C C O A I B

Conseil de Concertation des Organisations d'Appui aux Initiatives de Base

Report of Assessment of the Irrigation Scheme Management Model: Identifying Gaps, Challenges and Strategies for Improvement.

May, 2023

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EXECUTIVE SUMMARY

The efficient management of irrigation scheme infrastructures is pivotal in ensuring food security and sustainable agricultural development. The government of Rwanda, in collaboration with various development partners, has undertaken extensive efforts to modernize agriculture through irrigation scheme development, aiming to improve farmers' livelihoods, promote sustainable agriculture, and stimulate economic growth. CCOAIB, an umbrella organization for NGOs in development, has been instrumental in advocating for sustainable agriculture, good governance, climate resilience, and financial access. They have conducted research to support evidence-based advocacy.

In districts such as Kamonyi and Kirehe, the improved performance of irrigation schemes could have a substantial impact on the livelihoods of local farmers and contribute to economic prosperity. The irrigation schemes have the potential to significantly increase crop yields, reduce vulnerability to weather fluctuations, and enhance the resilience of smallholder farmers. For this, the Assessment of the Irrigation Scheme Management Model was commissioned to comprehensively assess the irrigation management model, identifying the challenges and gaps, and come up with practical recommendations for their improvement. The data collection included desk and content analysis of existing data, key consultations with individuals involved and the use of mixed-structured and open-ended questionnaires covering various aspects such as socio-economic characteristics, current irrigation scheme infrastructure management, stakeholder involvement, beneficiaries' suggestions, and focus group discussions.

The findings indicate that a majority of respondents perceive the scheme as effective, with approximately 79.17% suggesting that the model may have successfully met their needs and expectations. The analysis of the strengths of the irrigation scheme management model reveals several key factors contributing to its effectiveness. Community participation stands out as a significant factor, accounting for more than a quarter of the overall strength. If this strength is built upon, it should, in the long run, lead to local farmers' active involvement in the management and decision-making processes, which can lead to a greater sense of ownership and, consequently, more successful outcomes. The weaknesses identified in the irrigation scheme management model highlight various challenges that significantly affect agricultural production. The most prominent issue, as reported by beneficiaries, is inadequate infrastructure maintenance and upgrade, accounting for 25% of the identified weaknesses. This is likely due to the substantial investment required, especially for urgently needed improvements and repairs to the physical components of the irrigation system to prevent breakdowns and inefficiencies. Furthermore, technology-related problems, which constitute 20% of the identified weaknesses, underscore the importance of investing in modern irrigation technology to optimize water usage and crop yields.

To enhance the functionality of irrigation schemes, actions such as infrastructure investment become a top priority. This should focus on maintenance and upgrades to minimize water losses and improve distribution. Capacity building through technical training and extension services can empower farmers with the skills and knowledge needed for efficient irrigation practices. Effective governance structures (well-designed and functional systems for decision-making, oversight, and management), involving various stakeholders in decision-making, can strengthen the overall management of irrigation schemes. Robust data collection and monitoring systems must be established to track scheme performance, water usage, and crop yields. Promoting climate-resilient practices, including erosion control and construction of buffer zones around irrigation schemes, applying proposed improvement for enhanced functionality, is vital achieve the desired results.

By addressing these gaps, overcoming challenges, and capitalizing on opportunities highlighted in this assessment, the irrigation scheme management models in Kirehe and Kamonyi can be significantly improved. This will lead to sustainable agricultural production, food security, and the economic well-being of local communities.

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ABBREVIATIONS

CBO : Community-Based Organisations

CCOAIB : Conseil de Concertation des Organisations d'Appui aux Initiatives de Base

GDP : Gross domestic product

GoR : Government of Rwanda

Ha : Hectare

ISM : Irrigation Scheme Management

IWUA : Irrigation Water User Associations

MINAGRI : Ministry of Agriculture and Animal Resources

MINICOM : Ministry of Trade and Industry.

MoE : Ministry of Environment

NAEB : National Agricultural Export Development Board

NAKL : Nile Basin Akagera Lower

NAKN : Nile Basin Akanyaru

NAKU : Nile Basin Akagera Upper

NGO : Non-Governmental Organizations

NISR : National Institute of Statistics of Rwanda

NNYL : Nile Basin Nyabarongo Lower

RAB : Rwanda Agriculture and Animal Resources Development Board

RCA : Rwanda Cooperative Agency

REMA : Rwanda Environment Management Authority

RWB : Rwanda Water Resources Board

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CHAP I: BACKGROUND

The efficient management of irrigation scheme infrastructures is pivotal in ensuring food security and sustainable agricultural development. The government of Rwanda, in collaboration with various development partners, has undertaken extensive efforts to modernize agriculture through irrigation scheme development, aiming to improve farmers' livelihoods, promote sustainable agriculture and economic growth.

Recognizing the importance of the agriculture sector, CCOAIB, established in 1987 as an umbrella organization for national non-governmental organizations (NGOs) in the development sector, has played a significant role in advocating for policies that promote sustainable agriculture, good governance, climate resilience, and access to finance. CCOAIB has also conducted extensive research and studies, providing a strong foundation for evidence-based advocacy, particularly in the aforementioned components.

Similar to other agricultural initiatives, irrigation scheme infrastructure plays a crucial role in enhancing agricultural productivity and supporting agricultural transformation efforts. In districts such as Kamonyi and Kirehe, the improved performance of irrigation schemes could have a substantial impact on the livelihoods of local farmers and contribute to economic prosperity. The Irrigation schemes have the potential to significantly increase crop yields, reduce vulnerability to weather fluctuations, and contribute to the resilience of smallholder farmers in Kamonyi and Kirehe District. The GoR's plan is to expand irrigated areas to 102,284 ha by 2024, which is outlined in the PSTA-4[1]. Currently, the national irrigation coverage is estimated to be 66,840 ha[2]. The Irrigation Master Plan[3] identifies districts with a lot of potential for expanding irrigation to achieving the NST-1 and Vision 2050 development goals. Right now, Kirehe district has nearly 20 irrigation schemes, covering a total of 3,433 ha[4], and Kamonyi has nearly 8 irrigation schemes, covering a total of 1,309 ha[5]. These schemes involve more than 10,000 and 8,613 farmers[6], respectively, as farmers' beneficiaries.

The present management model in the highlighted irrigation schemes may exhibit numerous shortcomings in meeting user expectations. These limitations may hinder the realization of the full potential of the irrigation schemes and have broader implications for crop production and the socio-economic development of the beneficiaries. For instance, inefficiencies in water distribution and infrastructure maintenance, suboptimal water allocation practices, and the absence of a comprehensive monitoring and evaluation system not only reduce the effectiveness of irrigation but also generate conflicts among local farmers over resource allocation (water).

To better serve the needs of the Kamonyi and Kirehe districts and their irrigation scheme users, comprehensive evaluation of the existing model is necessary. This evaluation will help identify areas for

[1] MINAGRI (2018). Strategic Plan for Agriculture Transformation – Phase 4, 2018 – 2024. Ministry of Agricultureand Anima Resources.
[2] MINAGRI (2021). MINAGRI Annual Report for FY2020/21. Ministry of Agriculture and Animal Resources (MINAGRI).Republic of Rwanda.
[3] MINAGRI (2020). Rwanda Irrigation Master Plan. Ministry of Agriculture and Animal Resources (MINAGRI). Republic of Rwanda.
[4] Estimated from existing documents and CCOAIB collected data
[5] Estimated from existing documents and CCOAIB collected data
[6] Estimated from existing documents and CCOAIB collected data

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improvement and innovation. By addressing these areas, it is possible to create a more resilient and efficient irrigation scheme management model that can significantly contribute to sustainable development and food security in these districts. In the following sections of this assessment, we will delve deeper into the gaps and opportunities in the current irrigation scheme infrastructure management model, explore the challenges encountered during its implementation, and provide detailed recommendations for an improved and more effective system that can better support the agricultural sector in Kamonyi and Kirehe District.

1.1 Objective of the assessment

The main objective of this consultancy assignment was to comprehensively assess the former irrigation management model, identify challenges and gaps, and formulate practical recommendations for improvement.

The focus of the assessment was on two specific districts: Kirehe in the Eastern province and Kamonyi in the Southern province, and aimed to analyse both qualitatively and quantitatively the issues within the irrigation schemes management. It gathered data on the past state of irrigated schemes, with a strong emphasis on utilizing respondent testimonies to capture valuable insights. The ultimate goal was to determine the areas that required enhancement in the previous irrigation scheme infrastructures management model and address the challenges in its implementation, ultimately proposing improvements for more effective functioning.

The specific objectives were as follows:

Specific objective 1: Assess Current Irrigation Scheme Infrastructure Management:

- Evaluate the existing management model of irrigation schemes in the Kirehe and Kamonyi districts, focusing on their strengths, weaknesses, opportunities, and threats.
- Identify the key stakeholders involved in the management of irrigation infrastructure and their roles.

Specific objective 2: Identify gaps, challenges and opportunities

- Identify and document the gaps, challenges and opportunities in the implementation of the current irrigation scheme management model.
- Determine the primary obstacles that hinder the effective functioning of irrigation schemes in Kirehe and Kamonyi districts.

Specific objective 3: Propose improvements for enhanced functionality

- Develop feasible recommendations and strategies to address the weaknesses and gaps identified in the current irrigation management model.
- Suggest innovative approaches and improvements for better functionality, sustainability, and productivity of irrigation schemes.

Specific objective 4: Provide actionable insights:

- Produce a comprehensive assessment report that presents actionable insights into the current state of irrigation scheme management in Kirehe and Kamonyi districts.

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- Offer recommendations that can guide policy-making and decision-making processes for improved irrigation management.

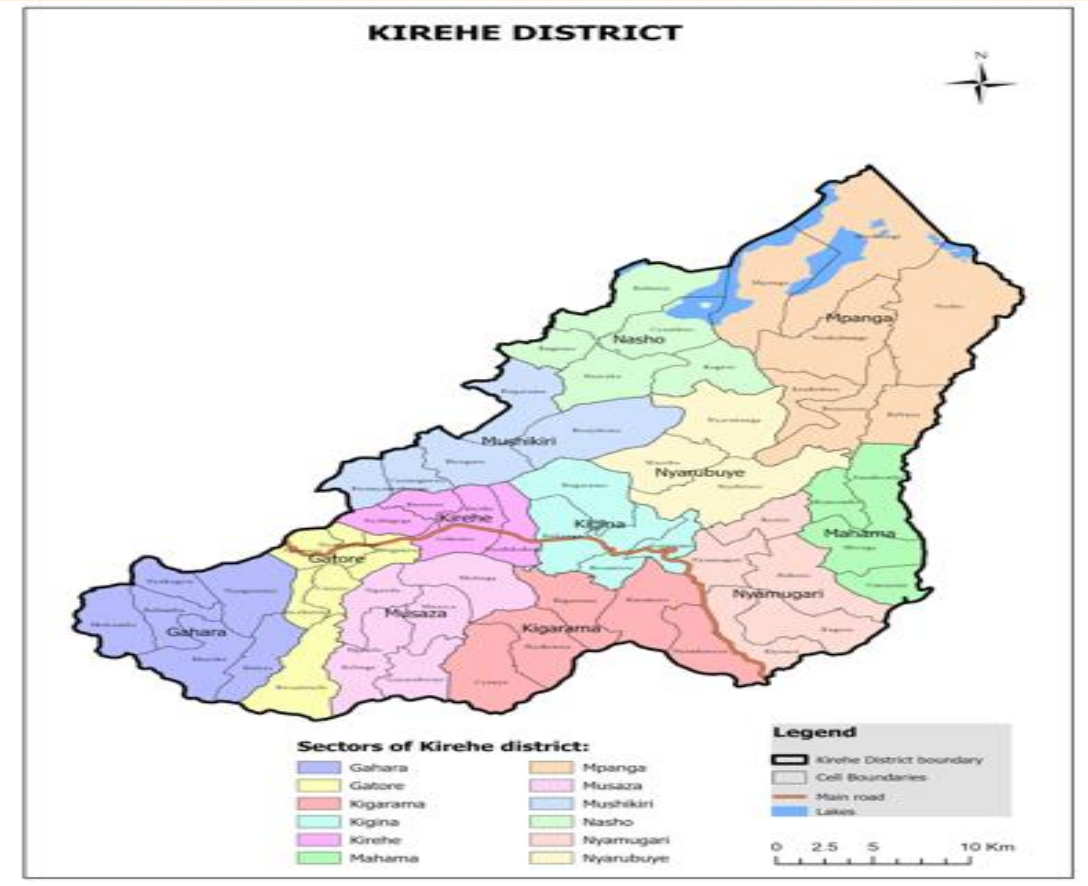
1.2 Brief description of the study area

1.2.1 Profile of KIREHE District

Kirehe District, in the Eastern Province, comprises 12 sectors, 60 cells, and 612 villages. It shares borders with Tanzania to the East (Ngara and Karagwe districts), Burundi to the south, Ngoma District to the South-West, and Kayonza District to the North. The district's terrain is a low plateau with an average altitude of 1,500 m, and the Akagera River serves as its primary water source. The population figure of 460,860 is composed of 221,763 males and 239,097 females[7].

Kirehe District has a favorable climate, which allows its agricultural activities and experiences four distinct annual seasons, heavily relying on rainfall-dependent agriculture. The district's average annual temperature is 19.4°C, with 898mm of precipitation[8]. Its topography features undulating hills separated by valleys, offering potential for modern irrigation systems and mechanized agriculture.

Although the district's economy primarily depends on agriculture, it is not yet fully modernized, resulting in relatively low productivity. Key crops grown in the district include bananas, beans, rice, and pineapples.



Map 1: Kirehe District in eastern province

7 Rwanda Statistical Year book 2022
8 Kirehe District Development Strategy 2018

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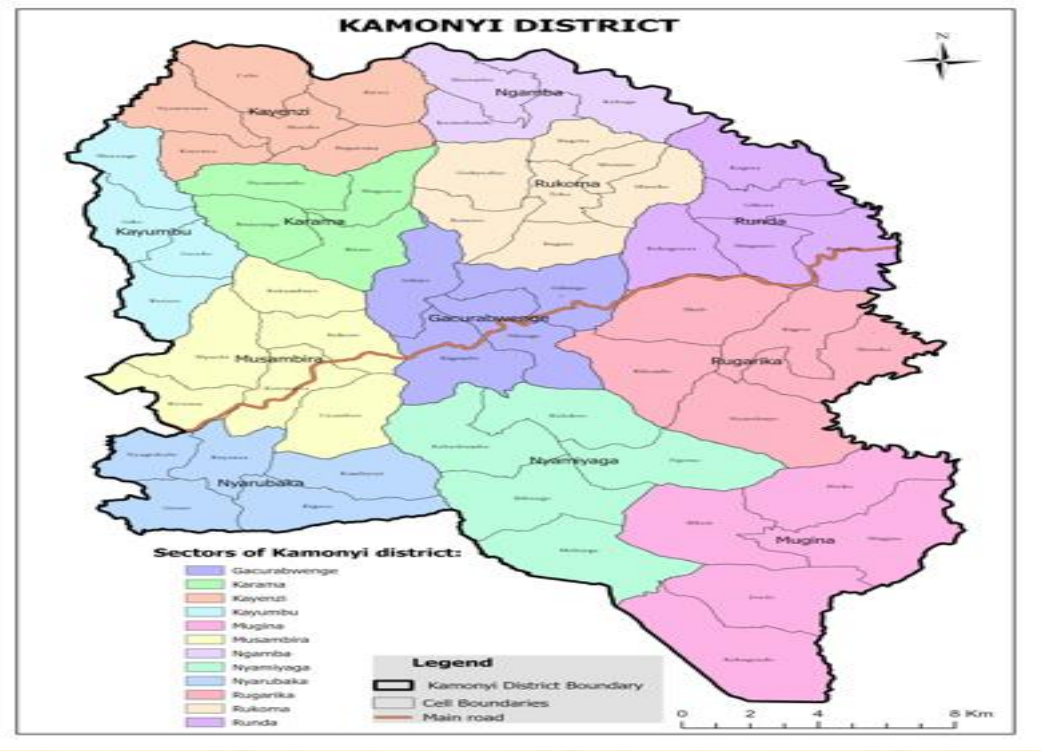
1.2.2 Profile of KAMONYI District

Kamonyi District, located within the Southern Province of Rwanda, constitutes one of the eight districts in this province. Comprising 12 sectors, namely Gacurabwenge, Karama, Kayenzi, Kayumbu, Mugina, Musambira, Ngamba, Nyamiyaga, Nyarubaka, Rugarika, Rukoma, and Runda, the district is further subdivided into 59 cells and 317 villages. The district's population stands at 450,849 individuals, with 217,570 males and 233,279 females[9]. Kamonyi District shares its boundaries with Ruhango District to the South, Muhanga District to the West, Bugesera and Nyarugenge Districts to the East, and Gakenke and Rulindo Districts to the north.

Kamonyi District benefits from a moderate climate, characterized by ample rainfall, with humidity levels ranging from 1,200 to 1,400 mm and an average temperature of 20°C[10]. The district's topography consists of a low-lying plateau, though the western portion is more mountainous. It is drained by the Nyabarongo River in the East and North, and the Akanyaru River, forming its eastern border. Additionally, numerous smaller water sources, including Kayumbu, Bakokwe, Gikoro, Mukunguri, Nyabuvomo, Bishenyi, Gatimbazi, and Ruvubu, collectively offer approximately 843 water sources.

Geographically, Kamonyi District is primarily situated on a low-lying plateau, ranging from 1,500 to 2,000 m in altitude. The district's soil is predominantly humus-rich, permeable, and fertile, contributing to the steady increase in agricultural productivity. Nevertheless, the region faces challenges related to soil erosion and over-exploitation, mainly due to demographic pressures. The district's economy is primarily based on the traditional agriculture and livestock sectors. Key crops grown in Kamonyi District include maize, beans, cassava, rice, soybeans, various vegetables, and bananas.



Map 2: Kamonyi district in south province

[9] Rwanda Statistical Year Book, 2022
[10] Kamonyi District Development Strategy 2018-2024

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1.2.3 Irrigation Schemes Overview in Kirehe and Kamonyi District

Kirehe and Kamonyi districts in Rwanda are situated in different regions and have varying priorities when it comes to the development of irrigation schemes, as outlined in the Rwanda Irrigation Master Plan. Rwanda is divided into nine catchments, and three of them have been prioritized for the advancement of irrigation schemes. These priority catchments are the Nile Basin Muvumba (NMUV), Nile Basin Akagera Upper (NAKU), and Nile Basin Akagera Lower (NAKL). Kirehe is located in two of these priority catchments, namely NAKU and NAKL, while Kamonyi is situated in Nile Basin Nyabarongo Lower (NNYL) and Nile Basin Akanyaru (NAKN) catchments. Annual rainfall in Rwanda is categorized into three priorities: Priority 1 (up to 850mm), Priority 2 (850mm – 1100mm), and Priority 3 (above 1100mm). Areas with lower rainfall are considered to have higher irrigation potential. Kirehe district falls into Priority 1, while Kamonyi district falls into Priority 2. These differences explain why Kirehe has more irrigation schemes than Kamonyi, making it an area with higher irrigation potential.

Most publicly funded irrigation schemes in Rwanda have been designed to be gravity-fed in order to reduce energy consumption and operational costs. While it is possible to recover operation and maintenance costs, recovering the investment costs in public irrigation schemes has proven to be challenging. Water fees are currently very low, and they do not even cover the operation and maintenance costs. Public investment in irrigation infrastructure is generally seen as a "public good," as the cost of storage and conveyance is often beyond the means of the beneficiaries. The recovery rates for operating and maintenance costs in public schemes depend on the "willingness to pay," which, in turn, is influenced by the net returns farmers earn from their crop production. These returns are based on target yields and effective utilization of their plots throughout the year.

In Kirehe, most irrigation schemes are gravity-fed marshlands, with relatively few areas of level land that are not marshy, allowing for large-scale irrigation schemes. These non-marshy areas are typically grouped with hillside irrigation schemes, such as Nyamugali, Kinoni-1, and Kinoni-2. There are also a few pumped schemes like Mpanga-1&2. In contrast, Kamonyi relies solely on gravity-fed marshland for its irrigation needs.

Unfortunately, many of the established irrigation schemes in both districts suffer from low performance, low water uses efficiencies, and low production levels, leading to reduced productivity and incomes for farmers. Some irrigation infrastructures, including dams and field networks, remain underutilized or idle.

The institutional framework established under the Water Resources Management Program (WRMP) involves several ministries and affiliated agencies, including MoE, MINAGRI, MINECOFIN, MININFRA, MoH, MINALOC, MINICOM, MINEDUC, MIGEPROF, MoD, RDB, and more. These ministries have specific roles and responsibilities in water resources management. However, the coordination among these institutions remains inadequate[11].

[11] MINAGRI (2020). Rwanda Irrigation Master Plan. Ministry of Agriculture and Animal Resources (MINAGRI). Republic of Rwanda.

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CHAP II: APPROACH AND METHODOLOGY

2.1 The approach and methods for the assessment.

The approach and methods employed in data collection for the assessment of the Irrigation Scheme Management Model to identify gaps, challenges, and strategies for improvement, as well as the testimonies in irrigation management and the proposed management model improvement required in the irrigation scheme in Kamonyi and Kirehe districts, were necessary. Consequently, in response to the study's specific objectives, various sources and categories of data were gathered.

(1) A desk and content analysis of existing relevant secondary data was conducted to inform the objectives of this study. This analysis included the examination of existing reports from relevant institutions, such as MINAGRI, RAB, NAEB, NISR, RWB, Kirehe, and Kamonyi Districts, as well as CCOAIB. Additionally, the existing dataset on irrigation schemes and surveys previously conducted by CCOAIB and other agencies was also reviewed

(2) Key consultations were carried out with individuals involved in the day-to-day management of these infrastructures. This included personnel at the irrigation scheme level, related agencies, and local decentralized levels (e.g., Staff from RAB, NAEB, RCA), as well as at the district level (e.g., agronomists, technicians, and officials in charge of cooperatives).

(3) A mixed-structured and open-ended questionnaire was employed to collect the necessary data for assessing the management models of the sampled irrigation schemes. Some of the questions were organized into categories such as:

- ***Socio-economic characteristics of the respondents***: included information on age, level of education, occupation, and geographical location.
- ***Assess Current Irrigation Scheme Infrastructure Management***: The information, such as equity in water distribution, the efficiency of water usage to minimize waste, the sustainability of water management, and transparency in the allocation of water resources, was gathered. Opportunities for improvement were identified, and strengths and weaknesses of the existing model were evaluated. The timing of maintenance, flexibility in water usage and how to address water unavailability or insufficiency during scheduled irrigation times and how to handle members who damaged irrigation structures were examined in detail.
- ***Stakeholder Involvement***: The information and data on key stakeholders involved in the management of irrigation schemes in the Kirehe and Kamonyi districts were gathered. Subsequently, the respective roles of these stakeholders were profiled, highlighting those who are perceived to have a more active role, as well as those who are currently not involved, according to the perspective of the irrigation scheme beneficiaries. Additionally, we assessed the level of stakeholder satisfaction, as well as the extent and quality of communication and collaboration within the irrigation scheme management model.
- ***Water fee management:*** The information regarding water payment modalities, the management of water fees, and the intended purposes for which water fees were to be used, as well as the purposes for which they should not have been used, was gathered during the assessment.
- ***Opportunity identification***: The untapped opportunities or potential areas for improvement in the current irrigation scheme management model were assessed. The best practices and successful experiences within the scheme that could be shared with other scheme

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operators to enhance irrigation management were also profiled. Furthermore, the best practices and successful experiences from other schemes, regions, or countries that could be adapted to enhance the irrigation management model of the existing schemes were explored.

- ***Beneficiaries suggestions***: Beneficiaries' suggestions, including specific actions or changes recommended by water users, were gathered with the intention of presenting them to policymakers and other stakeholders for the enhancement of irrigation scheme management model.
- ***Focus group discussions and key informant interviews****:* Focus group discussions and key informant interviews were organized with various stakeholder groups, including farmer cooperatives, water user associations, and community leaders. These discussions provided a deeper understanding of community needs and aspirations. Additionally, key informant interviews were conducted with stakeholders at district and sector levels, as well as technicians in agriculture, using interview guides designed for collecting that information. In total 9 FGD and KII and 6 FGDs and KIIs were conducted in Kirehe and Kamonyi respectively.

PHOTO 1:DATA COLLECTION SESSION

PHOTO 2: PHOTO TAKEN DURING DATA COLLECTION

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(4) **Survey KOBO Toolbox:** The questionnaire was programmed and formatted using the electronic survey software Survey Kobo Toolbox. This software platform was installed on handheld mobile devices of data collectors and was used for data collection and management. Kobo Toolbox-enabled mobile devices were connected to a data server to improve real-time field data collection and eliminate several shortcomings and errors during data collection and data entry.

2.2 Sampling and categorization

In order to assess the irrigation scheme management models in Kirehe and Kamonyi districts, representative samples were selected, taking into account geographical representativeness and the potential sizes, diversity of irrigation scheme and number beneficiaries in each irrigation scheme and the desired level of statistical significance. Kirehe district had approximately 20 irrigation schemes, totaling nearly 3,433 ha[12], while Kamonyi district had around 8 irrigation schemes, covering a total of 1,309 ha[13].

The appropriate sample size for this assessment was determined using the following formula:

$$\text{Sample Size (n)}^{14} = [Z^2 * p * (1 - p)] / E^2$$

Where:

- **n** is the required sample size.
- **Z** is the Z-score corresponding to the desired confidence level (for a 95% confidence level, Z ≈ 1.96).
- **p** is the estimated proportion of the population that exhibits the behaviour interested in. For this study, it was assumed p=95%, which maximizes the sample size for a given margin of error.
- E is the desired margin of error (expressed as a decimal). (e.g., 5% margin of error corresponds to E = 0.05, for 4.5% E= 0.045).

Applying the formula, the total number of interviewed beneficiaries was calculated as follows:

$n = [1.96^2 * 0.95 * (1 - 0.95)] / (0.045)^2$ so calculate the sample size became

$n = (3.8416 * 0.95*0.05) / 0.002025$

n = 90.1 almost 91 beneficiaries

To ensure a more representative sampling, we classified all irrigation schemes based on the number of beneficiaries within Kirehe and Kamonyi districts. Each class was then represented by a single irrigation

[12] Estimated from existing documents and CCOAIB collected data
[13] Estimated from existing documents and CCOAIB collected data
[14] Fundamental concept in statistics and research methodology, https://www.quora.com/What-is-the-author-name-and-original-source-of-the-following-Sample-Size-Formula-Sample-Size-n-N-Z2-p-1-p-e2-N-1-Z2-p-1-p-e2

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scheme. The table below illustrates the classification of all irrigation schemes according to the respective districts.

TABLE 1: SAMPLE CLASSIFICATION IN KIREHE DISTRICT[15]

Classification-1:	1 to 200 beneficiaries	**Classification-4:**	401 to 600 beneficiaries	**Classification-7:**	1,001 to 1,100 beneficiaries
Classification-2:	201 to 300 beneficiaries	**Classification-5:**	601 to 800 beneficiaries	**Classification-8:**	1,101 to 1,200 beneficiaries
Classification-3:	301 to 400 beneficiaries	**Classification-6:**	801 to 1,000 beneficiaries	**Classification-9:**	>1,200 Beneficiaries

TABLE 2: SAMPLE CLASSIFICATION IN KAMONYI DISTRICT[16]

Classification-1:	1 to 600 beneficiaries	**Classification-3:**	1001 to 1100 beneficiaries	**Classification-5:**	1,301 to 1,500 beneficiaries
Classification-2:	601 to 1000 beneficiaries	**Classification-4:**	1101 to 1300 beneficiaries	**Classification-6:**	>1,500 beneficiaries

Using the sample size formula provided above and taking into account the specified classes, approximately 9 irrigation schemes were chosen for interviews in Kirehe, while roughly 6 irrigation schemes were selected for farmer interviews in Kamonyi District. The table below displays the list of selected irrigation schemes for information collection.

TABLE 3: SELECTED IRRIGATION SCHEMES IN KIREHE

No	Name of Irrigation Scheme	Estimated number of beneficiaries	Classification
1	Binoni	942	Class 6
2	Nyamugali	481	Class 4
3	Kinoni-1	263	Class 2
4	Kinoni-2	320	Class 3
5	Mpanga Lot-1	300	Class 2
6	Mpanga Lot-2	182	Class 1
7	Cyunuzi-2	984	Class 6
8	Cyunuzi-1	1,309	Class 9
9	Kinnyogo	771	Class 5

TABLE 4: SELECTED IRRIGATION SCHEMES IN KAMONYI

No	Name of Irrigation Scheme	Estimated number of beneficiaries	Classification
1	Bishenyi	537	Class 1
2	Gikoro	964	Class 2
3	Kibuza	1,281	Class 4
4	Ruboroga	1,442	Class 5
5	Kayumbu	1,067	Class 3
6	Mukunguri	2,198	Class 6

[15] Classification made by the consultant
[16] Classification made by the consultant

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The following are the estimated numbers of interviewers assigned to each selected district, corresponding to the irrigation scheme classification:

TABLE 5: ESTIMATED NUMBER AT EACH SELECTED DISTRICT

District	Number Scheme	Number of people interviewed	Name of Scheme	Estimated number of beneficiaries	Classification	Number	Number of IWUA interviewed	Number of coop. interviewed
KIREHE	8	55	Binoni	942	Class 6	9	6	3
			Nyamugali	481	Class 4	5	3	2
			Kinoni-1	263	Class 2	3	2	1
			Kinoni-2	320	Class 3	3	2	1
			Mpanga -1	300	Class 2	3	2	1
			Mpanga-2	182	Class 1	2	1	1
			Cyunuzi-2	984	Class 6	10	7	3
			Cyunuzi 1	1,309	Class 9	12	8	4
			Kinnyogo-1 &2	771	Class 5	8	5	3
SUB TOTAL	**8**	**55**	**Total**	**5,552**		**55**	**36**	**19**
KAMONYI	6	42	Bishenyi	537	Class 1	3	2	1
			Gikoro	964	Class 2	5	3	2
			Kibuza	1,281	Class 3	8	5	3
			Ruboroga	1,442	Class 4	8	5	3
			Kayumbu	1,067	Class 5	6	4	2
			Mukunguri	2,198	Class 6	11	7	4
SUB TOTAL	**6**	**41**	**TOTAL**	**7,489**		**41**	**26**	**15**
GRAND TOTAL	**14**	**96**		**13,041**		**96**	**62**	**34**

2.3 Analytical process

The analytical process for this survey data involves a structured approach, including data cleaning and preparation, exploratory data analysis, categorization, statistical analysis, and data visualization. The data collected from the irrigation schemes survey was analyzed using SPSS, STATA, and Advanced Excel. Additionally, the triangulation method was employed in the data analysis to ensure the accuracy of the conclusions and recommendations.

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CHAP III: ANALYSIS OF ISM MODEL IN KIREHE AND KAMONYI DISTRICT

3.1 Community-Based Irrigation Management in Kamonyi and Kirehe Districts

The management of irrigation schemes in Kamonyi and Kirehe districts follows a community-based approach, where farmers are organized into Irrigation Water User Associations (IWUAs) and cooperatives. These two distinct organizational structures work closely together to ensure effective irrigation system management. The primary purpose of IWUAs is to represent the interests of water users, overseeing equitable water distribution and efficient system operation. IWUAs handle tasks such as collecting water fees, maintaining infrastructure, and implementing agreed-upon schedules. They are registered within RGB, and their membership comprises farmers reliant on the system for their agricultural needs. Generally, IWUAs do not own the land or infrastructure but hold rights to access and utilize them. Additionally, there is a shared membership between Cooperatives and IWUAs.

On the other hand, cooperatives in irrigation schemes are established by individuals engaged in collective agricultural activities. While these cooperatives frequently play a role in irrigation, their focus extends beyond water management. They involve broader economic and social objectives, incorporating various aspects of agriculture such as joint purchasing, marketing, and resource-sharing.

The government, through the aforementioned districts, has been actively promoting irrigation schemes as part of its comprehensive strategy to modernize agriculture, enhance food security, improve crop yields, and mitigate the impact of climate change. Investments have been made in canals, water storage reservoirs, and distribution systems, empowering farmers to efficiently access and manage water resources.

Furthermore, training and capacity-building programs, facilitated by the Rwanda Agriculture and Animal Resource Development Board (RAB) and other stakeholders, have educated participating farmers on farmer's organization. The work specifically involves the establishment of Irrigation Water User Associations and the implementation of appropriate crop rotation practices. However, farmers still lack skills in efficient water use, sustainable irrigation techniques, and climate adaptation and mitigation measures, posing challenges to the long-term sustainability of the irrigation scheme management model. The following photos provide a visual representation of the current state of irrigation schemes in the mentioned districts.

PHOTO 3: GIKORO IRRIGATION SCHEME[17]

[17] Photo taken during data collection for this assessment

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PHOTO 4: CURRENT STATE OF KIBUZA AND RUBOROGA IRRIGATION SCHEME CHANNELS IN KAMONYI[18]

PHOTO 5: STATE OF CHANNELS IN RUBOROGA IRRIGATION SCHEME[19]

3.2 SWOT analysis done for Kamonyi and Kirehe irrigation schemes

Generally, a comprehensive understanding of internal and external factors was achieved through focus group discussions and key informant interviews. The findings are presented in the table below to

[18] Photo taken during data collection for this assessment.
[19] Photo taken during data collection for this assessment.

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contribute to the advancement of the irrigation scheme management model in Kirehe and Kamonyi Districts.

TABLE 6: SWOT ANALYSIS

STRENGTH	WEAKNESS
• Both districts benefit from being situated in different prioritized catchments, providing a range of water sources and irrigation opportunities. • Both districts are located in areas with lower rainfall; hence, they are considered to have higher irrigation potential. • Gravity-Fed Systems: The emphasis on gravity-fed systems in both districts helps reduce energy consumption and operational costs, contributing to sustainable and cost-effective irrigation. • Community Involvement: The scheme involves active participation farmers and collaboration with local communities • Infrastructure Development: Initial investment in infrastructure is done in different area that need only replacement for old material, maintenance or rehabilitation • Presence of Irrigation Water User Association and cooperatives	• Established irrigation schemes in both districts suffer from low performance, indicating potential technical, operational and management challenges. • Inefficiencies in resource utilization, such as certain irrigation infrastructures like dams, and an idle canal network due to scarce water, are evident. • Aging or inadequate infrastructure, such as outdated/expired vanes, outlets, pipes, pumps, or canals, leading to inefficiencies in water distribution. • Lack of access to modern and efficient irrigation technologies may hinder optimal water use and crop yield. • Insufficient training and capacity-building programs for farmers and irrigation system operators • Limited funding for maintenance, repairs, and upgrades leading to deteriorating infrastructure and reduced effectiveness of the irrigation system • Weak governance structures leading to poor decision-making, lack of transparency, and difficulties in managing (fees) and maintaining the irrigation systems. • Inefficient water management practices taking into account eco system and climate practices
OPPORTUNITIES	**THREATS**
• Maximization of all factor of factor of production including properly managed irrigation can lead to increased crop yields, improving food security and supporting local economies. • Irrigation schemes in Kamonyi and Kirehe allow for the cultivation of a variety of crops throughout the year, promoting crop diversification. • The development and maintenance of irrigation infrastructure can create jobs, contributing to local economic development. • Irrigation can help mitigate the impact of climate variability by providing a more reliable water supply for agriculture. • Opportunities exist for the adoption of modern irrigation technologies, which can enhance efficiency and water use.	• In certain irrigation schemes with limited water resources, the demand for irrigation can lead to water scarcity issues, leading to conflicts over water use. • Poorly managed irrigation systems may contribute to soil erosion and other environmental issues. • Insufficient funding for the development and maintenance of irrigation systems can limit their effectiveness and sustainability. • Climate change issues leading to erosion and floods

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3.3 Assessment of membership, gender, age and education of Respondents

3.3.1 Demographic insights of respondent.

The table provided summarizes key demographic information related to the ages of respondents in an assessment. It reveals a wide age range, with respondents spanning from 21 to 83 years old. The average age of respondents is approximately 47.54 years, indicating a predominantly middle-aged group. However, the standard deviation of around 10.991 suggests variability in age within the dataset, indicating the presence of both younger and older individuals.

In the context of irrigation scheme management in Kamonyi and Kirehe districts, these findings have several implications. First, it is essential to acknowledge the age diversity within the community in the irrigation scheme and tailor management strategies and services to meet the varied needs and expectations of different age groups.

Second, this diversity indicates that the assessment has received and valued the input of a wide range of community members, fostering inclusivity in irrigation scheme management.

TABLE 7: AGE OF RESPONDENT

Description	Respondents	Minimum	Maximum	Mean	Std. Deviation
Age	96	21	83	47.54	10.991
Valid N (list wise)	96				

3.3.2 Membership distribution and gender

Understanding the dynamics of membership distribution within irrigation associations has been vital for comprehending the irrigation management model, identifying gaps, addressing challenges, and determining necessary improvements to promote equitable and sustainable agricultural practices. The analysis involved the examination of data collected from the Kamonyi and Kirehe districts, with a focus on the composition of Irrigation Water User Associations (IWUAs) and cooperatives.

By exploring the distribution of members and their gender representation, valuable insights have been gained into the community's participation in irrigation schemes. In the subsequent table, the characteristics of beneficiaries were described, contextual information was provided, and meaningful suggestions were drawn to illuminate the membership landscape in these districts.

TABLE 8: THE CHARACTERISTICS OF BENEFICIARIES[20]

[20] Analysis done using IBM SPSS Statistics 21

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District				Irrigation Water User Associations / Cooperative Member		Total	Percentage
				No Member	Member		
Kamonyi	Farmer	Gender	*Female*	0	21	21	
			Male	1	15	16	
	Other	Gender	*Male*		1	1	
	Total	Gender	*Female*	0	21	21	55%
			Male	1	16	17	45%
		Total		**1**	**37**	**38**	**100%**
Kirehe	Farmer	Gender	*Female*	0	24	24	
			Male	2	31	33	
	Other	Gender	*Male*		1	1	
	Total	Gender	*Female*	0	24	24	41%
			Male	2	32	34	59%
		Total		**2**	**56**	**58**	**100%**
Total	Farmer	Gender	*Female*	0	45	45	
			Male	3	46	49	
	Other	Gender	*Male*		2	2	
	Total	Gender	*Female*	0	45	45	47%
			Male	3	48	51	53%
		Grand Total		**3**	**93**	**96**	**100%**

The figures presented offer a visual representation of membership status within Irrigation Water User Associations (IWUAs) and cooperatives in the Kamonyi and Kirehe Districts, categorized by gender. In Kamonyi District, the data shows that 55 percent of participants in irrigation water user associations were female, while 45 percent were male.

It was noticed also, one male individual actively utilizing the irrigation scheme but not holding membership in the water user association or cooperative. In contrast, in Kirehe District, the sample consisted of 41 percent females and 59 percent males actively participating in water association activities. Two male individuals in this district indicated their no adherence in water user associations. These figures collectively depict a balanced gender-based distribution of members in irrigation water user associations, underscoring gender participation in irrigation water management activities in both districts.

3.3.3 Educational trends and decision-making challenges in irrigation scheme

The assessment has conducted a comprehensive review of educational categories, revealing that primary education consistently stands out as the most prevalent category across all districts. When considering data from all districts and educational groups, it's clear that approximately 78.1% of Irrigation Water User Association Members belong to the primary education category.

This dominance in primary education can have an impact on decision-making, particularly by potentially leading to a narrow focus during the decision-making process, in fundraising efforts, and resource mobilisation for irrigation scheme maintenance and upgrades. Consequently, this can result in

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imbalances in decision-making, inefficiencies, and the neglect of other critical aspects of irrigation scheme development and sustainability. The table below provide the picture depending on data collected.

TABLE 9: EDUCATION LEVEL OF RESPONDENTS

District				Irrigation Water User Association / Cooperative Member		Total	Percentage
				No Member	Member		
KAMONYI	Farmer	Education	None	0	3	3	
			Primary	1	27	28	
			Secondary	0	4	4	
			Vocational training	0	2	2	
	Other	Education	Primary		1	1	
	Total	Education	None	0	3	3	7.9%
			Primary	1	28	29	76.3%
			Secondary	0	4	4	10.5%
			Vocational training	0	2	2	5.3%
		Total		**1**	**37**	**38**	100.0%
KIREHE	Farmer	Education	None	0	3	3	
			Primary	2	44	46	
			Secondary	0	8	8	
	Other	Education	Secondary		1	1	
	Total	Education	None	0	3	3	5.2%
			Primary	2	44	46	79.3%
			Secondary	0	9	9	15.5%
		Total		**2**	**56**	**58**	**100.0%**
TOTAL	Farmer	Education	None	0	6	6	
			Primary	3	71	74	
			Secondary	0	12	12	
			Vocational training	0	2	2	
	Other	Education	Primary		1	1	
			Secondary		1	1	
	Total	Education	None	0	6	6	6.3%
			Primary	3	72	75	78.1%
			Secondary	0	13	13	13.5%
			Vocational training	0	2	2	2.1%
		GRAND TOTAL		**3**	**93**	**96**	**100.0%**

3.4 Current State of Irrigation Scheme Infrastructure Management

In light of the comprehensive analysis of irrigation scheme management in Kirehe and Kamonyi Districts, the analysis was made into several crucial aspects. Firstly, the current management model's effectiveness in achieving its intended objectives. The strengths, weaknesses, and the overall clarity of rules and guidelines for water allocation within these schemes was examined. This in-depth evaluation helped gain a nuanced understanding of the existing infrastructure management model.

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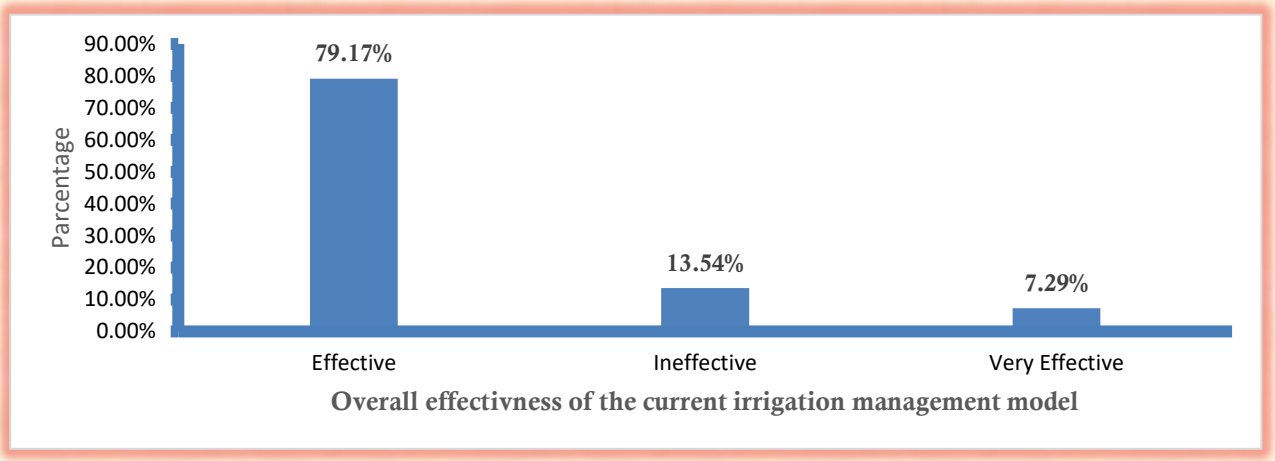
Additionally, it was explored the opportunities for improvement identified by beneficiaries who play a central role in these schemes. They also considered potential threats and challenges that could hamper the sustainability and success of these irrigation schemes. The objective was to provide a holistic view of the current state of irrigation scheme management.

Furthermore, the data collection process included methods employed in irrigation, the frequency of irrigation activities, and maintenance practices for irrigation structures. The analysis went deeper to investigate the response to deviations from irrigation schedules and measures taken to address members who damage the irrigation infrastructure. This multifaceted analysis aimed to enhance productivity and sustainability in these districts, ensuring that irrigation schemes continue to play a crucial role in supporting local agriculture and food security. The results are presented in the following paragraphs:

3.4.1 Assessing the Success of ISM model: User Perceptions and Implications

The comprehensive assessment of the irrigation scheme management model in Kirehe and Kamonyi districts has yielded valuable insights into its effectiveness. Through a meticulous analysis, it has examined the strengths and weaknesses of the existing model to provide a holistic view of its operational efficiency and potential areas for improvement. The data collected present the following results in terms of the distribution of responses in table below.

FIGURE 1: DISTRIBUTION OF RESPONSES REGARDING IRRIGATION SCHEME EFFECTIVENESS



In the analysis of the effectiveness of the irrigation scheme management model in Kamonyi and Kirehe, the data presented in the figure above reveals that a significant majority of respondents, approximately 79.17%, perceive the scheme as effective. This suggests that the model may have successfully met the needs and expectations of a substantial portion of the user community. Going further into this positive perception of effectiveness, it may significantly depend on equity in water distribution—a fair and just allocation of water resources among different users, ensuring equal access for their basic agricultural activities as one of the respondent highlighted. Additionally, this may imply that the scheme likely holds the potential to contribute to improved crop yields, enhanced food security, and better livelihoods for the local community.

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Following up on the smaller proportion, approximately 13.54% of respondents who reported the ineffectiveness of the irrigation scheme, they suggested moving beyond concerns about equity in water distribution and delving deeper into other issues, such as inadequate infrastructure maintenance and inappropriate technology and capacity building. These issues may contribute to the scheme's ineffectiveness, highlighting the need to address those areas to improve irrigation effectiveness.

The high satisfaction rate among the beneficiaries, which stands at 7.29%, indicates that the scheme has the potential to go beyond meeting basic needs. It may have led to significant agricultural productivity gains if all factors were considered.

TABLE 10: DISTRICT WISE PERCEPTION

District		Effective	Ineffective	Very Effective	Total
Kamonyi	IWUA	31	5	2	38
	Percentage	82%	13%	5%	100%
Kirehe	IWUA	45	8	5	58
	Percentage	78%	14%	9%	100%
Total		**76**	**13**	**7**	**96**

In the district of Kamonyi, the data from the table indicates that beneficiaries have predominantly expressed positive feedback regarding the effectiveness of the irrigation scheme management model. A significant portion, totalling 82%, view the scheme as effective, with an additional 5% expressing very high satisfaction.

In contrast, in the district of Kirehe, while positive feedback is prevalent, the proportion of respondents who find the scheme ineffective is slightly higher at 14%. This suggests that, although the majority of beneficiaries in Kirehe appreciate the scheme's effectiveness, there is still concerns about its performance. HABANABAKIZE Jean Baptiste is a farmer in Cyunuzi 1 irrigation scheme in Kirehe district.

I have been farming over 20 years in this marshland. In fact, there are changes we have made after its development. Before the development, we used to grow various types of crops like taro, beans, sorghum, etc., so we kept doing it and you saw people going from nowhere to nowhere. After development, we planted rice, we started to worry that the rice was useless, but now the harvest is available because the farmer who cultivates about 8 ares, he can have up to one and a half tons. Now we have bought cows, we are paying for children's education, we have cemented our houses. Another important thing when money is at home conflicts reduces.

Implication

Overall, both districts exhibit a generally positive outlook on the irrigation schemes, but there is still room for improvement, particularly in addressing the concerns of those who perceive them as ineffective, as the scheme has the potential to exceed basic needs

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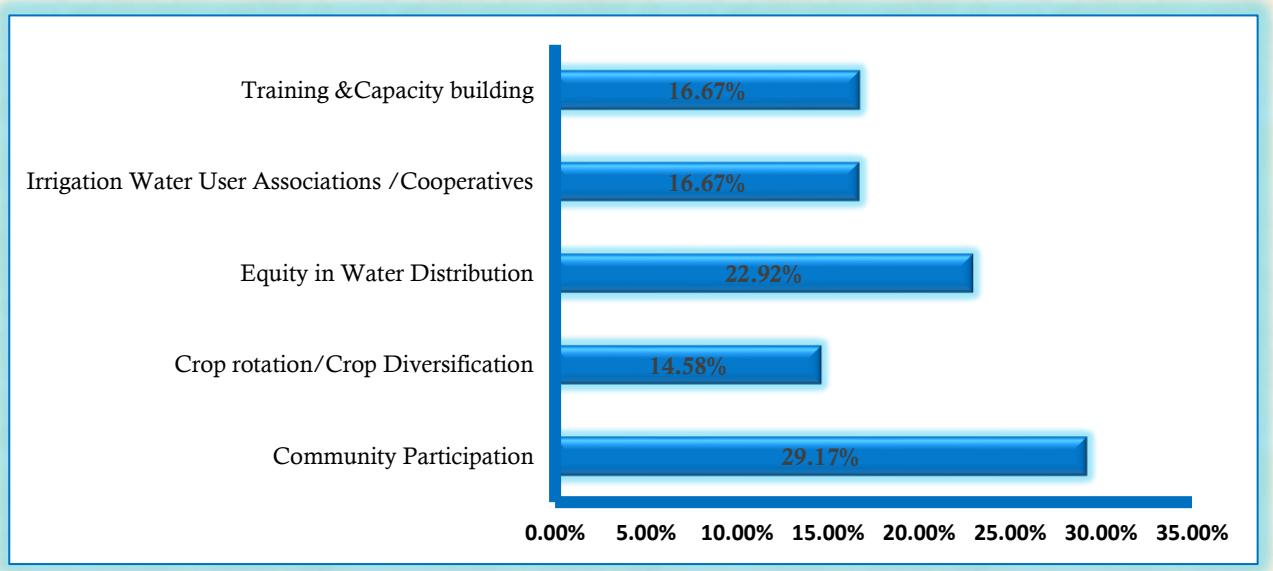
3.4.2 Assessment of the Strengths of the Current Irrigation Scheme Management Model

In this assessment, it was found that there are noteworthy strengths that deserve recognition. These strengths play a pivotal role in ensuring the successful functioning and effectiveness of these systems, contributing to increased agricultural productivity and sustainable water management. Acknowledging and further strengthening these aspects will be instrumental in optimizing the irrigation schemes for the benefit of local farmers.

FIGURE 2: STRENGTHS AND FACTORS INFLUENCING IRRIGATION SCHEME MANAGEMENT



The analysis of the strengths of the irrigation scheme management model in Kamonyi and Kirehe districts reveals several key factors contributing to its effectiveness. Community participation stands out as a significant factor, accounting for more than a quarter of the overall strength. If this strength is built upon, it should, in the long run, lead to local farmers' active involvement in the management and decision-making processes, which can lead to a greater sense of ownership and, consequently, more successful outcomes. The effectiveness in term of equity water underscoring the importance of transparency in distributing water resources to enhance community participation.

Additionally, the presence of training and capacity building programs highlights the importance of equipping farmers and stakeholders with the necessary skills and knowledge for effective irrigation management. While crop rotation and diversification play essential role in maintaining soil health and sustainable agricultural practices. The relatively lower percentage for Irrigation Water User Associations indicates room for improvement in organizing and coordinating efforts among users.

3.4.3 Weaknesses of the Current Irrigation Scheme Management Model

Alongside the strengths, the assessment has revealed notable weaknesses in the current irrigation scheme management model which can result in operational inefficiencies and potential obstacles to the performance and sustainability of irrigation scheme.

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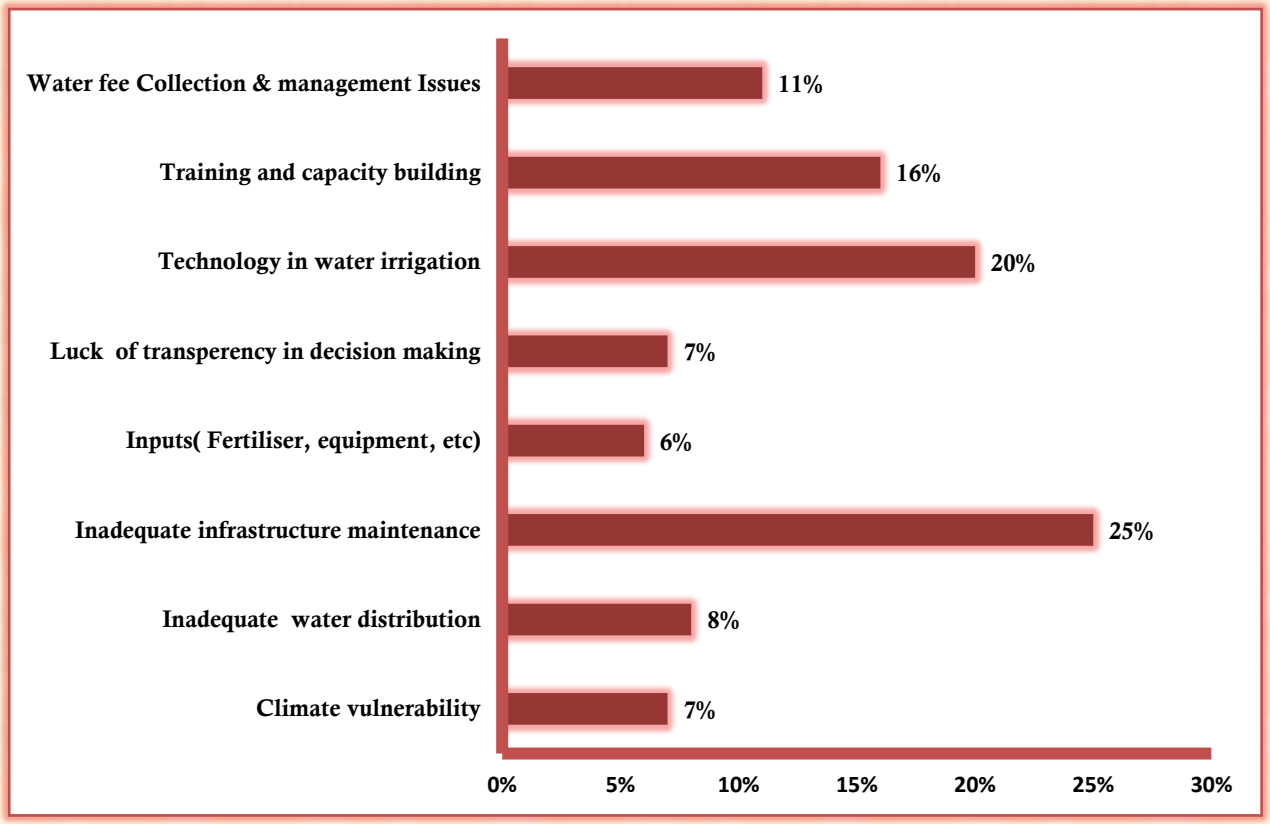
FIGURE 3: IDENTIFIED WEAKNESS OF CURRENT SCHEME IRRIGATION MANAGEMENT



The weaknesses identified in the irrigation scheme management model for Kamonyi and Kirehe districts highlight various challenges that significantly affect agricultural production in these irrigation schemes. The most prominent issue, as reported by beneficiaries, is inadequate infrastructure maintenance, accounting for 25% of the identified weaknesses. ***This is likely due to the substantial investment required, especially for urgently needed improvements and repairs to the physical components of the irrigation system to prevent breakdowns and inefficiencies. As previously mentioned and emphasized in the irrigation investment plan, the current water fees collected are exceptionally low and fail to cover the costs associated with operation and maintenance.***

Furthermore, technology-related problems, which constitute 20% of the identified weaknesses, underscore the importance of investing in modern irrigation technology to optimize water usage and crop yields. The pictures below depict some examples that could be burdensome for the community, possibly leading to the observed responses.

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PHOTO 6: RUBOROGA AND CYUNUZI IRRIGATION SCHEME IN KAMONYI AND KIREHE DISTRICT

Discussing with Mr. MUVUNYI Primien de Cyunuzi irrigation scheme in COPROKI Cyunuzi he said: ***"Our dam at Cyunuzi was fully operational in the past, allowing us to control the water flow by opening and closing the vanes as needed. However, the vanes have become inoperative, and we are now solely reliant on water from the spillway".***

PHOTO 7: NONFUNCTIONING WATER CONTROL VANE IN THE CYUNUZI IRRIGATION SCHEME

Training and capacity building (16%) emerge as another critical concern, indicating a gap in knowledge and skills among farmers and scheme operators. The key causes of this, as highlighted by the respondents, can be attributed to a lack of comprehensive training and capacity-building initiatives within the irrigation schemes. Additionally, issues related to transparency in decision-making (7%) and water fee collection and management (11%) point to potential shortcomings in governance structures and procedures, underscoring the importance of accountability.

To address these challenges effectively, it is essential to implement a tailored capacity-building program. This program should be designed to specifically address the knowledge and skill gaps among farmers and scheme operators to enhance their capabilities, promoting more efficient irrigation practices.

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Furthermore, enhancements in governance structures, with a focus on transparent decision-making processes, and the resolution of issues related to water fee collection and management, are crucial aspects of a holistic approach. A comprehensive intervention strategy, incorporating targeted capacity building, can significantly contribute to addressing the identified concerns in decision-making and water fee collection and management, thereby fostering sustainable irrigation practices.

"*Additionally, when it rains, the water becomes discoloured, often turning brown due to erosion. Unfortunately, we are unable to open the vanes to allow the waste to be carried away. This accumulation of waste raises concerns about the condition of the dam and its potential negative impact. We fear that the lack of controlled water release may affect the overall state of our dam*". He mentioned one of the respondent

Some key strategies, like a turnaround program, aim to implement corrective actions and strategic initiatives to achieve positive results and restore the viability of irrigation systems:

"These strategies may include tailored capacity building, introducing a material replacement appropriate strategy, implementing appropriate planning, financing and monitoring strategies, and ensuring transparent decision-making processes. Effectively collecting and managing water fees is crucial for gaining trust from stakeholders and maintaining the sustainability of the irrigation scheme.

In summary, addressing these weaknesses through infrastructure maintenance, technological upgrades, training, and improved governance is vital to enhance agricultural productivity in Kamonyi and Kirehe districts.

3.4.4 Water equity, efficiency, flexibility and Sustainability Assessment in Water usage

One other element in the evaluation focuses on assessing the equity of water distribution within these irrigation schemes. Ensuring that water resources are distributed fairly among local farmers is a fundamental aspect of sustainable irrigation scheme management and development. The results shed light on the current state of water equity and provide insights into measures to promote a more just allocation of this resource within the irrigation scheme.

Additionally, sustainability and efficiency in water distribution, along with flexibility in water usage, represent crucial aspects of any irrigation scheme management model. The assessment systematically analysed these components to gauge farmers' perceptions as water users, aiming to provide a roadmap for enhancements that can result in more efficient water utilization, reduced wastage, and increased adaptability to changing agricultural requirements.

The results indicated that fairness in water distribution within the Kamonyi and Kirehe district irrigation scheme is perceived positively, with 75% of respondents agreeing that the distribution is fair. This suggests that a majority of stakeholders view the water allocation as equitable and just. The implication of this positive perception is the promotion of cooperation and social harmony among stakeholders, which is vital for the sustainable management of the irrigation scheme.

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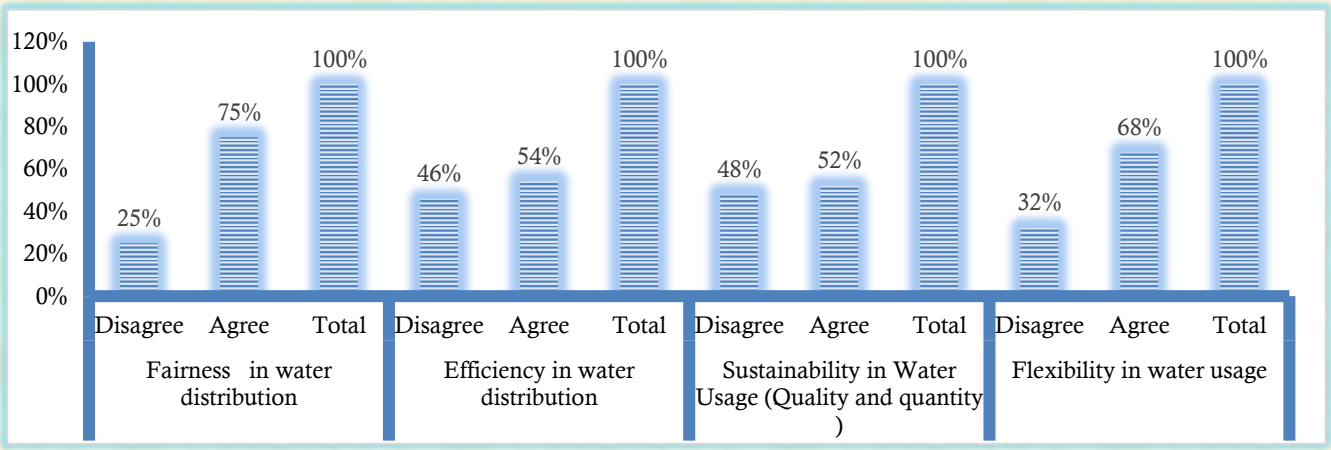
Efficiency in water distribution appears to be an area that needs improvement, as 54% of respondents agree that water distribution is efficient, while 46% disagree. This near-even split suggests that there is room for enhancement in terms of optimizing water usage. Improved efficiency will result in increased crop yields, reduced water waste, and a positive impact on overall agricultural productivity.

The results show that also a majority of respondents, 52%, agree that water usage in terms of both quality and quantity is fairly sustainable. This indicates that positive practices aren't being followed consistently in maintaining the long-term health of the ecosystem and water resources. However, this average perception may be due to the fact that most of the irrigation schemes visited suffer from soil erosion, highlighting the need for good agricultural practices and preservation of the environment.

Flexibility in water usage is perceived positively, with 68% of respondents agreeing that the system is flexible, while 32% disagree. This majority agreement suggests that the irrigation scheme has a fair ability to adapt to changing conditions and user demands. The figure below gives the detail.

FIGURE 4: WATER EQUITY, EFFICIENCY, FLEXIBILITY AND SUSTAINABILITY ASSESSMENT



While equity, sustainability, and flexibility in water distribution and usage are generally viewed positively, there is room for improvement in several key areas:

1. *Implementing effective conflict resolution mechanisms.*
2. *Adopting more efficient irrigation techniques and improving the maintenance of infrastructure.*
3. *Implementing erosion control mechanisms.*
4. *Employing eco-friendly irrigation systems and promoting responsible water management.*
5. *Implementing good agricultural practices as both an adaptation and mitigation measure for climate change.*

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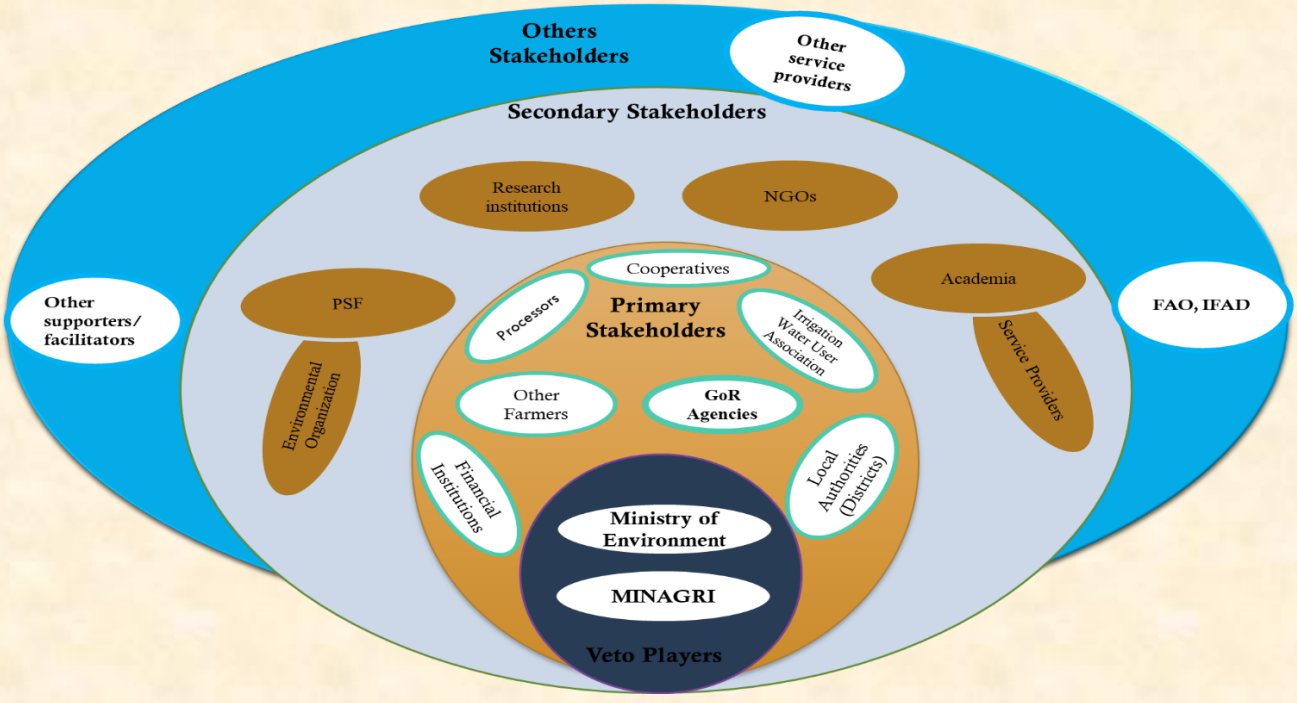
3.4.5 Key stakeholders involved in the management of irrigation scheme

The irrigation scheme in Kirehe and Kamonyi districts involves various stakeholders who play crucial roles in its management, each with a specific role and set of responsibilities. Farmers are the primary beneficiaries and must utilize the irrigation system efficiently, maintain their plots, and provide feedback on its performance. They are supported by Irrigation Water User Association/ Cooperatives, which represent their collective interests, mobilize farmers, manage memberships, and ensure infrastructure maintenance. Local Government Authorities, including district, sector, and cell officials, provide governance and support by allocating land for the scheme especially land in marshlands, issuing some permits, overseeing regulatory compliance, and supporting in dispute resolution.

The Government through the related ministries like Ministry of Agriculture and Animal Resources (MINAGRI), ministry of Environment and their agencies offers policy guidance and support, developing policies, providing technical assistance, and facilitating funding opportunities. The Rwanda Water Resources Board (RWB) regulates water use, monitoring compliance with regulations, ensuring water quality, and promoting sustainable water resource management. Rwanda Environment Management Authority (REMA) play a crucial role in safeguarding the environment by enforcing regulations and overseeing compliance to prevent harm to the local ecosystem. Additionally, finance institutions and partners provide essential funding while research institutions and universities contribute technical knowledge, research support, training, and advice based on research findings. Lastly, non-governmental organizations (NGOs) promote community involvement and sustainability, engaging with the local community to creating awareness and assisting in technical aspects of irrigation scheme development. Here below is the summary of documented irrigation scheme relationship and stakeholder map.



MAP 3:IRRIGATION SCHEME STAKEHOLDER MAP

TABLE 11: SUMMARY OF DOCUMENTED IRRIGATION SCHEME RELATIONSHIP

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SN	CATEGORY	INSTITUTION	DESCRIPTION	RESPONSIBILITIES
1.	Veto Stakeholders	MINAGRI and MoE	Decide and have great influence on the irrigation scheme management. They also have the final authority to veto a particular decision or change technical	Policy and strategies setting and even great support in term of finance and technical
2.	Primary stakeholders (directly involved)	• Farmer Cooperatives, • Irrigation Water User Associations • Individual farmers operating in irrigation schemes • Government Agencies at the local or national level may be primary stakeholders, especially if they provide funding, policy support, or regulatory oversight for the irrigation scheme (MINICOM, RAB, NAEB, RSB, RALIS, RCA, District authorities, BDF and Project • Financial institutions (Banks and MFIs) • Rice Processing Plants	Primary stakeholders are those actors who have a direct and significant interest in the success and outcomes of the irrigation scheme. They are typically those who are directly involved in the day-to-day operation, management, or utilization of the irrigation system	• Day to day responsibilities like water usage • Supervision, monitoring and reporting • Advocacy, technical support, Capacity building and financing • Conflict resolution • Regular capacity building
3.	Secondary stakeholders (Indirectly involved)	• Environmental Organizations (REMA, RWB) • Non-Governmental Organizations (NGOs) like Good neighbours, Yean Rwanda, Tubura, Duhamic Adri, SEMAUL, RUMBUKA, KOICA, COCOF etc. • Researchers and Academia • Private Sector and Agribusinesses (Companies	Secondary stakeholders are those actors that have an indirect or less immediate interest in the irrigation scheme. While they may not be directly involved in its daily operation, they can still be impacted by its activities.	Other relates issues that may comprising environment, inputs, research, investment, capacity building etc.
4.	**Others**	FAO, Meteo-Rwanda, & other service providers for capacity building programs	These are stakeholders that support at any time	other service providers for technical and capacity building programs

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3.5 General identified gaps, challenges and opportunities in irrigation schemes

In the current implementation of irrigation scheme management in Kirehe and Kamonyi, several critical gaps, challenges, and opportunities have been identified.

3.5.1 Maintenance and repair

By exploring the field during data collection, one significant gap is the state of infrastructure, with aging and poorly maintained systems leading to water losses and inefficient distribution. For instance, photos from various irrigation schemes, such as Cyunuzi in Kirehe, reveal issues like dead dam gates or vanes that control water release and damaged sills lasting like 3 years. Additionally, in Kinoni 1, there are reports of damaged and non-functional of the water outlet build in the farm for water distribution. In Kinnyogo, the canal that used to have a sill is now damaged, likely due to soil erosion.

PHOTO 8:DEAD DAM GATES OR VANES THAT CONTROL WATER RELEASE AND DAMAGED SILL IN CYUNUZI

PHOTO 9:DAMAGED AND NON-FUNCTIONAL OUTLET IN KINONI AND DAMAGED SILL IN KINNYOGO

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PHOTO 10: POOR QUALITY OF IRRIGATION WATER DUE TO EROSION AND REPARATION USING BANANA STEMS DUE TO DAMAGED DOORS.

3.5.2 Access to finance

The lack of access to affordable finance is another gap, hindering farmers' ability to invest in irrigation equipment and technology. Moreover, there is a shortage of technical knowledge among farmers, making it challenging to operate and maintain irrigation systems effectively.

This is very important thing because members say they have no financial means to repair the damaged structures. Usually, IWUAs receive water fees, which are between 200rwf and 300rwf per one are during the season. Cooperatives that grow rice have two seasons, while those that grow corn and vegetables grow three seasons a year. It means that the water fee is given for each season, means it is given twice or three times a year depending on the seasons of the year. Others charge an annual water fee. This amount is small compared to the value of the structures GoR has built in irrigation schemes. Even the Rwanda irrigation master plan showed that it is not enough to do the maintenance and repair of irrigation structures.

When the problem beyond the capacity of IWUAs, they have report at the District and RAB. These problems are present in many irrigation schemes. For example, Mukunguri, Ruboroga, and Bishenyi have damaged weirs, but while discussing with the director of agriculture in Kamonyi District, he revealed that in fact the problems are known but there is no budget to repair them. He pointed out that they make a report and send it to the RAB and other stakeholders, and that they also see that it is beyond the capacity of the IWUAs.

3.5.3 Inadequate monitoring and evaluation

Inadequate monitoring and evaluation systems also exist even water user association are available and this is resulting in a lack of data for assessing scheme performance and water usage. Additionally, limited stakeholder engagement and cooperation pose challenges in decision-making and management processes.

When discussing with farmers during data collection and farmer group discussions on related challenges and opportunities, they come up with a given ranking as follows:

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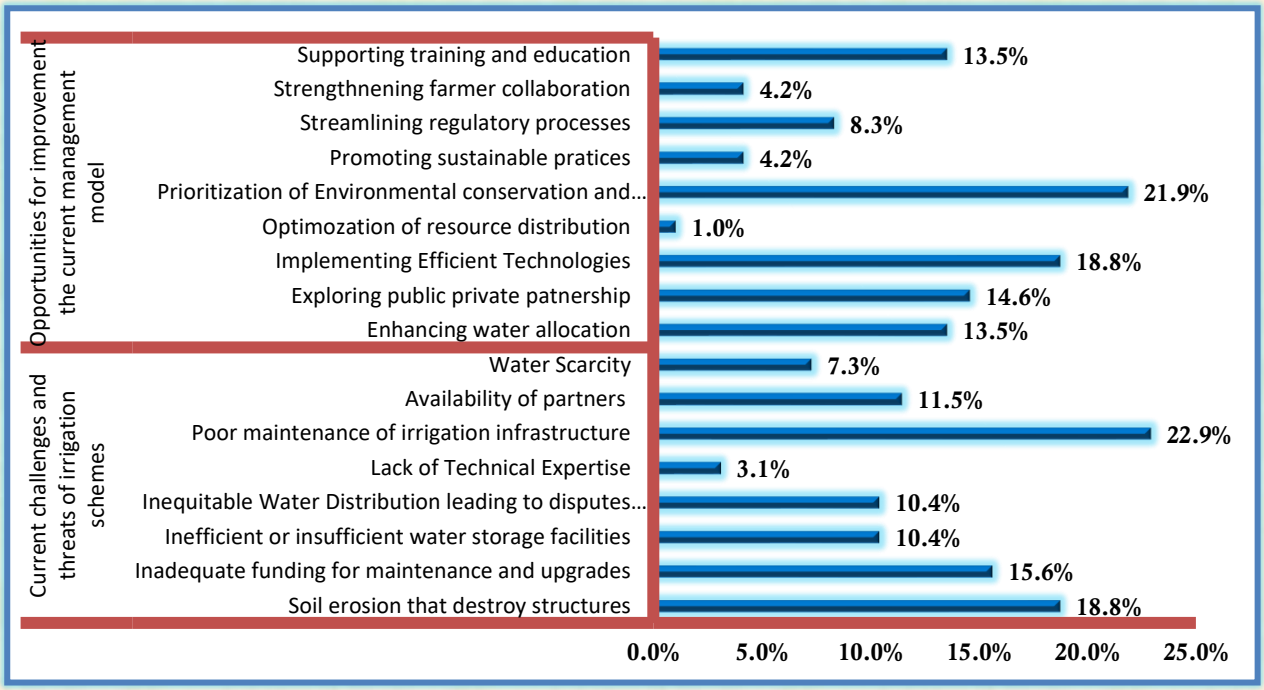

FIGURE 5: IDENTIFIED CHALLENGES AND OPPORTUNITIES

In the presented data, the key challenges and threats facing irrigation schemes include soil erosion (18.8%), inadequate funding for maintenance and upgrades (15.6%), and poor maintenance of irrigation infrastructure (22.9%). These issues can lead to structural damage, financial constraints, and reduced system efficiency.

On the bright side, several opportunities for improvement in the current management model emerge from the data collected and discussions conducted. Prioritizing environmental conservation and erosion reduction (21.9%) stands out as a significant opportunity, along with implementing efficient technologies (18.8%). Exploring public-private partnerships (14.6%) especially in Kirehe district and enhancing water allocation (13.5%) also offer potential pathways to more effective irrigation management.

3.5.4 Limited public-private partnership

In some irrigation schemes, especially those in Kamonyi, they have many stakeholders such as NGOs like SAEMAUL, Good Neighbors, etc. But Kirehe district has few stakeholders, so many schemes apart from government institutions they have no other stakeholders. These stakeholders help in many different ways. They help in construction infrastructures like stores, hangars, maintenance and repair, capacity building and access to finance.

It has been found that irrigation schemes that do not have many stakeholders are the ones that have the most problems while those that have many stakeholders are the ones that work well. For example Kinnyogo irrigation scheme they tell you that apart from government institutions there are no other stakeholders. This is combined with the fact that it has a lot of erosion problems, so many fields have been seriously damaged, many canals have been damaged and many weirs have been completely destroyed so it is necessary to build new ones. They don't have an access road in their scheme, so getting their produce to the hangar and store from the farm is very difficult for them because there is no road even for bicycles or wheel barrows.

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These stakeholders have an important role in these irrigation schemes because where they are present there are positive changes while where they are not, the schemes face different problems. For example, the Gikoro irrigation scheme in Kamonyi district has different stakeholders who have developed it. They have a hangar and store, and there we found a cold room powered by solar for vegetables. The members believe that the cold room helps them a lot because their vegetables will not spoil if they do not find the market and can be stored until they find the market.

PHOTO 11: STATE OF IRRIGATION SCHEME MPANGA 1

"Here, as you can see, we irrigate our farm using portable sprinklers. However, due to their age, they are not as efficient as when they were first installed. Consequently, there are areas where water cannot reach, and we try to use pipes because the existing materials are old. As the structures age without replacement, the available materials diminish, and we keep moving the remaining ones to irrigate different parcels. Eventually, as you understand, it will take time to complete the circle, causing the crops to suffer from insufficient water, especially where we started. It's evident that when both water and irrigation materials are scarce, it adversely affects the crops. Our suggestion is to seek assistance in replacing this old irrigation equipment with a center pivot system": She Suggested Ms. NYIRASENGIYAREMYE Théodosie, COVAMIS Mpanga 1.

Key actions to improve the prevailing situation comprise implementing erosion control and infrastructure maintenance measures, constructing a buffer zone to reduce hillside erosion, developing sustainable financial plans and seeking adequate funding, enhancing technical expertise through training, actively collaborating with partners, promoting water and environmental conservation, adopting climate-resilient practices, prioritizing sustainable farming practices, and investing in outreach programs to enhance knowledge and skills.

The assessment of irrigation methods within the scheme and the reasons for the selection, the weekly timing of irrigation, and the maintenance schedule of irrigation structures provides valuable insights into on-field practices. It is well-acknowledged that challenges frequently arise from these components,

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including instances of member-induced damage to irrigation assets. The following table present the key figures:

TABLE 12: FREQUENCY TABLE

Description		Frequency	Percent
Method used for Irrigation	Sprinkler irrigation	7	**7.3**
	Surface irrigation/ Furrow irrigation	89	**92.7**
	Total	96	**100.0**
Weekly irrigation	Five times	3	**3.1**
	Four times	2	**2.1**
	None	2	**2.1**
	Once	2	**2.1**
	Seven times	14	**14.6**
	Three times	50	**52.1**
	Two times	23	**24.0**
	Total	96	**100.0**
Meeting for maintenance of irrigation structures	Monthly	37	**38.5**
	None	1	**1.0**
	Other (If need be)	9	**9.4**
	Weekly	49	**51.0**
	Total	96	**100.0**
Actions taken when a member destroys an irrigation structure	Fine	40	**41.7**
	IWUA repair it	22	**22.9**
	No follow up	4	**4.2**
	Repair it	30	**31.3**
	Total	96	**100.0**
Actions taken when a member is not available for their irrigation scheduled time	Assisted any they are available	6	**6.3**
	No irrigation schedule	35	**36.5**
	Other member irrigate for your behalf	42	**43.8**
	Wait for the next time	13	**13.5**
	Total	96	**100.0**

The table provides insights into irrigation practices within the surveyed group. Nearly all respondents (92.7%) use surface irrigation or furrow irrigation, while only a small minority (7.3%) use sprinkler irrigation. In terms of irrigation frequency, a little over half (52.1%) of the respondents irrigate their fields three times a week, followed by 24.0% who irrigate twice a week. There are also variations in the number of times respondents irrigate, including those who irrigate seven times a week (14.6%) and those who irrigate less frequently.

The data reveals that more than half of the respondents (51.0%) favour weekly meetings for the maintenance of irrigation structures, while a significant portion (38.5%) opt for monthly meetings. Only a very small percentage (1.0%) reported having no meetings for maintenance, highlighting the importance placed on regular maintenance activities to keep irrigation structures in working order.

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In the case of a member damaging an irrigation structure, the majority (41.7%) confirm to impose a fine as a response. Another significant portion (31.3%) takes the responsibility of repairing the damage themselves. A smaller percentage (22.9%) relies on the Irrigation Water Users Association (IWUA) to handle the repairs. Some respondents (4.2%) reported having no follow-up action, indicating a limited willingness to enforce consequences for such actions.

When a member is unable to attend their scheduled irrigation time, the most common practice (43.8%) is to have another member irrigate on their behalf. A substantial number (36.5%) reported having no specific irrigation schedule in their scheme. Some respondents (13.5%) choose to wait for the next opportunity, and a smaller fraction (6.3%) confirms being assisted whenever they are available for irrigation, showcasing a flexible approach to scheduling in some schemes.

The data demonstrates a strong presence of surface and furrow irrigation methods among the surveyed group, with a clear emphasis on maintaining irrigation structures through regular meetings. Responses to damage of irrigation structures range from imposing fines to taking responsibility for repairs or involving the IWUA. In the context of member absence during scheduled irrigation, the flexibility of having other members irrigate in their place is common. These insights shed light on the community's collective approach to irrigation practices, maintenance, and conflict resolution within the irrigation system.

CHAP IV: RECOMMENDED IMPROVEMENTS FOR ENHANCED FUNCTIONALITY

4.1 Specific Improvements for Enhanced Functionality, Sustainability, and Productivity

The specific improvements needed were identified based on a physical field visit and testimonials from the beneficiaries, and Rwanda irrigation master plan. During a discussion with Mr. Theoneste MBONYINSUTI of the Kinnyogo Irrigation Scheme within the ISABANE Nyarubuye Cooperative in Kirehe, he highlighted that**:**

"The contracted individual responsible for execution of irrigation scheme works for us; probably, they may not have done their studies properly. Because when I compare it to other irrigation schemes such as Nyagatare whose infrastructure was built many years before ours, it remains strong, but ours, even though it was built recently, has been badly damaged. In many places, landslides have flooded many fields so that the arable land has been reduced".

Below are the specific issues and the improvements required to enhance functionality and productivity, as suggested by the farmer beneficiaries.

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TABLE 13: SPECIFIC ISSUES AND IMPROVEMENT SUGGESTED BY BENEFICIARIES

KIREHE		
Irrigation scheme	**Specific Issues**	**Categorization and the proposal of key interveners depending on the nature of the issue**
Cyunuzi 1 and Cyunuzi 2	They are facing a significant challenge with low water supply. Cyunuzi-1 relies on the surplus water from Cyunuzi-2, which also has a damaged dam. However, both schemes are currently experiencing a severe issue involving a damaged dam with seriously impaired vanes that release all the water and damaged weir and that are beyond IWUAs capabilities. Consequently, they are using water from the spillway. This means that when the water level in the reservoir drops to a point where it cannot pass through the spillway, the reservoir becomes ineffective, while the rice crops require more water. Erosion originating from nearby hills poses a threat to their infrastructure, particularly sewers, and channels. They have problems of interaction between cooperative and IWUAs.	Infrastructure rehabilitation is needed as follows: ➢ Repair of outlet vanes of the dam and repair of damaged weir are beyond IWUAs capabilities as require heavy investment they need stakeholder support or government intervention ➢ Erosion control on nearby hillsides requires significant effort, and even cooperative members do not have control over hillside farms. This necessitates intervention from stakeholder, central, and local authorities. ➢ Regular maintenance of irrigation channels could be carried out by IWUAs.
Kinoni 1 and Kinoni 2	They have cooperative leadership issues and some members acting as if there is no leadership. The water taps that supply water for irrigation are in a damaged state, and there is no consistent plan in place for their maintenance or repair. Furthermore, they are confronted with erosion problems.	➢ Rehabilitation of water taps can be carried out by IWUAs. ➢ They need support from RCA and stakeholders to build the cooperative capacity and assist them in resolving cooperative issues ➢ Erosion control measures require intervention from stakeholder, central and local authorities.
Mpanga 1 and Mpanga 2	They practice irrigation using sprinkler systems, with a motor used to pump water directly from the lake to the sprinklers for distribution. Their major challenge lies in the condition of their sprinklers, as most of them are damaged. The primary causes of damage include incidents involving hippopotamuses and the use of portable sprinklers. Hippopotamuses also pose a threat to their cultivated crops and sprinklers.	➢ Fencing to prevent hippos from entering the scheme from Nasho Lake requires government intervention and stakeholder support, such as RDB, as it is beyond the capacity of farmers' cooperative ➢ The replacement of the sprinkler system with a centre pivot irrigation system can be supported by MINAGRI or other stakeholders. ➢ Regular maintenance of irrigation channels could be carried out by IWUAs.

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Binoni	They are engaged in rice cultivation and face challenges related to a shortage of sills. Furthermore, some of existing weirs are damaged. When these damages occur, they report the issues to their leaders, particularly RAB and the district authorities. However, these entities have been unable to facilitate the necessary repairs. They have reported problem of few weirs in the scheme. Additionally, neighbouring farmers at hill sides, who cultivate the land up to the canals, are causing damage.	➢ The provision of new additional weirs could be carried out by the government through MINAGRI and RAB, as it requires heavy investment. ➢ Putting in place a buffer zone is beyond the water user association's capacity and requires support or partnership with others, such as MINAGRI or stakeholders. ➢ The maintenance of the channel is well-managed and can be done by IWUA.
Kinnyogo	In Kinnyogo, the issue of erosion is severe, with many fields left uncultivated due to the accumulation of sand brought down by erosion. The beneficiaries believe that the individuals responsible for the irrigation design and implementation have performed their tasks poorly. They point to the fact that neighbouring schemes, constructed earlier, remain intact and operate effectively, while their own scheme has been significantly affected.	➢ They express the need for a scheme reassessment by the government. ➢ The rehabilitation of the scheme and buffer zone requires government and stakeholders' intervention ➢ IWUA continues to perform maintenance on channels
Nyamugali	They face issues with their irrigation hoses, which are now old and leaking. While some farmers have the means to purchase new hoses, they struggle to find reliable sources for buying them. Erosion poses a threat to their irrigation water, and the water quality can be poor due to erosion. They face the problems with the taps that supply water in the field from irrigation canals, as some these taps are no longer functional. They use hoses to take water from canals using pumps while water was designed to enter field by gravity. The dam outlet vanes have suffered extensive damage, resulting in water leakage	➢ The rehabilitation of taps and irrigation channels can be done by IWUAs. ➢ Repairing irrigation hoses and outlet vanes, which leak water from the dam, is beyond the current capabilities of IWUAs. ➢ Their irrigation channel is constructed with cement; however, there are instances of damage that may exceed their financial capacity to address
KAMONYI		
Mukunguli	They face challenges due to significant mountain erosion, which fills their canals with sand, damages the structures, and they incur costs that exceed their financial capacity.	➢ They suggested a machine capable of removing the sand carried into their canals due to soil erosion, to be provided by the government or stakeholders.

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	They have weirs that completely damaged so that they need new ones and that is beyond their capacity.	➢ The replacement of a weir that is completely damaged is beyond the current IWUA capacity and requires third-party intervention.
Ruboroga	They lack infrastructure, such as dams, to capture water during the rainy season, which leads to destructive effects and limited access to water during the dry season. Hill side Erosion also damage to the irrigation channels. The existing infrastructure need rehabilitation there are where even they use banana stem as water gate	➢ The provision of alternative water storage structures and weirs by the government or stakeholders is suggested. ➢ Erosion control with the buffer zone is beyond their capacity and requires heavy investments.
Kayumbu	The scheme is not development. To facilitate irrigation, they depend on water pumps to raise water from the river. Additionally, the cooperative is poorly managed,	➢ A feasibility study is proposed and could be conducted by the government through MINAGRI. ➢ Development of the irrigation scheme is needed, requiring intervention from stakeholders and the government. ➢ Leadership improvement is needed and supported by RCA. The water user association is idle as the scheme is not well developed.
Bishenyi	The scheme suffers from a lot of soil erosion	➢ Buffer zone and erosion control measures are required, and cooperative members do not have control over hillside farms. This necessitates intervention from stakeholders, central, and local authorities.
Kibuza	They are facing erosion issues. The irrigation machines are heavy, making them challenging to lift, and their large hoses can potentially damage cultivated crops	➢ Buffer zone and erosion control measures are required, and cooperative members do not have control over hillside farms. This necessitates intervention from stakeholders, central, and local authorities.
Gikoro	They face a challenge of few sills in the system and issue of damaged water gates. They have a limited number of chutes in the canals, and some of them are damaged. They lack a means of water storage so that they rely on the water that flows.	➢ The provision of water storage facilities in the scheme requires intervention from stakeholders and the government. ➢ Some damaged chutes need to be repaired and require intervention from MINAGRI or other stakeholder ➢ Regular maintenance of irrigation channels could be carried out by IWUAs.

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4.2 Buffer zones to protect reservoirs, canals, and irrigated farms

IWUAs are facing threats from neighbouring farmers who cross borders with irrigation schemes because they cultivate and sometimes destroy irrigation canals. Additionally, some farmers allow animals to graze near the canals, causing further damage. IWUAs claim that irrigation schemes must have buffer zones such as 5 to 10 meters from primary irrigation canals to protect the canals from being damaged by farmers who cultivate the hills, harmful animals that come to drink water from the canals and erosion control by construction of cut-off drains, silt traps. Green belt of perennial grasses or shrubs can be grown in this buffer zone. These have deep root systems that help stabilize soil and reduce erosion. This buffer zones can be supported by stakeholders or provided by Governement through MINAGRI.

There is also a need for fencing, for example Mpanga 1 and Mpanga 2 where the hippos from the lake damage their crops and the sprinklers. Fencing by construct sturdy fences around the fields, where fences should be tall and robust enough to withstand the strength of hippos. Consider using materials like chain link to deter them effectively. Lights and Noises fences by install motion-activated lights or noise-making devices around the perimeter of the fields. These can startle and discourage hippos from approaching.

Vegetative buffers by planting unattractive vegetation to hippos can also be used (Consider planting vegetation around the fields that hippos find unappealing). This might include dense plants that make it less inviting for them to enter. Use of certain plants like citrus, acacia, eucalyptus may have odors that discourage them from entering specific areas.

4.3 Erosion Control

Many IWUAs have shown that they are threatened by erosion from the hills around the Irrigation schemes. Although erosion control has been mentioned as the most important thing in the buffer zone, erosion control has to be done at all nearby hillsides around irrigated schemes, as most irrigation structures are destroyed by erosion. Some erosion control measures can be done by IWUAs and cooperative members but others are beyond their capabilities so that they need stakeholders to help them. Different erosion control measures have to be done especially in the most threatened schemes like Kinnyogo in Kirehe district, Mukunguri, Ruboroga, and Bishenyi in Kamonyi District.

Erosion can be controlled by vegetative cover like grass cover and cover crops other may be done by terracing construction and Install small dams or check structures along drainage channels to slow down water flow and reduce erosion.

4.4 Capacity Building

An assessment revealed that 78.1% of IWUAs and cooperatives members have primary education, significantly impacting their ability to maintain, repair, plan, and manage water fees. Although some members could handle repairs of damaged structures, they often refrain due to a lack of knowledge and bad management of water fee. For instance, in Kinoni 1 and Kinoni 2, taps carrying water from canals to fields could easily be repaired with minimal resources, such as less than 10kg of cement, a piece of pipe, and valves but it is not done. While some members could handle repairs of damaged structures, other schemes neglect essential tasks like applying oil to the gates of dams and weirs, which is within their capacity.

While these similar small issues could be addressed by IWUA members using water fees, they often seek stakeholder assistance, leading to prolonged damage. This highlights the need for technical training in maintenance, repair, and scheme management

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Although Farmer Field Schools are currently popular and productive, they primarily focus on agriculture. It would be more beneficial for IWUA members to receive technical training within their schemes, enabling them to perform simple repairs and maintenance without constantly relying on external experts. This approach has proven successful in schemes with stakeholders like YEAN, where members work alongside technicians. The members do the work for themselves with the help of a technician. That makes us believe that if they can receive technical training in the schemes they will be able to maintain and repair simple damage even for small cost.

Furthermore, the establishment of **an advisory or audit committee** at the scheme or district level is needed to ensure IWUAs and cooperatives fulfill their responsibilities effectively. This would address concerns in many cooperatives where members feel their assets are mismanaged. The lack of knowledge, as revealed in the assessment, contributes to poor asset management. An audit committee could provide guidance and prevent long-lasting damage to irrigation structures, so that there is no damage to the irrigation structure that will last for three years' period as it was seen during assessment.

4.5 Public-Private Partnerships

In nearly all irrigation schemes, there are challenges that exceed the financial and technical capacities of IWUAs and cooperatives. For instance, the maintenance of damaged vanes at Cyunuzi and Kinoni 1 dams, as well as issues like damaged canals and weirs in various schemes, and erosion problems in both Kirehe and Kamonyi districts.

While engaging in discussions with various key informants such as directors of agriculture and animal resources in those districts, they acknowledge that the problems are recognized, and the Government is making efforts to address them. However, they emphasize the challenge of solving all these issues simultaneously. Additionally, they highlight the involvement of various stakeholders, including NGOs, international organizations such as SAEMAUL, KOICA, Good Neighbors, and others, who collaborate with the GoR in addressing specific problems.

This highlights the importance of establishing a regular public-private partnership, as it is crucial in addressing various needs that farmers have, such as capacity building, repair and maintenance, and the promotion of good agricultural practices. The assessment indicates that stakeholders have been effective, and they are continuing to increase their efforts in the development of irrigation schemes in various ways.

Various stakeholders, including NGOs and private companies, can provide both financial and technical support for activities that go beyond the capacity of farmers, addressing the issues presented in this report. These activities include the rehabilitation of irrigation schemes, the construction of fences to prevent hippo damage to crops and irrigation structures in Mpanga 1 and Mpanga 2, establishing vegetative buffers alongside irrigation schemes, constructing cut-off drains and silt traps, and implementing erosion control measures suitable for the hills surrounding the irrigation scheme and capacity building

4.6 Best practice

The Gikoro Irrigation Scheme in Kamonyi district, managed by the cooperative COAMALEKA, stands out as a well-managed example. Their regular canal maintenance, conducted weekly by IWUAs, ensures prompt identification and resolution of issues. The weirs are consistently maintained, preventing damage. The presence of an irrigation technician from YEAN Rwanda and an agronomist from RUMBUKA contributes to their success. Notably, they've implemented initiatives like a cooling room for vegetable storage and, in collaboration with RUMBUKA, ventured into corn seed production. The close collaboration between IWUAs and cooperative management enhances the efficiency of irrigation

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structure maintenance. While activities like erosion control on surrounding mountains may be beyond their capabilities, they have effectively managed everything within their means.

Implementing the following measures will contribute to the development of more efficient, sustainable, and community-oriented irrigation systems in Kamonyi and Kirehe District: establishing monitoring and evaluation systems, maintaining and upgrading infrastructure, promoting research and innovation, and addressing environmental and climate-related considerations

4.7 Actionable Insights and Innovations for the Irrigation Scheme Management Model

To enhance the functionality of irrigation schemes, the following actions need to be proposed:

TABLE 14: ACTIONABLE INSIGHTS AND INNOVATIONS

SN	Actionable Insights for the Irrigation Scheme Management Model	Innovative actions	Responsible
1	Prioritizing infrastructure investment, with a focus on maintenance and upgrades to minimize water losses and enhance distribution.	Consider also introducing solar-powered pumps and water distribution systems where feasible to reduce reliance on traditional sources and minimize environmental impact.	The veto skaholders like MINAGRI, RAB and District in collaboration with key partners
2	Capacity building through technical tailored training and extension services to empower farmers with the skills and knowledge needed for efficient irrigation practices	Initiate mobile applications to provide real-time support and information to farmers, ensuring continuous access to expert advice and guidance.	MINAGRI, RAB and Primary stakeholders and partners
3	Facilitating financial inclusion by providing access to affordable credit and grants can encourage investments in irrigation technology	Collaborate with microfinance institutions where possible to create tailored financial packages for farmers, making credit more accessible and affordable.	MINAGRI, RAB and Primary, secondary stakeholders and other partners
4	Involving various stakeholders in decision-making, can strengthen the overall management of irrigation schemes, and promote Effective governance structures.	Implement digital platforms for transparent communication and decision-making, ensuring that information flows efficiently among all stakeholders.	MINAGRI, RAB and Primary, secondary stakeholders and other partners
5	Robust data collection and monitoring systems must be established to track scheme performance, water usage, and crop yields.		MINAGRI, RAB, District, sectors, IWUAs

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6	Promoting climate-resilient practices including erosion control and construction of buffer zone around irrigation scheme and suitable crop varieties is vital to combat the challenges posed by climate change.	Engage local communities in climate resilience projects, such sustainable land management practices, creating a more comprehensive approach to climate adaptation.	MINAGRI, MoE, RAB, RWB, REMA, District, sectors, IWUAs and cooperatives
7	Developing market access through market linkages and value chains will ensure farmers that theyhave reliable outlets for their irrigated produce.	Establish quality certification programs to ensure that the irrigated produce meets market standards, enhancing the reputation of the schemes and their products in the market	MINAGRI, RAB, NAEB, District, Cooperatives and other partners

CONCLUSION

The assessment of irrigation scheme management models in Kamonyi and Kirehe reveals several challenges, gaps that need to be addressed to mitigate climate change challenges and ensure sustainable agriculture production and food security. Notable successes and promising prospects for sustainable agriculture and climate resilience have emerged, such as community involvement, especially the establishment of Irrigation Scheme Water Associations, a positive perception among beneficiaries, equitable water distribution for sustainable agriculture, and climate resilience in both regions. Local community involvement in scheme management stands out as a key strength, fostering ownership and responsibility among farmers.

However, challenges persist, including infrastructure degradation, erosion in most irrigation schemes, issues with leadership in water user associations and cooperatives, and the need for technology upgrades. These challenges demand attention for the long-term success of the schemes. It is recommended that the government, local authorities, and stakeholders invest in infrastructure rehabilitation, provide financial support, and promote sustainable and smart agricultural practices, considering climate resilience measures. Knowledge sharing and collaboration with other regions and neighbouring areas are crucial for enhancing agricultural resilience in the face of climate change.

By addressing these gaps, overcoming challenges, and capitalizing on opportunities highlighted in this assessment, the irrigation scheme management models in Kirehe and Kamonyi can be significantly improved, leading to sustainable agricultural production, food security, and the economic well-being of local communities.

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REFERENCES

1 KAMONYI (2018), *Kamonyi District Development Strategy*, South Province, Rwanda
2 KIREHE (2018), *Kirehe District Development Strategy*, East Province, Rwanda
3 MINAGRI (2018). *Strategic Plan for Agriculture Transformation – Phase 4 (PSTA 4) 2018 – 2024.* Ministry of Agriculture and Animal Resources (MINAGRI). Republic of Rwanda.
4 MINAGRI (2020). *Rwanda Irrigation Master Plan*. Ministry of Agriculture and Animal Resources (MINAGRI). Republic of Rwanda.
5 MINAGRI (2021). *MINAGRI Annual Report for FY2020/21*. Ministry of Agriculture and Animal Resources (MINAGRI). Republic of Rwanda.
6 MINECOFIN (2017). *National Strategy for Transformation (NST-1)* 2017-2024. Seven Years Government Programme. Ministry of Finance and Economic Planning (MINECOFIN). Republic of Rwanda
7 MINECOFIN (2020). *Rwanda Vison 2050. Revised version*. Ministry of Finance and Economic Planning (MINECOFIN). Republic of Rwanda.
8 NISR (2022), *Rwanda Statistical Year Book,* Kigali Rwanda

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ANNEXES

1.1 Structured Survey questionnaire for IWUA and Cooperatives

SURVEY QUESTIONNAIRE FOR WATER USER ASSOCIATIONS AND COOPERATIVE MEMBER IN IRRIGATION SCHEME IN KAMONYI AND KIREHE

IDENTIFICATION

District	
Sector	
Cell	
Village	
Interviewer name	
Name of Respondent	
Respondent contact number (Phone)	
Date of interview	**|__|__| / |__|__| / 2023**
Water User Association Member |__| **Cooperative Member |__|**	

1. Demographic characteristics of the respondents

1.1. Gender of Respondent [1] Male |__| [2] Female|__|	
1.2. What is your marital status of the respondent? [1] Single |__| [2] Married |__| [3] Living with partner |__| [4] divorced |__| [5] Widowed |__|	
2. Socio-economic characteristics of the respondents	
2.1. What is your age? |__|	***2.2. WHAT IS THE HIGHEST LEVEL OF EDUCATION COMPLETED? (TICK)*** **[1] *NONE* |__|** **[2] *PRIMARY LEVEL* |__|** **[3] *SECONDARY LEVEL* |__|** **[4] *VOCATIONAL TRAINING* |__|** **[5] UNIVERSITY LEVEL |__|**

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2.3 WHAT IS YOUR MAIN OCCUPATION [1] Famer [2] Casual labor in agricultural activities [3] Self employed in business [4] Student [5] Civil servant [6] Other ……	
3. Assess Current Irrigation Scheme Infrastructure Management	
3.1 Please rate the overall effectiveness of the current irrigation scheme management model in your scheme on a scale of 1 to 4 (1 being very ineffective, 4 being very effective). [1] Very ineffective |__| [2] Ineffective |__| [3] Effective |__| [4] Very effective |__|	
3.2 ***WHAT DO YOU CONSIDER TO BE THE STRENGTHS OF THE CURRENT IRRIGATION SCHEME MANAGEMENT MODEL?*** …… …… …… …… …… …… …… ……	3.3. What do you perceive as the weaknesses of the current irrigation scheme management model in here? …… …… …… ……..
3.4 Is water distributed fairly among different users, taking into account their needs, rights, and priorities (Equity)? YES|__| NO|__| If No how?..... …… ……..	3.5 Is water effectively used for its intended purposes to minimise waste?(Efficiency). YES|__| NO|__| If No how?..... ……
3.6 Water management used in a way that preserves their quality and quantity for future generations and minimizes negative environmental impacts (Sustainability). YES|__|	3.7 Is water usage flexibile? For example adapting water allocation to changing conditions, such as shifts in demand etc… YES|__|

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NO|__| If No how?..... ……. ……..	NO|__| If No how?..... ……..
3.8 Is there any clear rules and guidelines for water allocation to promote accountability and reduce conflicts among users? (Transparency). YES|__| NO|__| If No how?..... ……. ……..	3.9 Are there any opportunities you see for improvement in the current management model?(Choice 3) • Enhancing Water Allocation • Implementing Efficient Technology • Promoting Sustainable Practices • Strengthening Farmer Collaboration • Optimizing Resource Distribution • Streamlining Regulatory Processes • Supporting Training and Education • Exploring Public-Private Partnerships • Prioritizing Environmental Conservation • Other..... ..... • ....
3.10 Do you perceive any strengths of the current irrigation scheme management model (Yes/No) If Yes , Which? Choose • Efficient resource allocation. • Strong stakeholder collaboration. • Robust infrastructure maintenance. • Adequate water supply. • Effective environmental conservation measures. 1)…… …… 2)…… ……	3.11 Do you perceive any weaknesses of the current irrigation scheme management model in your district? (Yes/No) If yes, Which? Choose • Lack of transparency in decision-making. • Inefficient resource allocation. • Limited stakeholder engagement. • Infrastructure maintenance issues. • Water scarcity during peak demand periods. • Environmental sustainability concerns. • Infrequent maintenance delays. • Other 1)…… 2)……
3.12 Can you identify any opportunities that the current management model provides for improving irrigation schemes? (Yes/No) If yes Choose • Resource optimization. • Technological advancements. • Community involvement. • Sustainable practices. • Policy enhancements. • Suggest others 1)…… ……	3.13 Are there any threats or challenges that the current management model poses to irrigation schemes in your district? (Yes/No), If yes select • Water scarcity. • Inefficient resource allocation. • Lack of infrastructure maintenance. • Environmental sustainability concerns. • Stakeholder conflicts. • Suggest Others 1)……

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2)…… ……	2)……
3.14 Which method do you use for Irrigation water application? • Surface irrigation |__| • Sprinkler irrigation |__| • Center pivot irrigation |__| • Drip irrigation |__| • Other, Please specify |__|	3.15 how many times per week do you irrigate? |__|
3.15 when do you meet for maintenance of irrigation structures? a. none |__| b. weekly |__| c. monthly |__| d. Other |__| if Other explain	3.15 What do you do if you are not available for your irrigation scheduled time? a. We don't have irrigation schedule |__| b. other members will irrigate for you |__| c. You will wait for next time |__| d. You will be assisted to irrigate any time you are available |__|
3.17 what do you do for a member who destroy irrigation structure? a. He/she has to repair it him/herself |__| b. WUA association will repair it |__| c. Cooperative will repair it |__| d. No follow up |__| e. Other |__| Please mention ……. …….	
4. Stakeholder Involvement	
4.1 Please select the key stakeholders involved in the management of irrigation infrastructure in your district. (Select all that apply) • Government Agencies|__| • Local Communities|__| • NGOs/Development Organizations|__| • Farmers' Associations/Cooperatives|__| • Private Sector/Companies|__| Others (please specify): _____	***4.2 WHAT ROLES DO THESE STAKEHOLDERS PLAY IN THE MANAGEMENT OF IRRIGATION SCHEMES?*** …… …… …… ……
4.3 Are there any stakeholders you believe should have a more active role or that are currently not involved?..... .... …….	***4.4 HOW SATISFIED ARE YOU WITH THE LEVEL OF COMMUNICATION AND COLLABORATION BETWEEN STAKEHOLDERS IN THE IRRIGATION SCHEME MANAGEMENT MODEL? FROM 1 TO 5*** 1: Very Dissatisfied 2: Dissatisfied 3: Neutral 4: Satisfied 5: Very Satisfied

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……..	
5. *WATER FEE MANAGEMENT*	
5.1 How do pay the water fee? a. yearly |__| b. Seasonally |__| c. monthly |__|	***5.2 DO YOU PERCEIVE THE WATER FEE IS WELL MANAGED?*** YES|__| NO|__|
5.3 23. What do you perceive water fee must be used for? ……..	***5.4 23. WHAT DO YOU THINK WATER FEE MUST NOT BE USED FOR?*** ……
6. Opportunity identification	
6.1 Can you identify any untapped opportunities or potential areas for improvement in the current irrigation scheme management model? YES|__| NO|__| If Yes…… …… ……..	6.2 Are there any best practices or successful experiences in your scheme that could be shared with other scheme to enhance irrigation management? YES|__| NO|__| If Yes…… ……
6.3 Are there any best practices or successful experiences from other regions or countries that could be adapted to enhance irrigation management in here? YES|__| NO|__| If Yes……	
7. Policy Recommendations	
7.1 Do you have any additional comments or suggestions regarding irrigation scheme management in your district? (Open-ended) …… ……	7.2 What specific actions or changes would you recommend to policymakers and stakeholders based …… …….

Thank you!!!!

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1.2 Key informant interview guide

Objective 1: Assess Current Irrigation Scheme Infrastructure Management

1. Can you provide an overview of the current irrigation scheme infrastructure management model in Kirehe and Kamonyi districts, highlighting its key features and components?
2. From your perspective, what are the main strengths of the current irrigation scheme management model in these districts?
3. What weaknesses or challenges have you observed in the current management model of irrigation schemes in Kirehe and Kamonyi districts?
4. Are there any notable opportunities that you believe exist within the current irrigation scheme management model for improving irrigation practices?
5. In your experience, what threats or external factors could potentially impact the effective management of irrigation infrastructure in these districts?

Objective 2: Identify Gaps, Challenges, and Opportunities

1. Based on your expertise, what gaps or deficiencies have you identified in the implementation of the current irrigation scheme management model?
2. Could you elaborate on specific challenges that have hindered the efficient operation of irrigation schemes in Kirehe and Kamonyi districts?
3. Are there any obstacles or barriers, such as regulatory, technical, or financial issues, that you consider as primary challenges in irrigation infrastructure management?
4. Have you come across any untapped opportunities or potential areas for improvement in the current irrigation scheme management approach?

Objective 3: Propose Improvements for Enhanced Functionality

1. From your perspective, what feasible recommendations and strategies would you propose to address the weaknesses and gaps you've identified in the current irrigation management model?
2. Are there innovative approaches or best practices from other regions or countries that you would recommend for enhancing the functionality, sustainability, and productivity of irrigation schemes in Kirehe and Kamonyi districts?

Objective 4: Provide Actionable Insights

1. Do you believe that a comprehensive assessment report on the current state of irrigation scheme management in Kirehe and Kamonyi districts would be beneficial?
2. Is there any additional information or perspective you would like to share regarding irrigation scheme management in these districts that we haven't covered in the previous questions?

1.3 Specialised Focus group discussion

Objective 1: Assess Current Irrigation Scheme Infrastructure Management

[1] What are your perceptions of the current management model of irrigation schemes in Kirehe and Kamonyi districts?
[2] Can you share any positive experiences or success stories related to irrigation scheme management in your community?
[3] What are some common challenges or issues that farmers and stakeholders face in the management of irrigation infrastructure?
[4] How do you think the current management model has contributed to the overall development and productivity of agriculture in your district?

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Objective 2: Identify Gaps, Challenges, and Opportunities

[1] In your opinion, what are the major gaps or deficiencies in the current irrigation scheme management model?
[2] Have you personally encountered any obstacles or difficulties in accessing and utilizing irrigation services?
[3] Are there any specific opportunities or innovations that you believe could enhance irrigation practices and overcome existing challenges?
[4] How do you think climate change and variability impact irrigation practices and the challenges faced by farmers in these districts?

Objective 3: Propose Improvements for Enhanced Functionality

[1] What improvements or changes do you believe are necessary to address the weaknesses and gaps in the current irrigation management model?
[2] Are there any local practices or traditional knowledge that can be integrated into modern irrigation schemes to improve their functionality?
[3] How can the community actively contribute to the sustainability and success of irrigation schemes?
[4] Are there any ideas for utilizing technology or modern techniques to improve irrigation efficiency and effectiveness?

Objective 4: Provide Actionable Insights

[1] What kind of information or recommendations would you like to see included in such a report?
[2] How can the findings and recommendations from this assessment be used to influence local policies and decision-making processes related to irrigation management?

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