³ /sec)	N°	Name of the site	Water level (m)	Discharge (m ³ /sec)
1	Nyundo	0.352	2.799	26	Rubyiro-Bugarama	0.33	4.990
2	Karambo	0.21	0.324	27	Ruhwa-Bugarama	1.26	19.156
3	Pfunda	0.394	1.230	28	Mudasomwa/Rukarara	0.723	18.380
4	Bihongora	0.18	0.632	29	Ururumanza	0.21	0.492
5	Mahoko	0.46	2.0786	30	Warufu/Nyagihanga	0.31	0.867
6	Agatobwe	0.40	1.487	31	Yanze	0.76	1.516
7	Akanyaru-Upper	1.012	17.261	32	Kamanyora	2.69	165.949
8	Base-Kinoni	0.41	5.331	33	Kivu/Rusizi-outlet	3.201	166.760
9	Bashara-Muvumba	0.70	10.780	34	Kanzenze	3.128	215
10	Kabuga-Muvumba	0.51	9.613	35	Akanyaru-Lower	2.2	25.213
11	Cyamutara	0.91	3.297	36	Mfunu	2.25	117
12	Karundura	1.41	5.875	37	Mukunguri	0.83	5.541
13	Gihinga	3.126	37	38	Ngaru-Nyabarongo	2.61	124.119
14	Kagitumba	2.15	20.124	39	Ngaru-Mukungwa	1.3	48.719
15	Kamiranzovu	1.401	2.099	40	Karuruma	2.112	9.573
16	Karundura	1.41	5.875	41	Nyagisozi	2.734	25.426
17	Koko	0.23	1.885	42	Ruliba	3.08	119.754
18	Mbirurume	0.52	22.245	43	Musogoro	0.2	1.216
19	Muhazi-Outlet	0.163	0.432	44	Giciye	0.41	7.096
20	Muregeya	0.28	1.883	45	Nyamutera	0.27	2.490
21	Nyabisindu/Mwogo	0.52	7.313	46	Rubagabaga	0.36	3.257
22	Nemba	0.63	10.396	47	Satinsi	0.4	4.279
23	Giswi	0.691	7.849	48	Akagera-outlet	1.318	452.652
24	Nyakinama	1.231	15.085	49	Gatore	3.31	170
25	Nyamukongoro	0.28	1.146	50	Kirimbi-Nyamasheke	0.5	3.203
				51	Gatumba	1.21	27.845

III.3.2. Groundwater resources monitoring

It is crucial to consider groundwater sustainability on a large scale to effectively plan and develop future groundwater resources. This can be achieved by gathering data from various sources such as groundwater monitoring stations, groundwater wells, and springs.



Figure 11: Tools for data collection, groundwater monitoring station and location of monitoring boreholes

Data Collection Approach

Groundwater data are obtained in three ways: Telemetric groundwater stations, Data loggers or Diver data recording stations, and Piezometric groundwater stations.

Figure 12: Data collection process by downloading long-term recorded data from data loggers

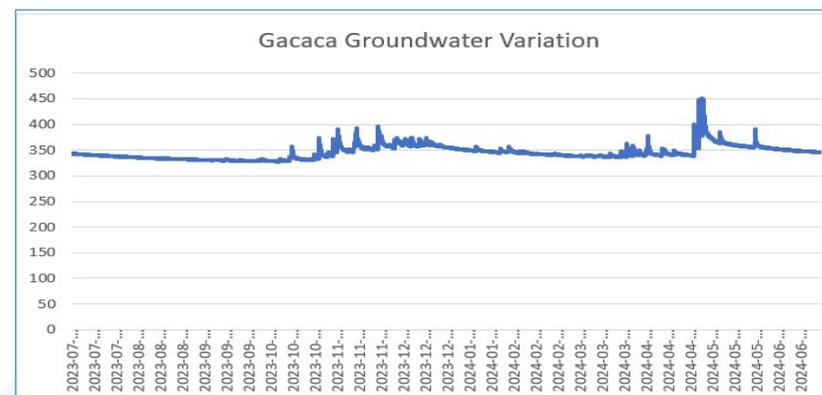


Figure 14: Gacaca Groundwater variation from 1st July 2023 to 30th June 2024

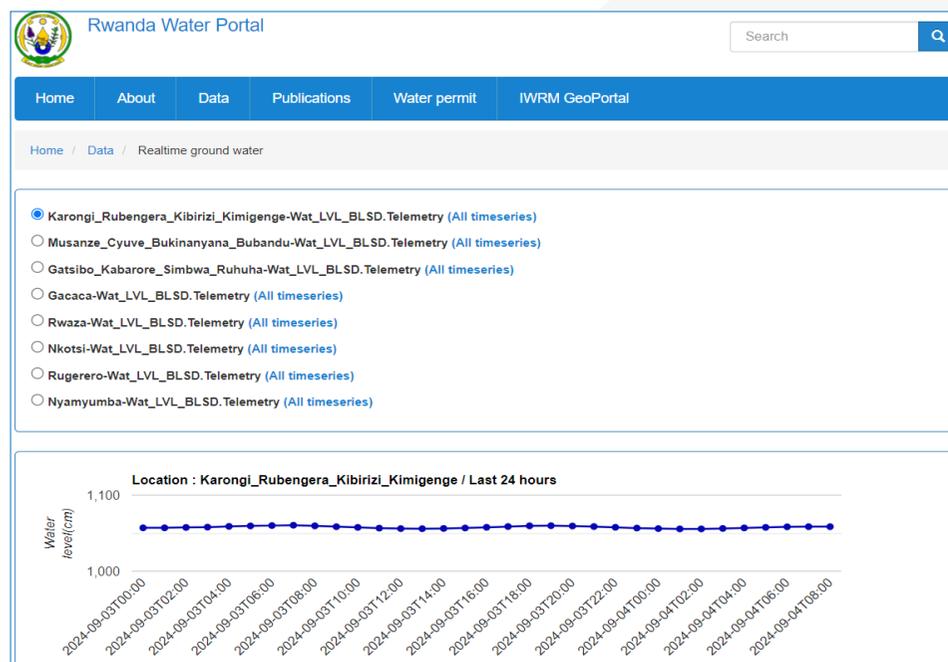


Figure 13: Groundwater real-time monitoring station installed at Karongi_Rubengera

III.3.3. Water Pollution investigation in slaughterhouses

During the fiscal year 2023-2024, pollution investigation mainly focused on slaughterhouses. The waste generated from slaughterhouses, including blood, bones, fat, and other organic matter, can contaminate soil, water bodies, and air if not properly managed. This pollution can harm local ecosystems, disrupt aquatic life, and degrade soil quality.

During the fiscal year 2023-2024, a total number of 23 slaughterhouses have been assessed. After the investigation in terms of waste management, the visited slaughterhouses were categorized as follow:

- i. **Outdated slaughterhouses:** Old infrastructure, Poor wastewater drainage systems, Inefficient digestion ponds with leakages,
- ii. **Modern slaughterhouses:** Fully constructed and meeting all requirements,
- iii. **Slaughterhouses under construction:** Nearing completion, and
- iv. **Poor animal killing centers:** Facilities that are inadequate and potentially hazardous Risk of pollution to surrounding water bodies.

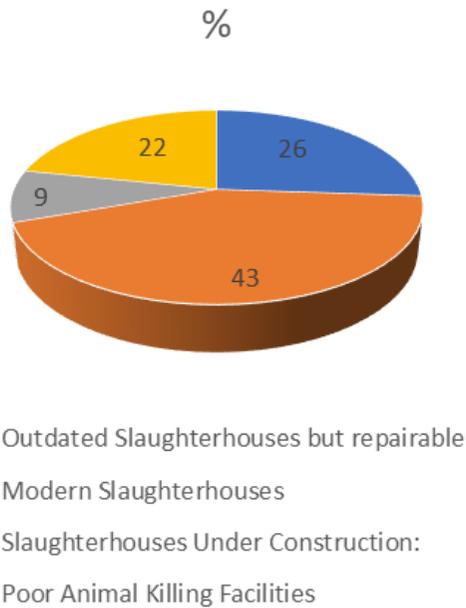


Figure 15: The chart showing the percentage of visited slaughterhouse categories



Figure 16: Rubavu Modern slaughterhouse with well-constructed digestion pond for waste management

Findings

Investigations into wastewater management at various slaughterhouses have revealed significant issues, putting surrounding water bodies at high risk of pollution. The findings indicate that most of the current wastewater treatment and disposal practices are inadequate, contaminating local rivers and streams with harmful pollutants. The investigation uncovered that many slaughterhouses discharge untreated or insufficiently treated wastewater, which contains high levels of organic matter, nitrogen, phosphorus, and other pollutants. These pollutants can cause eutrophication, leading to the depletion of oxygen in water bodies, which is detrimental to aquatic life and can result in “dead zones” where life cannot be sustained.

III.3.4. Restoration of Cyohoha North Lake through water weeds harvesting

Cyohoha North Lake, located in Bugesera District and spanning the sectors of Ngeruka, Mareba, Musenyi, and Mayange, covers an area of 630 hectares. Since the early 2000s, the lake faced severe ecological challenges due to the proliferation of invasive water weeds. These include the free-floating species *Salvinia molesta*, locally known as *Imishabishabi*, and rooted floating species such as those from the *Nymphaea* genus. The infestation has led to the near conversion of the lake into agricultural land.

a. Mechanical removal of water weeds from Cyohoha North Lake

Efforts to restore the lake have been ongoing, primarily through manual removal of the water weeds. However, this approach has proven ineffective over time, as the weeds rapidly re-emerge and spread. In response, RWB launched a project focused on the mechanical removal of these invasive species. This method is both cost-effective and expedites the clearing process and minimizes health risks to the personnel involved, particularly in deeper areas of the lake.

Water weed harvesting activities in Cyohoha North Lake during the 2023-2024 fiscal year achieved significant progress, particularly in the Kibugabuga area, where a large concentration of water weeds was identified. A total of 312 containers, approximately 901.68 m³, of water weeds were harvested,

leading to the reclamation and maintenance of 630 hectares of the lake, ensuring better ecological health and improved water conditions in the area.

b. Valorizing the removed water hyacinth into fertilizer

The removed water weeds are used as organic fertilizer by the local population. This organic material, rich in nutrients like nitrogen and sodium, is utilized by local farmers on vegetable farms around the lake, which represents a successful integration of environmental management and sustainable agriculture. This initiative not only restores the health of the lake but also provides significant economic and agricultural benefits to the local community.



Figure 17: Water weeds harvesting in Cyohoha North Lake (before and after)

III.3.5 Water Quality Monitoring

To fulfill its mandate of developing strategies for the preservation of water resources both quantity and quality, RWB conducted Water Quality Monitoring campaigns of 67 sampling

sites encompassing the 9 level-I catchments of Rwanda during both rainy and dry seasons. The campaign focused on monitoring water quality, specifically at selected sampling sites. Seven parameters were considered for monitoring: Temperature, pH, Electrical Conductivity (EC),



Figure 18: Water weeds removed from the lake then transported to farms for composting or use as mulching & A plot of cabbages with a good mulching

Dissolved Oxygen (DO), Total Dissolved Solids (TDS), Total Suspended Solids (TSS), and Turbidity. The campaign took place during the Dry season (August-September), short rain season (November-December) and the long rain season (April-May).

Findings

The obtained results indicated that the temperature, Electric Conductivity, pH and Total Dissolved Solid levels observed at all monitoring sites remained within acceptable standards outlined in the Rwanda Standards for Discharged domestic water (RS 110: 2022), Discharged industrial wastewater (RS 109: 2022), and EAS 12:2018 for Natural Potable water (untreated potable water). The total Suspended Solids (TSS) and Turbidity consistently exceeded the acceptable range specified by the standard limit as shown in Figure 24 and 25.

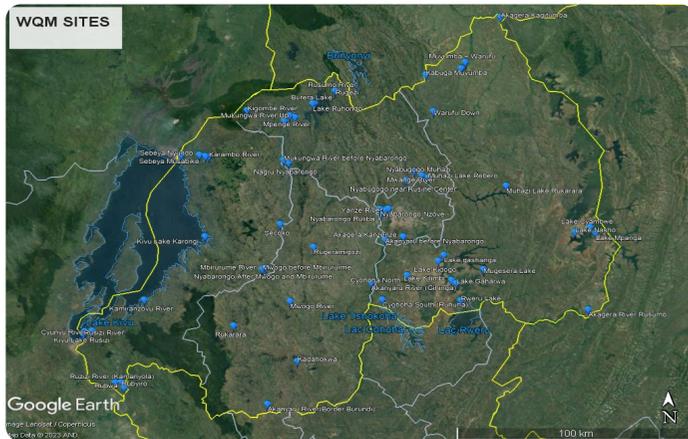


Figure 19: Sampling site map

A decrease in DO saturation rates resulted in a notable deviation from the standard limit, indicating non-compliance. This is attributed to the presence of agriculture inputs, water hyacinth, which is predominant vegetation species, and wastewater discharge. These factors disrupt the diffusion process of oxygen from the atmosphere into the water, consequently leading to a reduction in oxygen levels.

Figure 20: Turbidity variation for phase I, II and III

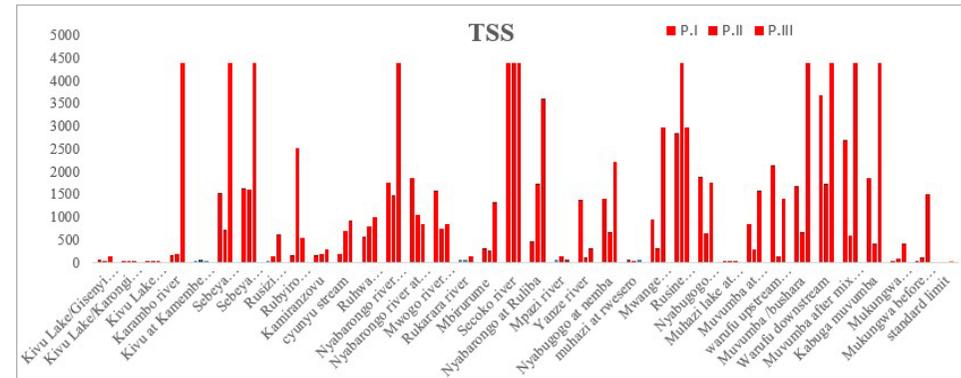


Figure 21: Total suspended solids variation for phase I, II and III

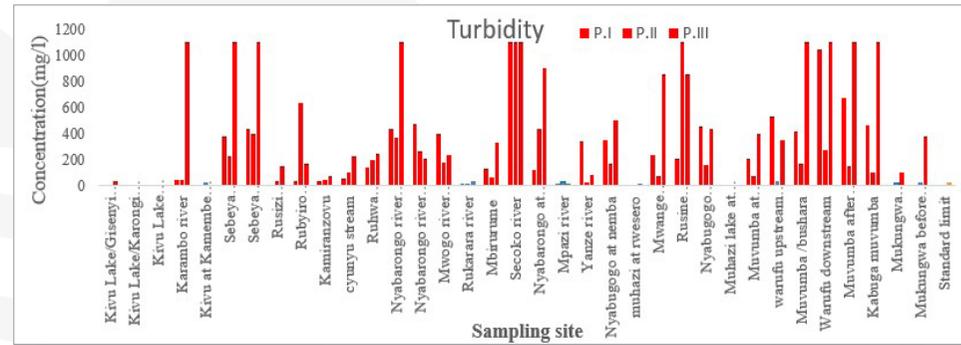
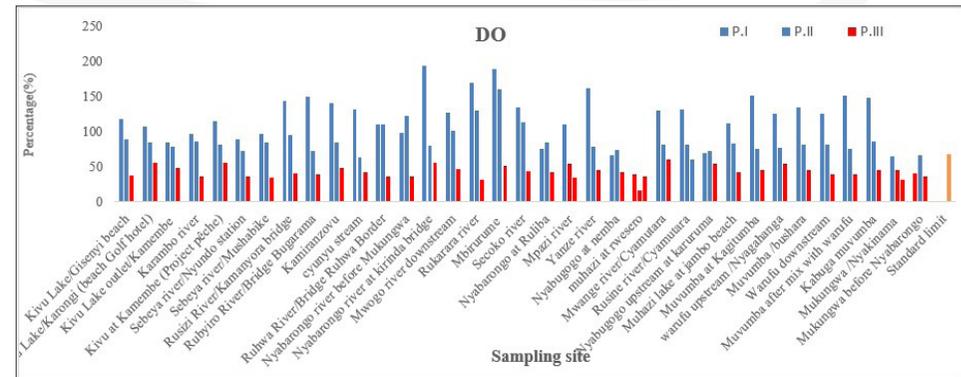


Figure 22: Dissolved Oxygen variation for Phase I, II and III



III.3.6. Acquired Water Quality Monitoring Lab Equipment

RWB significantly advanced its capabilities in understanding and managing water resources through water quality monitoring. **Here's a brief overview of the equipment in use:**

Figure 23: MPS probe with the reader (Left) & water quality test at Muvumba River (Right)



Multi-parameter sensors: These sensors allow for real-time monitoring of various water quality parameters such as pH, turbidity, dissolved oxygen, and conductivity.



PICARRO set for water isotope analysis: for detailed studies of water sources by examining the isotopic composition of water samples. This can provide insights into: i. Source Tracking: Identifying the origins of water sources and understanding the hydrological cycle, and ii. Pollution Tracking: Tracking the movement of pollutants and their sources.



Metalyzer for heavy metal analysis: This equipment helps to detect and quantify metals like lead, mercury, and cadmium in water samples, ensuring that water sources are safe and compliant with health standards.



The Aquasafe® MSL50: is a dedicated microbiological kit that allows easy and portable incubation of samples through a dual incubator unit. Two efficient independently controlled chambers simultaneously allow discrete testing of two organisms, such as fecal (thermotolerant) and total coliforms. Its single waterproof wheeled case allows easy mobility and protection.



Spectrophotometer: This device is used to analyze the concentration of various substances in water by measuring how much light is absorbed at different wavelengths. It can be used for a wide range of analyses, including detecting pollutants and measuring nutrient levels.

All these tools enhanced RWB's ability to monitor and manage water resources effectively, supporting better decision-making and ensuring the sustainability of water resources.



III.4

Water Permits

The water Law n°49/2018 of 13/08/2018 Determining the Use and Management of Water Resources in Rwanda, stipulates that “the use of water resources in different activities and installations susceptible to modify the flow or the level of water or to degrade their quality, or to threaten water related ecosystems, wetlands and the environment are subjected to water use permit”. Water use permitting is one of the tools to gather the information that we need for the optimal management of our water resources and contributes to the mission of Rwanda Water Resources Board which is to ensure the availability of enough and well managed water resources for sustainable development.

III.4.1 Inspections for water use compliance

During this fiscal year of 2023-2024, 91 field inspections were planned aiming to verify the water users’ compliance with terms and conditions regarding water use. In these inspections, different methods were adopted; including a desk review that involved the consultation of the water permit register; interviewing different representatives of targeted water users; and a field checklist to verify the water permit holder’s compliance with the terms and conditions stipulated in the signed contract related to the water use permit. Responding to the total target shares of Performance contracts (RBM) relating to field inspections, one hundred twenty-nine (129) inspections were carried out to inspect water users located in different districts across the country; Thus, total planned field inspections for fiscal year 2023-2024 were successfully achieved at 100%.

Table 5: Inspections related to water user compliance in FY 2023/2024

Quarters (Q)	Conduction Date	Targeted Use	Location (Province)
Q1	18-22/09/2023	Mining, Irrigation, and industries	Northen and Eastern
	8-10/09/2023	Fish Farming in Ruhondo and Muhazi Lakes	Northen and Eastern
Q2	18-22/12/2023	All uses	Northern and Western
Q3	11-15/03/2024	Coffee washing	Western
Q4	15-19/04/2024	Fish Farming in Kivu Lake	Western

During the 2023/2024 FY, RWB has carried out a field visit to assess the water use-related claims raised by Rural and Urban Support for Architecture, Building, and Others that has been permitted to carry out recreation activities in Muhazi Lake. The claim was about continuous loading of “Amarebe”; commonly known as common water hyacinth from the concession upstream, continuous sediment loading from Murama River that deteriorates the aesthetic view of the concession due to the massive turbidity, and discharge of effluent from nearby milk collection center (MCC) deteriorates the quality of water in the authorized concession and affects the ecosystem in the lake.

Based on the water user’s operational status, the inspected water users were categorized into four (4) categories; including non-operational activities with valid water use permits, non-operational activities with expired water user permits, operational activities with valid water use permits, and operational activities with expired water use permits.

Following the terms and conditions related to the water use permit over the issued concessions, the concessionaires who were found not complying, their water use permits (authorizations) were canceled so that the concessions can be allocated to the new potential water permit applicants. In addition, there was another user who was initially issued a large concession (68Ha) that was found to be too much following the user’s working capacity as the user was only using 4 ha.

The overall water user’s compliance status in terms of water use efficiency, operational status, and environmental protection was rated 87.95%. The inspection of cage fish farmers in Muhazi and Ruhondo lakes that aimed to ensure sustainable and responsible aquaculture practices has found an overall compliance status of 37.03% of twenty-seven (27) inspected concessionaires. Compliance with environmental protection is 100%. On the other hand, 52% were found not complying with operational status; thus, thirteen water permits.

To verify the water users' compliance with terms and conditions regarding water use. Among the inspected users, 74.19% were found fully complying. While inspecting the water users' compliance with operational status in concessionaires located in Kivu Lake, the compliance status was found to be 59.38%.

III.4.2 Assessment and provision of water use permits

During the fiscal year 2023-2024 Quarter1, the target for provision of new water use permits to the applying and complying water users was 25 water use permits. RWB managed to issue 28 water use permits. These water use permits were issued to different sectors namely: domestic water supply, irrigation, recreational activities, Coffee washing stations, Hydropower, Industries and, fish farming; both in lakes and ponds in the following districts: Kayonza, Kirehe, Ngoma, Kamonyi, Ruhango, Nyaruguru, Rutsiro and, Rusizi. Quarter2, the target for provision of new water use permits to the applying and complying water users was 25 water use permits. RWB managed to issue 25 water use permits. These waters use permits were issued to different sectors namely: irrigation, industrial activities, coffee washing stations, mining activities, dam construction and, fish farming; both in lakes and ponds, in the following districts: Gasabo, Bugesera, Gatsibo, Ngoma, Kamonyi, Nyamagabe, Rutsiro, Rusizi, Ngororero, Nyabihu, Gakenke, Burera and, Rulindo.

Quarter3, the target for provision of new water use permits to the applying and complying water users was 25 water use permits. RWB managed

to issue 27 water use permits. These water use permits were issued to different sectors namely: irrigation, industrial activities, coffee washing stations, mining activities, recreational activities, domestic use and, fish farming; both in lakes and ponds, in the following districts: Gasabo, Bugesera, Kayonza, Nyagatare, Rwamagana, Ngoma, Nyaruguru, Rutsiro, Nyamasheke, Gakenke, Rulindo and, Karongi. Quarter 4, the target for provision of new water use permits to the applying and complying water users was 20 water use permits. RWB managed to issue 19 water use permits.

These water use permits were issued to different sectors namely: domestic water supply, coffee washing stations, irrigation, Mining activities, recreational fishing, and fish farming in the following districts: Bugesera, Rwamagana, Gatsibo, Kirehe, Nyagatare, Gicumbi, Muhanga, Gisagara, Rusizi, Nyamasheke, and Karongi. The fiscal year 2023-2024 target was achieved at 104.21%; where 99 Water use permits have been issued, making it a cumulative progress of 1,002 Water Use Permits. The 99 water use permits are shown on the **figure 24** below:

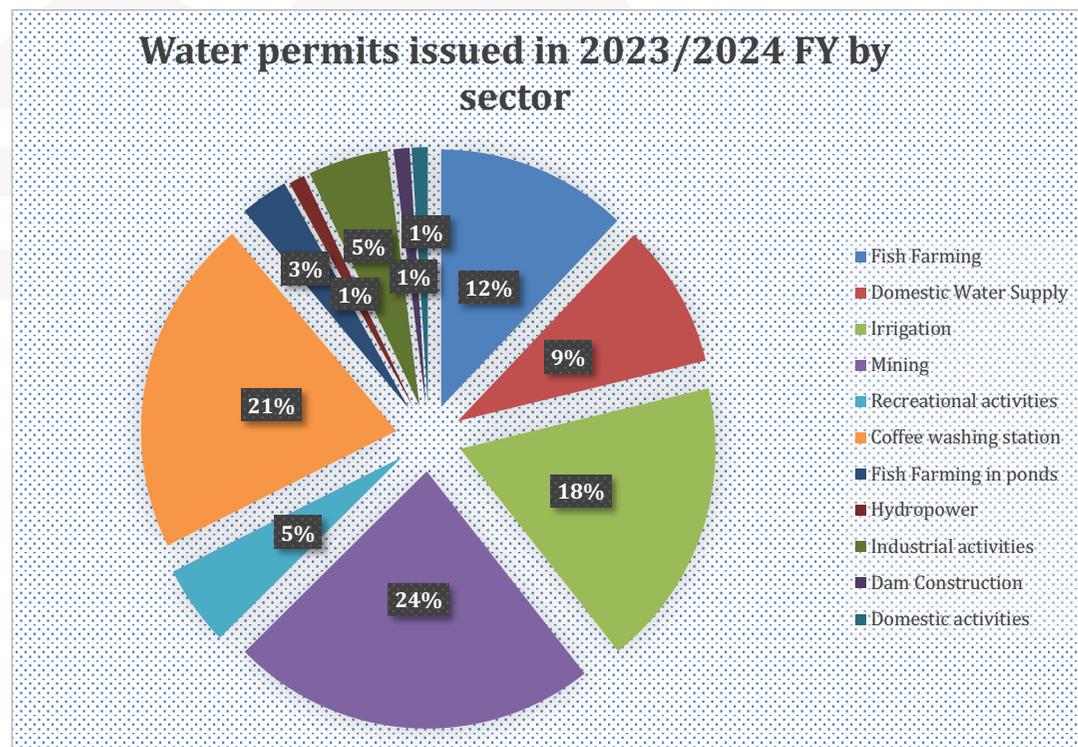


Figure 24: Water permits issued in 2023/2024 FY by sector

III.4.3 Water User Survey

In the framework of assessing the service delivery regarding the issuance of water use permits, the Rwanda Water Resources Board (RWB), through the Water Permits Division has initiated a survey for the registered water users. Eighty (80) water users were sampled and requested to respond to the provided questionnaire. The used questionnaire aimed at assessing the status of water user satisfaction with the rendered services related to the water use permitting.

Key findings demonstrated that 81% of water users have received their permits on time; 93.7% recognize the value of possessing a water use permit for legal compliance, business attractiveness, and access to subsidies and investments. However, 12% reported difficulties during the application process, while 8% still face water use-related conflicts.

Respondents emphasized the need for continuous awareness campaigns through various channels to encourage non-permitted users to apply for permits, highlighting the importance of simplified and digitalized application process, enforcement, and penalties for non-compliance.



Figure 25: Water users

1. The effectiveness of dissemination channels for public awareness of water use permit services

To assess the status of water user satisfaction with service delivery regarding the issuance of water use permits, the survey has significantly contributed to evaluating the effectiveness of dissemination channels for public awareness of these services. Insights shared by respondents revealed that information relating to water use permit services is primarily distributed through word of mouth (27%) among water users, as illustrated in the figure below.

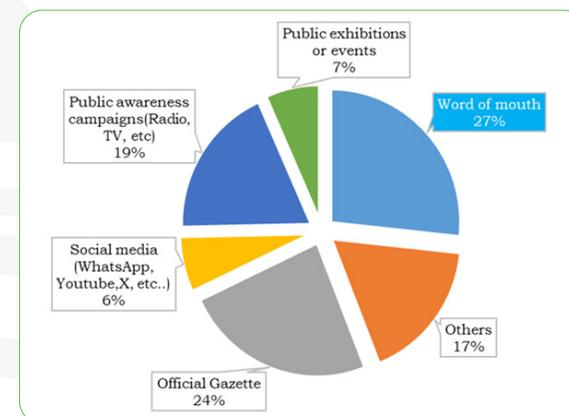


Figure 26: Effectiveness of dissemination channels for public awareness of water use permit services

2. The duration of time for water permit issuance

Article 7 of the Ministerial Order No. 001/MoE/24 of 02/04/2024 relating to water resources use permit states that the applicant should be notified about the decision on his or her application for water resources use permit in a period not exceeding 90 days (3 months) from the date of receipt of application.

To assess the status of water user satisfaction with the service delivery regarding the issuance of water use permits, the survey aimed at assessing water users' perspectives on the convenience of the duration of time for water permit issuance. The results have shown that 81% of the respondents received water use permits within three months, including 16% that received the permits within one month, and 65% that received the permits between one and three months.

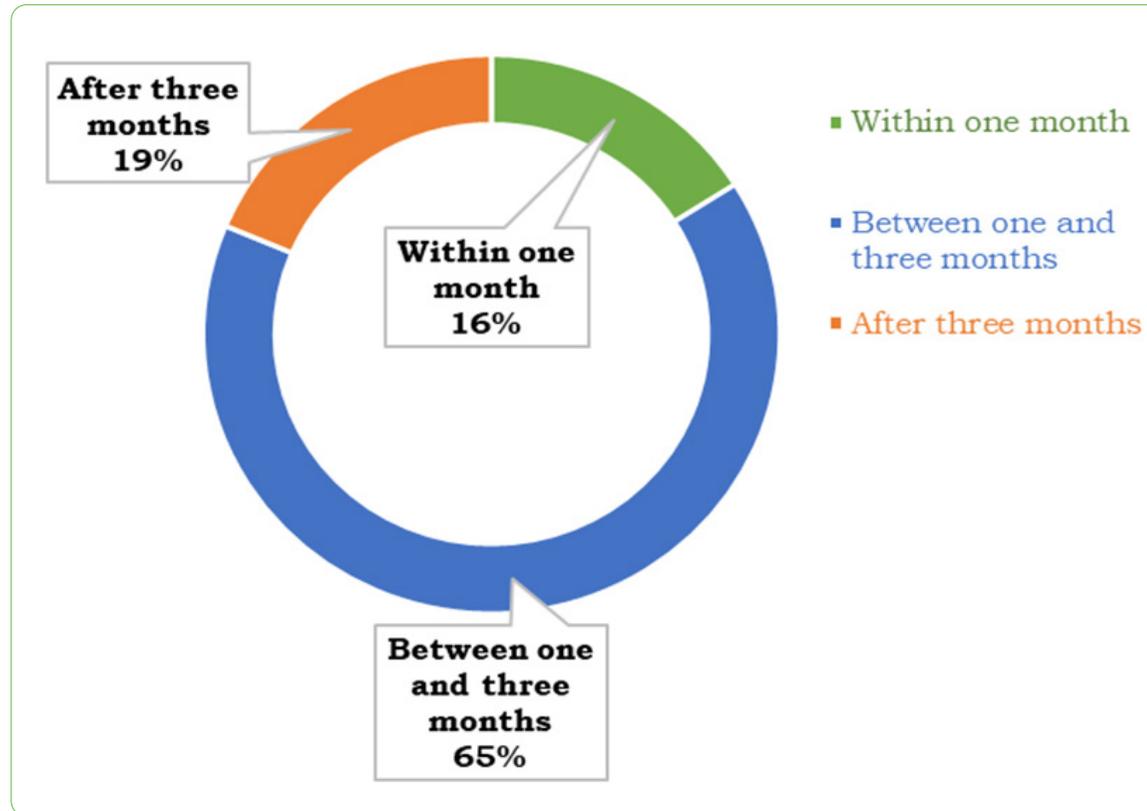


Figure 27: Duration for water use permit processing

III.4.4 Lakes Water Use Master Plan

A master plan for water use in 5 identified key Lakes namely Kivu, Burera, Ruhondo, Muhazi and Mugesera has been developed and validated by stakeholders. The Lakes Water Use Master Plan will serve as a guiding tool not only for water users but also for decision makers about suitability of different categories of activities, Lakes zoning, and equitable allocation of water resources. This Master Plan provides an in-depth analysis of the water resources in Rwanda, with a particular focus on the management of lakes and their associated ecosystems. The plan combines both secondary and primary data sources, utilizing a combination of desktop reviews and field surveys to gather comprehensive and reliable information.

III.4.5 Water Use Regulation

The new Ministerial Order relating to water resources use permit was gazetted. It determines activities, works, and installations subject to water resources use permit; as well as conditions and procedures for acquisition and use of water resources use permit, its extension and transfer.

III.4.6 Water Use Fees

The process of establishing water use fees has started. A study is ongoing for environmental, social and economic analysis in line with determining water use fees. SEI (Stockholm Environment Institute) has been recruited by the NDC Partnership on behalf of the Ministry of Environment and RWB.



III.5

Flood Management and Water Storage Development

Flood management and water storage development are critical components of sustainable water resource management, particularly in regions prone to climate variability and extreme weather events. Effective flood management involves designing and implementing infrastructure and practices that mitigate the impact of floods, protect communities, and preserve ecosystems.

This includes the construction of dykes, dams, and detention ponds, as well as the restoration of natural floodplains. Additionally, the construction of bridges, culverts, drainage channels, and the stabilization of river and gully banks are essential to ensure the safe passage of water and prevent erosion. Water storage development focuses on capturing and storing excess water during periods of surplus for use during times of scarcity.

Below are the key achievements of the year 2023-2024. Significant progress was made in the implementation of flood management and water storage initiatives, including construction works of flood control retaining walls on Sebeya river in Rubavu district, detention ponds for flood control in Cyuve gully (Musanze District), stone masonry flood wall along Kazirankara River in Nyabihu District, and flood control work in Volcano area: new Nyabutosha water channel downstream flood hotspot, Feasibility Study for Flood Control Measures in Volcano and Vunga Corridor, and construction of Muvumba Multipurpose dam & Hydropower plant installation.

III.5.1 Construction works of flood control retaining walls on Sebeya river in Rubavu district

The initiative to construct flood control retaining walls along the Sebeya River in Rubavu District emerged in response to the devastating flooding that occurred on 2nd and 3rd May 2023. This catastrophic event resulted in loss of lives, damage to public infrastructure, and destruction of local properties. The works were executed diligently, and the completion report reflects the successful construction of 960m of retaining walls, distributed across 7 hotspots, surpassing the initially planned 814m. The project has made commendable progress in addressing the immediate flood risks along Sebeya River.



Figure 28: Executed works along Sebeya River near Mahoko Bus Station

III.5.2 Construction of detention ponds for flood control in Cyuve gully, Musanze District

Heavy rainfall in the volcano area often results in floods. Whereas the observed floods may appear similar in nature, the dynamics of floods in the volcano area are quite different according to their locations: classic torrential rivers in the Musanze urban area (W4G, 2017). It is in this regard that the Rwanda Water Resources Board started to construct the flood control works in volcano area, where various structural and non-structural measures were constructed to mitigate flood risks and to optimize benefits from flood plains area.

It is in this context, the construction of flood control infrastructures (ponds, culverts, drainage channels and bridges) and gully buffer zone protection was implemented to in the targeted sub-catchments of Cyuve and Ruvumu some of the pictures highlighting the works on the critical sections of gullies to mitigate peak flows are given below. The overall progress of the project for the construction of the detention ponds along the Cyuve gully was at 70.8 % at the end of 2023/2024 FY.



Figure 29: Cyuve-Ruvumu detention pond (left) & Cyuve detention pond (Right)

III.5.3 Construction of flood control work in Volcano area: new Nyabutoshwa water channel downstream flood hotspot

The construction work for the New Nyabutoshwa Water Channel Downstream Flood Hotspot consisted of the implementation of engineering solutions to mitigate flood risks and protect the surrounding area, **The main tasks included the following;**

- i. Excavation of open canal on Nyabutoshwa downstream gully
- ii. Masonry work for open canal;
- iii. Construction of bridges at Rugezi and Gakoro
- iv. Construction of detention pond

III.5.4 Construction of stone masonry flood wall along Kazirankara River in Nyabihu District

The construction of a stone masonry flood wall along the Kazirankara River was completed to enhance flood protection. Kazirankara, located in the Shyira Sector of Nyabihu District, is where two streams, Gisoma and Nyagahondo, converge before flowing into the Mukungwa River. The river passes through Kanyamitana and Kintarure Cells and flows near GS Vunga and the IDP Model Village downstream, before joining the Mukungwa River. The catchment area of Kazirankara lies in a steep region, with hills featuring slopes as steep as 72%, which accelerates the speed of runoff in the area. The completed stone masonry flood wall is a crucial



Figure 30:
Constructed bridges at Rugezi and Gakoro



Figure 31:
Completed Masonry work for open canal (left) & constructed of detention pond (right)

measure to protect the school and the IDP Model Village from future floods.

III.5.5 Feasibility Study for Flood Control Measures in Volcano and Vunga Corridor

The study is part of the Volcanoes Community Resilience Project (VCRP) and aims to develop feasibility studies, as well as preliminary and detailed designs for flood control measures

in gullies, rivers, and streams. This will take into account land use changes and climate change across sub-catchments and rivers within the study area. The study area encompasses 43 level 3 sub-catchments in the Volcano area and the Vunga Corridor.

The major outputs of this study will include a feasibility study and detailed engineering designs for the proposed flood control measures. The study is ongoing and is currently in the hydrological and hydraulic modeling phase.

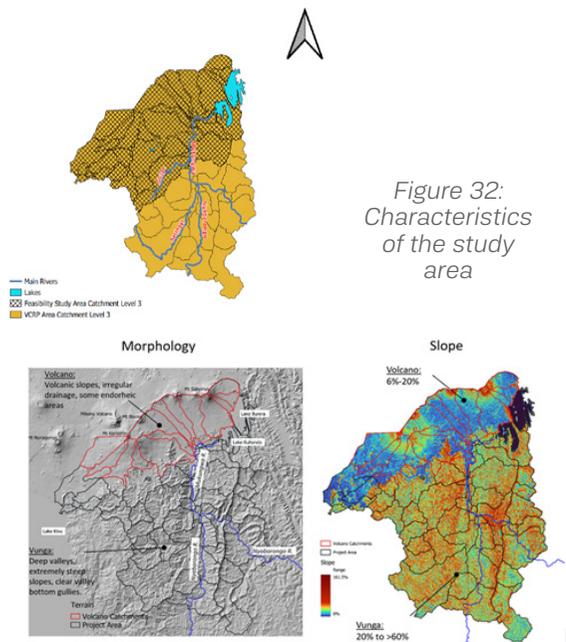


Figure 32: Characteristics of the study area

III.5.6 Muvumba Multipurpose dam & Hydropower plant installation Project

The Government of Rwanda has received financing from the African Development Bank for the implementation of the Muvumba Multipurpose Water Resources Development Program (MMWRDP). The program is being implemented in Nyagatare District by Rwanda Water Resources Board (RWB). Its main objective is to improve water, food, energy and nutrition security by harnessing water resources for irrigation, domestic, livestock and hydropower use while ensuring the sustainability of the resources and building resilience against climate change and variability through catchment protection, forest management and capacity development.

The first set of activities under the program i.e. the project is the construction of the Muvumba multipurpose dam including installation of the hydropower plant and preparatory studies for downstream investments for irrigation and livestock use.

The dam comprises several ancillary facilities/components such as the construction of contractor's camp site, five access roads, temporal disposal, borrow pits, dumping sites, batching/crusher plant and stone quarrying activities, construction of spillway, coffer dam as well as the upgrade and construction of 3 transmission lines to supply electricity to different construction components. **Figure 33** (left) illustrates all components of the dam while table 2 shows all the detailed dam characteristics.



Figure 33: Dam with its components

III.5.7 Progress on land acquisition for the project

The total area of land for the project is estimated to be 763.86ha. This area includes the additional land equivalent to 283.9 Ha due to the dam design review. This additional land comprises the area for the camp site, disposal area, dam buffer zone area to ensure its protection against sediments. This additional land area is progressively acquired through expropriation and cash compensation.

III.5.8 Progress on dam construction

The construction phase of the dam is ongoing since October 2023. The **table 6** below shows the status of dam components implemented to date:

Table 6: Progress on dam construction progress

Nr	Planned Activities	Implementation status
1	Construction of the camp with different facilities: accommodations, site offices, toilets, and laboratory	<ul style="list-style-type: none"> · Installation of external ceiling and eave board · Construction of windows and doors · Excavation of platforms in the camp site, casting concrete for steps and soil compaction · Painting weather guard of external walls, · Construction of polyethylene water tanks
2	Crusher/batching plant installation	Making concrete of foundation of crusher and assemblage of crusher plant in progress
3	Construction of access roads of the dam site	All the 5 roads have been established.
4	Main dam Ëupstream coffer dam construction	Excavation works ongoing
5	Diversion works	Excavation works for diversion conduits are ongoing
6	Borrow area sources	Soil tests have been conducted for a zone of 35ha which was already identified and expropriated before dam design review. The area is located in the dam reservoir. The area was confirmed by supervision consultant to be a borrow area for construction. Investigations are ongoing for other areas.
7	Temporal access road to the identified permanent disposal area	Construction is ongoing: grabbing works and addition of top layer of soil
8	Stone quarry site installation and operation	Fencing the site, and creation of drilling holes
9	Temporal storage area for construction materials	Clearing and grabbing works are ongoing to prepare the site.

III.5.9 Environmental and Social safeguard implementation status

To implement the project in an environmental and socially acceptable manner, several environmental and social mitigation measures

are being implemented in line to safeguard the environment and the community in the project area. Some include: control of construction dust by regular spraying of water on sites, establishing movable and temporal toilets on site with sanitation facilities, provide personal protective equipment (PPEs) to workers to

prevent occupational injuries and accidents, stationing flaggers and road signages to control traffic movement and conducting awareness sensitizations to the community and workers on communicable diseases prevention, traffic movement, providing drinking water to workers during working hours.

III.5.10 Mugogo lowland cave system and contributing sub-catchment analysis for flood control and land restoration of the upstream catchments



Figure 34: Mugogo flooding issues

The Mugogo lowland is a plain with no surface drainage system. It is regularly impacted by floods from the Nyarugunga stream (southern catchment) and the Kinoni River as indicated by **Figure 34**, Inflows from these two rivers are drained through 17 active sinkholes or lava tunnels in the basalt layer connected to the scoria layer. Despite installing gabion weirs before each sinkhole to filter sediment, they are regularly clogged.

Over time, their infiltration capacity tends to reduce significantly; some are not operational anymore. To understand the hydrological complexity of the area a study **“Mugogo lowland cave system and contributing sub-catchment analysis for flood control and land restoration**

of the upstream catchments” is being carried out with the following deliverables:

- i. *Identification study of critical catchment characteristics;*
- ii. *Modeling of critical hydrological and hydrogeological sub-systems;*
- iii. *Initial Designs and Impacts;*
- iv. *Final Report and tender files*

The study covers the three level 3 sub-catchments of Kinoni, Karago and Bikwi, all located in the western part of the level 1 Mukungwa catchment. More precisely, the work aims to examine flooding hotspots in the three sub-catchments identified as the five zones Mugogo lowland, Nyiragaju area, Bikwi area, Mutera area and Karisimbi

systems. The study analyses and understand the hydrological and hydrogeological dynamics of these five zones. It includes modelling to assess the impact of measures, including flood control and land restoration.

Identification study of critical catchment characteristics resulted in Mapping of catchment areas, hydrographic networks and sinkholes in the five hotspots zones: Mugogo lowland, Nyiragaju area, Bikwi area, Mutera area and Karisimbi systems. Instruments for hydro-meteorological measurements, such as rainfall, streamflow, sedimentation and sinkholes’ infiltration capacity were installed.

Land use and land cover mapping, hydrogeological investigations consisting of geophysical and drilling inspections and Topographical survey in the hotspot zones were carried out and reported. **Figure 35** shows the Mugogo lowland cave system and contributing sub-catchments.

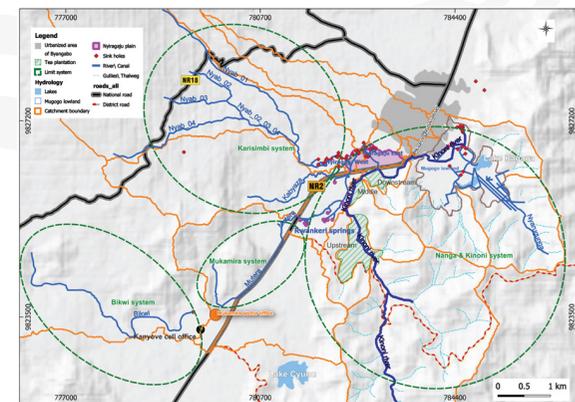


Figure 35: Mugogo lowland cave system and contributing sub-catchment

The Kinoni level 3 sub-catchment and Mugogo lowland, well known for their complexity, have been selected as pilot cases by the VCR project. The lowland is a plain in the Kinoni sub-catchment between Musanze and Nyabihu Districts. The lowland is subjected to repetitive flood events, contributing to mud flow logging, crops and human settlements destruction. Initial investigations show that the two other level 3 Bikwi and Karago sub-catchments are perceived to influence the Mugogo lowland through subsurface flows.

The hydrological and erosion modelling is performed on HEC-HMS Software. An erosion and sediment transport module has been added to the hydrological model. A semi-distributed and continuous model has been developed to simulate the dynamic of flows in the system contributing to Mugogo lowland. This model has been calibrated based on flow and sediment monitoring carried out during April to June 2023. **Figure 36** shows the simulated and observed hydrograph at Kinoni river.

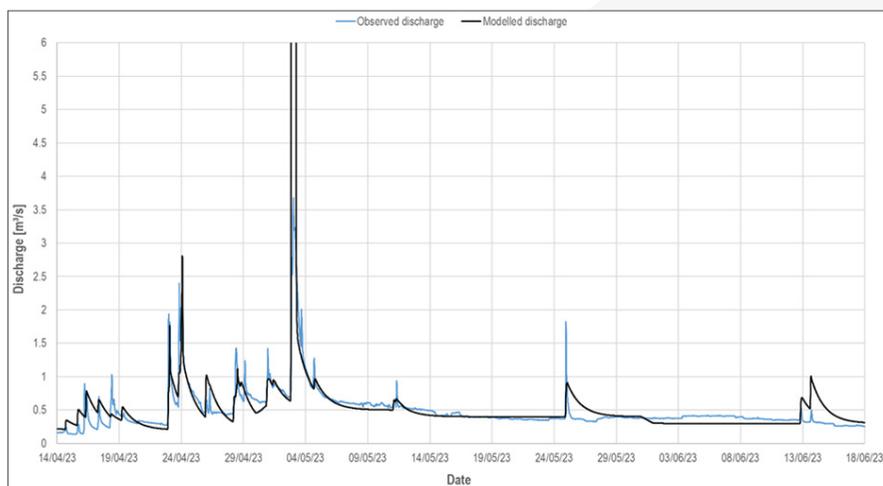


Figure 36: Modeled and observed discharges at KIN01 station

Results show that simulated peak discharges have the same pattern and magnitude as observed peak discharge.

The initial design report, containing proposed solutions for flood and sediment control while considering the existing catchment plans, recommendations from previous studies, flood mitigation, and sediment traps already implemented in the area, has been submitted by the consultant to RWB.

The proposed solutions are based on the following rationale:

- decreasing runoff and sediment production in the upstream reaches of the watershed through sustainable land management (SLM) practices such as agroforestry, vegetation strips, possibly stone bunds, minimum tillage, and the stabilization and rehabilitation of gullies, riverbanks, and landslides.

- Additionally, the solutions include partial storage of runoff and sediment control, ensuring safe downstream conveyance, and infiltration. The potential of combining Nature-Based Solutions (NBS) with grey structures, such as wooden barriers or gabion check dams with artificial groundwater recharge, has been studied.

- However, due to the magnitude of the problems, conventional solutions like detention dams have also been investigated. The detailed design and costing of the proposed flood and erosion control measures are expected to be finalized in the fiscal year 2024/2025.

III.6

Corporate Services

As part of strengthening the RWB's Human Resources, RWB submitted an updated structure for its SPIU to MIFOTRA. The submitted SPIU structure was approved and is composed of 35 positions. This was in line with the implementation of cabinet resolution of June 6, 2023 approving the new single project implementation unit (SPIU)

framework. In addition, during FY of 2023-2024, RWB convened a general staff meeting and the best professional and ethical employee of the FY 2023-2024 was selected and awarded. Godfrey MUSAFIRI who is the River Flood Control Specialist Team Leader in Rwanda Water Resources Board was selected as the employee of year.







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