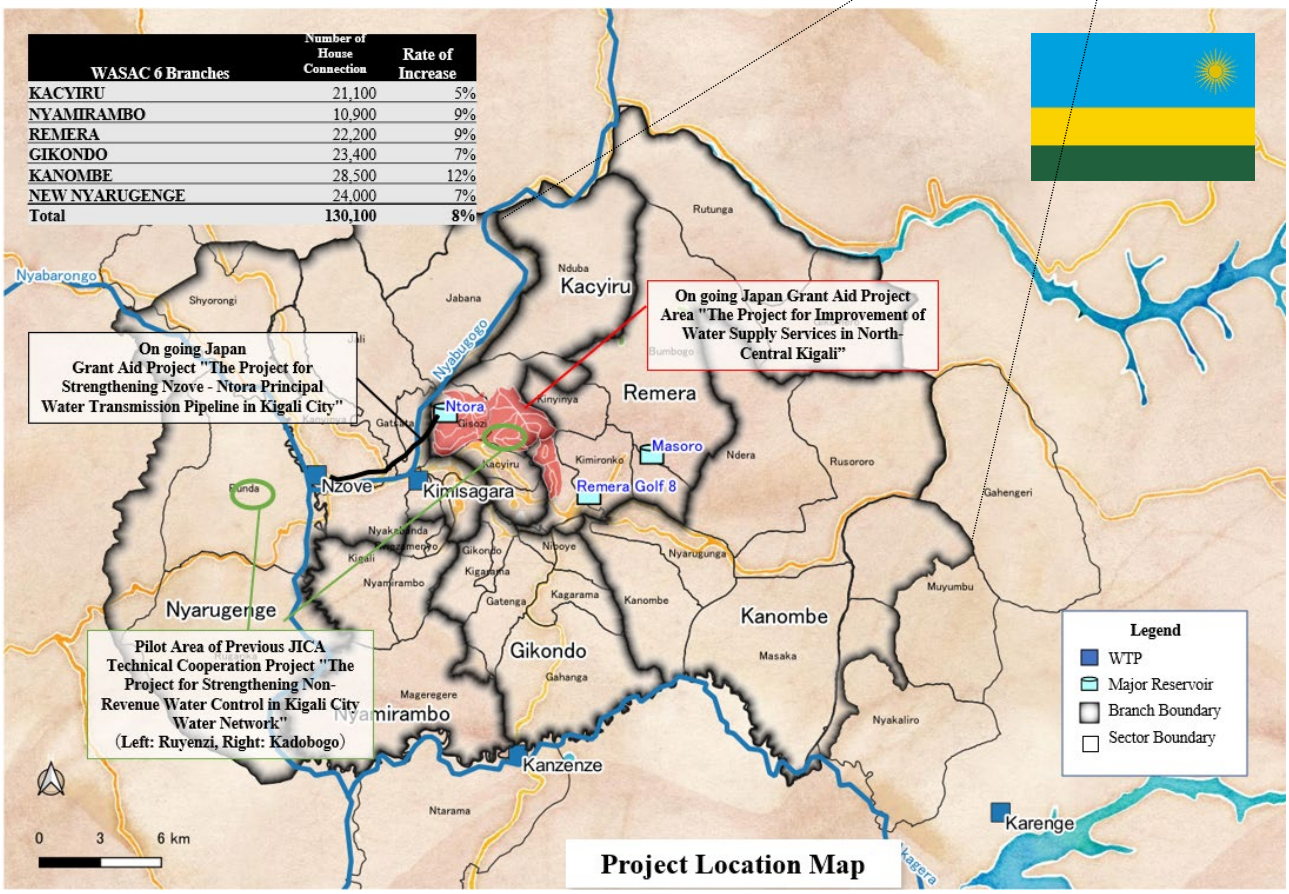
JICA PROJECT BRIEF NOTE

THE PROJECT FOR WASAC UTILITY TURNAROUND WITH KAIZEN APPROACH

July 2025

WASAC 6 Branches	Number of House Connection	Rate of Increase
KACYIRU	21,100	5%
NYAMIRAMBO	10,900	9%
REMERA	22,200	9%
GIKONDO	23,400	7%
KANOMBE	28,500	12%
NEW NYARUGENGE	24,000	7%
Total	130,100	8%



Project Location Map

1. Outline of the Project

1.1 Background of the Project

The target area of this project is the City of Kigali, the capital of Rwanda, and its surrounding seven sectors. The City of Kigali has a water supply population of approximately 1.4 million[i], a water production capacity of about 330,000 m³/day[ii], and has achieved a safe water coverage rate of approximately 98%[iii], marking a certain success in water supply expansion. However, due to insufficient water supply volume and transmission and distribution capacity, some area suffer from severe water shortages, with water supplied only once or twice a week, high non-revenue water (hereinafter referred to as "NRW") rates (All WASAC branches, annual total: 45% as of June 2022 - 37.8% as of June 2025), and inefficient water supply management characterized by energy consumption accounting for over 50% of operation and maintenance cost. Improving efficiency is the greatest challenge for future water supply expansion.

In addition, the City of Kigali extends across numerous hills, and its hilly terrain results in high electricity consumption for pumping. Water pressure is also difficult to manage, and in areas with high pressure, leakages increase significantly.

The water supply sector in Rwanda essentially operates under a model where government funds are used for facility development, and a management company operates the business under a concession license funded by water tariffs. The implementing agency of this project, Water and Sanitation Corporation Ltd (WASAC), was established as a public utility in 2014.

Since September 2023, it has transitioned to a unified system as WASAC Group Ltd, responsible for the development and management of water and sanitation nationwide. Under WASAC Group, there are two companies: WASAC Development Ltd, which undertakes facility development using government funds, and WASAC Utility Ltd, which operates maintenance and management services based on water tariffs. WASAC holds responsibility for water supply and sanitation across Rwanda, but historically, its services have focused heavily on urban piped water supply. In the City of Kigali, reducing intermittent water supply and improving water use efficiency remain challenges. Meanwhile, in rural areas, many communities rely on point water sources using springs, and expanding service coverage remains a major issue. Sustainable business operations are necessary to enable continuous investment.

Under these circumstances, the "Kigali Water Supply Improvement Master Plan Project," implemented from March 2019 to November 2021, formulated a comprehensive Kigali Water Supply Master Plan (hereinafter referred to as “M/P”) to secure water supply against the rapid increase in future water demand until 2050. The plan aims to utilize existing and new water supply systems more efficiently and effectively over the long term. However, realizing the master plan faces many challenges. In particular, the 15-year investment plan to achieve the water supply development scenario estimates an average annual required investment of 34 million USD until 2035. Securing such enormous investment funds and

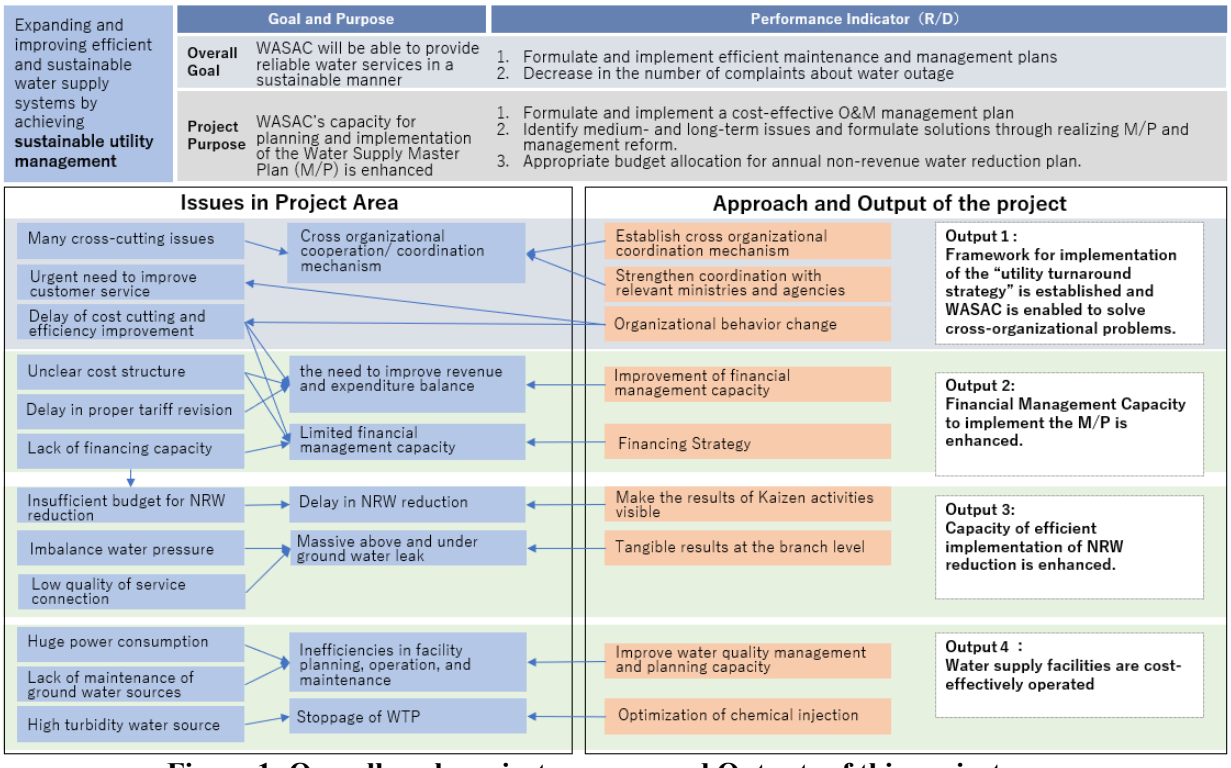


Figure 1: Overall goal, project purpose and Outputs of this project

improving management soundness and efficiency are major challenges. Against this background, a technical cooperation project for comprehensive management improvement was deemed necessary to implement the master plan.

1.2 Overall Goal, Project Purpose and Outputs

The Overall Goal of the Project is "WASAC will be able to provide reliable water services in a sustainable manner.", the Project Purpose is "WASAC's capacity for planning and implementation of the Water Supply Master Plan (M/P) is enhanced.", and the expected Outputs are shown in **Figure 1** in the previous page.

The Project aims to establish the M/P implementation system and to strengthen WASAC's organizational capacity in financial management, NRW reduction, and operational efficiency.

The Project is implemented over three (3) phases as shown in **Figure 2**, and this brief note is prepared at the end of Phase 2 (February 2022 to July 2025).

Project Period		Year					
		2022	2023	2024	2025	2026	2027
Project Period	Feb, 2022 - Mar. 2027 62 Months						
Phase 1	Feb, 2022 - Jan. 2024 24 Months						
Phase 2	Feb. 2024 - Jul. 2025 18 Months						
Phase 3	Aug. 2025 - Mar. 2027 20 Months						

Figure 2: Project Implementation Period

2. Methodologies and Approaches

2.1 Five-Year Business Strategic Plan and Planning Capacity Improvement (Output 1)

WASAC had previously formulated a five-year business strategic plan (5YSBP) as a medium-term plan; however, it was prepared by external experts and WASAC itself was not in a position to actively utilize, implement, or monitor it. Learning from this, the project aimed to create an effective plan as much as possible led by WASAC itself. Through collaboration between WASAC and JICA Expert Team, a new five-year business strategic plan (FY2024/25–2028/29) was developed.

The process employed a participatory approach, holding numerous workshops to encourage involvement of managers and practitioners in drafting the text. After the organizational restructuring in September 2023, WASAC provided inputs to the Ministry of Infrastructure's policy formulation as information providers, and in line with government policies, the WASAC Group planning team took the lead in compiling the plan as a proposal to realize government policies.

Furthermore, to support the implementation of the M/P, an organization-wide team called the "One Strategic Team (hereinafter referred to as "OST")" was established to promote cross-organizational problem-solving. Particularly, triggered by the five-year business strategic plan, OST functions as a forum to intensively address cross-organizational issues, thereby enhancing the plan's effectiveness.

2.2 Strengthening Financial Management Capacity (Output 2)

Building a solid foundation for implementation of the M/P requires improved financial management. By enhancing financial management capacity, the project reduces cost and NRW, improves WASAC's financial status, formulates a financing plan necessary for M/P implementation, and obtains cooperation from funding agencies. Additionally, to strengthen self-financing, tariff revision proposal would be prepared and regulatory and supervisory authorities would be explained accordingly. The position of financial management capacity development in this project is shown in **Figure 3**.

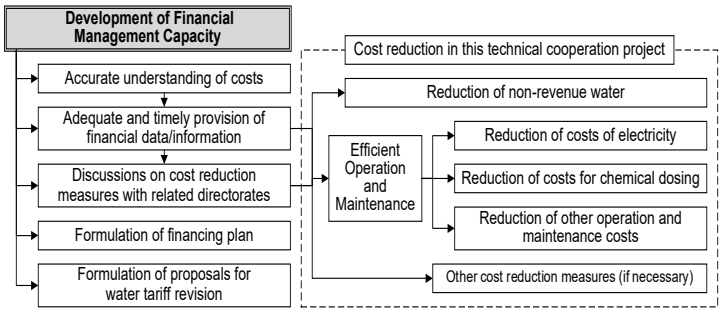


Figure3:Position of Financial Management Capacity Development

2.3 Effective NRW Reduction（Output 3）

The Project adopts an economically efficient NRW reduction approach based on the "branch" unit. This approach selects branches with sufficient scale as management units to ensure NRW reduction activities spread throughout WASAC, starting activities in the selected pilot branch. The pilot branch selected is Kacyiru Branch, located centrally among six branches in the City of Kigali and of medium scale (approximately 28,000 water service connections as of July 2025). This branch faces typical challenges in Rwanda, including aging pipelines and newly expanded areas. The project aims to use knowledge and evidence from this pilot branch to expand activities across WASAC.

Door-to-Door Acoustic Survey

Workshop for Leakage Detection Results

2.4 Efficient Operation of Water Supply Facilities（Output 4）

(1) Optimization of Chemical Dosage at the Water Treatment Plants

An assessment was conducted to identify inefficiencies in the operation and maintenance of water treatment plants. Due to the problem of chemical dosing, the largest water treatment plant, Nzove, frequently experiences operational stoppages during periods of high raw water turbidity, causing water outages and insufficient supply. Optimizing chemical dosing is also important for reducing maintenance costs, a point shared with counterparts. The project verified with the staff responsible for water quality management whether chemical dosing was maintained at appropriate levels in response to seasonal and climatic turbidity variations. The dosing decision process was clarified for each plant, and Standard Operating Procedures (hereinafter referred to as “SOP”s) were developed. The effect was quantitatively evaluated by comparing current dosing amounts with those after SOP implementation.

OJT for Optimizing Chemical Dosing at Nzove WTP

OJT for Optimizing Chemical Dosing at Kimisagara WTP

(2) Energy Saving of Water Supply Facilities

Electricity consumption, which accounts for the majority of energy use in water treatment and pumping stations and over 50% of WASAC Utility’s maintenance costs, was assessed as shown in **Figure 4**. To demonstrate energy efficiency improvements and raise awareness of the need for energy-saving investments, Variable Frequency Drive (VFD) equipment was introduced as a pilot in an existing pumping station. A VFD adjusts the frequency and voltage of the AC power driving a motor, thereby controlling the pump’s rotational speed to regulate discharge pressure and flow rate. This optimizes the motor’s speed and output, improving the overall efficiency of the pump.

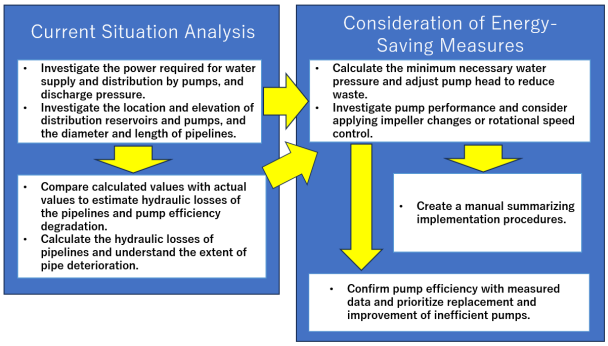


Figure 4: Energy conservation policy

3. Results of Applying these Approaches

The main activities conducted from Phase 1 to Phase 2 (February 2022 to July 2025) and their results are summarized below.

3.1 Activity Results Related to Output 1

(1) Formulation of the Five-Year Strategic Business Plan (5YSBP)

Initially, numerous workshops involving WASAC staff were held to promote WASAC-led discussions, resulting in a draft completed in May 2023, awaiting WASAC's approval. However, following the organizational restructuring in September 2023, the plan was completely revised again with the new WASAC Group.

The Five-Year Strategic Business Plan (Hereinafter referred to as "5YSBP") was formulated as a comprehensive plan for the entire WASAC Group, based on the national water and sanitation M/P and the latest development status. The document was prepared, focusing on how national goals influence the targets of WASAC Development and WASAC Utility, their strategic actions, and how each corporation should share and complement roles.

The completed 5YSBP was reviewed over two days by Directorates, confirmed by the OST and the Steering Committee, and finally approved at the WASAC Group Executive Management Meeting.

Figure 5: WASAC 5YSBP

(2) Operation of the 5YSBP and the 3-year rolling plan

The completed 5YSBP began operation by newly formed planning teams within each of the three WASAC Group companies as of March 2025, prior to the plan's completion, to facilitate evaluation of strategic progress at the end of FY2024/25 and support budget formulation for FY2025/26. Through workshops aimed at enhancing planning capabilities, these teams evaluate whether each budget item aligns with the 5YSBP and whether the budget formulation is adequate to achieve the 5YSBP, thereby striving to improve their capacity to advance the plan.

3.2 Activity Results Related to Output 2

(1) Selection of Priority Areas

Based on a capacity assessment of WASAC's finance-related directorates, the project identified the following seven priority activity areas:

a) Optimization of budgeting and costing
b) Formulation of financing plans and preparation of tariff revision proposals
c) Improvement of internal controls related to inventory management
d) Enhancement of cash management
e) Review of financial policies and procedure manuals
f) Strengthening of tax-related knowledge
g) Others (Improvement of financial reports, W/S on project appraisal, etc.)

Activities related to a) and b) had been prioritized from the Detailed Survey stage, which was to define the scope and schedule of the Project, as essential elements for improving financial management capacity to implement the M/P. Regarding c) and d), as the "financial accounting" to show the exact WASAC's financial status timely to the external stakeholders had been conventionally strengthened and reached the required level, the Acting Chief Financial Officer (CFO) at the time of the activity planning expressed his intention to shift focus

toward improving "management accounting" to enable effective and efficient management improvement of WASAC and "financial management" to manage funds and assets for WASAC management and growth leading to their addition as priority areas (see **Figure 6**).

Figure 6: Steps to improve financial management capacity

As for the above e), the current Financial Policy and Procedure Manual (hereinafter referred to as "FPPM") does not exactly match with the "Comprehensive Standard Operation Procedure Framework for Government-Controlled Companies" issue by the Ministry of Finance and Economic Planning in 2019 as well as the current practices of the WASAC's financial management.

In regards to the above f), substantial assistance deemed necessary to respond to the instructions of the external audit and to file taxes correctly, with support mainly from the local advisor employed by JICA Expert Team. Further, the above g) has been added to promote improvements if necessities arise from time to time.

(2) Capacity Development for Budget and Cost Optimization

Cost reduction efforts has been comprised of i) analysis of past financial and management indicators, break-even points, etc., as preparatory activity, ii) formation of a cost reduction team, iii) examination of target cost items for cost reduction other than NRW reduction by Output 3 team and electricity and chemical cost reduction by Output 4 team., the finance team has examined expense items for cost reduction.

For the first round, a cost reduction measure was selected to reduce the power factor penalty[iv], which is one of the major cost factors and relatively easy to reduce, as confirmed by a benefit-cost analysis. The measure obtained a budget and is currently being implemented. It is estimated that installation of the power factor correction equipment at two water treatment plants takes an initial cost of RWF 72 million and will save the penalty of RWF 32 million annually.

(3) Capacity Development for Formulation of Financing Plan and Preparation of Tariff Revision Proposal

Initially, formulation of financing plan and preparation of tariff revision proposal were planned to be carried out simultaneously. However, in the early stages for preparing the tariff revision proposal, it became clear that the tariff level would be unrealistically high when major investment costs were assumed to be covered by tariff collection. Then, it was decided that investment costs for major facility development were to be excluded in the tariff calculation, tariff collection was to cover O&M costs and investment costs only for last parts of connection with the customers and for NRW reduction, preparation of the tariff revision proposal was to be carried out in advance, and the formulation of financing plan was to be conducted separately and later.

Since September 2024, i) formation of a team in charge, ii) development of a model for tariff revision calculation, iii) explanation/consultation of the model and results of the calculation were conducted, iv) followed by review of the model based on the comments, and v) drafting tariff revision proposal had been carried out. However, a government policy was issued in December 2024, mentioning that the tariff would not be revised for the moment and the revenue gap under the existing tariff would be covered by subsidy. The team, then, calculated required amount of the subsidy. In response to the policy, the team has also started developing "Tariff Revision Standard Operation Procedure" and the "Excel Template" for future tariff revision.

Regarding formulation of financing plan, a mid-term

financial plan was formulated in align with 5YSBP for the first time in WASAC. Going forward, the activity plan will be reviewed in consultation with related stakeholders for formulation of a full-fledged financing plan.

(4) Capacity Development for Internal Control Improvement on Inventory Management

So far, the activities have included i) estimating the Cash Conversion Cycle, i.e., a period from capital investment and payment for supplies to collection of sales revenue and exploring ways to shorten it, ii) recognizing the need to address long-term retained inventory, iii) conducting physical inspections at the central store and Masoro warehouse alongside the staff of the Logistics Division, iv) identifying obsolete inventory of 332 items with total book value of RWF 194 million.

By now, Ministry of Infrastructure (MININFRA) and Ministry of Finance and Economic Planning (MINECOFIN) have approved to write off the obsolete inventory. The Logistics Division is currently examining the method for the disposal.

(5) Capacity Development for Treasury Management

Regarding treasury management, an orientation workshop was held in December 2023 to explain the basic concepts, such as objectives and components of treasury management. Priority activities for treasury management were discussed and determined later. For WASAC Utility, improvement of revenue projection was selected as a priority, and for WASAC Development, the priority was improvement in the calculation of budget requests submitted to the Government.

WASAC Utility is trying a new forecasting method that incorporates factors such as network expansion through facility development and progress in connection with new customers, changing the method from conventional trend-based projection, in collaboration with WASAC Development and the Commercial Directorate of WASAC Utility.

Meanwhile, WASAC Development will attempt to estimate, based on existing data, the costs required to efficiently achieve the water service access rate targets indicated in the National Strategy for Transformation 2.

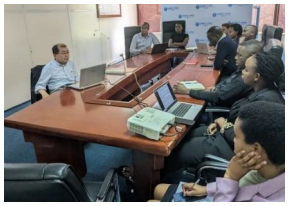
(6) Capacity Development for Review of Financial Policies and Procedure Manuals (FPPM)

Workshops were held in many times to discuss the points to be revised and to draft the proposals. A draft revised FPPM for discussion in the Senior Management Meeting of WASAC. Subsequently, a consultant hired by Ministry of Infrastructure (MININFRA) modified the draft to fit the three companies of WASAC Group. The revised draft was approved by Ministry of Infrastructure (MININFRA) and Ministry of Finance and Economic Planning (MINECOFIN). In Phase 3, workshops will be conducted for applying and operating the FPPM.

(7) Tax Training

Through consultation and guidance sessions, staff acquired extensive knowledge on i) corporate income tax, ii) deferred tax assets, iii) handling of value-added tax (VAT) on water tariffs for government and public institutions, iv) import tax, and v) new tax laws. Although retraining was necessary due to staff changes, organizational knowledge has been steadily enhanced.

Kick-off of Tariff Revision Proposal



Treasury Management Workshop

3.3 Activity Results of Related to Output 3[v]

NRW reduction activities implemented under the project are classified into reactive maintenance and

preventive maintenance as shown in **Table 1**.

Table 1 NRW reduction activities implemented under the project

Item	Main Interventions/Activities
1. Pilot Branch Selection and NRW Monitoring	Establishment of NRW calculation method and baseline measurement at the pilot branch
2. NRW Activity Plan Formulation	Formulation of NRW activity plans at branches
3. Reactive Maintenance	Immediate repair activities for leak response (zone management); high-quality and rapid leak repairs (deployment of technicians, procurement and maintenance of equipment and materials)
4. Preventive Maintenance	Planning, procurement, and implementation of pipeline renewal plans (not completed at the time of writing); underground leak detection (household acoustic surveys); preparation of water pipe construction handbook
5. Cost-Benefit Activities	Cost-effectiveness analysis
6. NRW Reduction Plan	Revision of the 5-year NRW reduction plan
Others	Improvement proposals, 5S activities

(1) Pilot Branch Selection and NRW Monitoring

To clarify NRW issues at an early stage, workshops were conducted based on the Quality Control (QC) circle activity model, which promotes quality control improvements through small group autonomous activities. Staff from various roles including branch managers, distribution managers, plumbers, billing monitors, and meter readers participated collaboratively to solve problems. The workshops emphasized each participant proposing improvements from their perspective and discussing solutions. Monthly meetings were held to monitor NRW rates, progress, issues, and ideas for solutions.

(2) Formulation of NRW Reduction Activity Plan

The issues identified by the improvement team at the branch office were organized using a cause-and-effect (fishbone) diagram, and possible solutions were narrowed down **(Figure 7**). The Kacyiru Branch, located in an urban area with high population density, experienced relatively few cases of water theft and had comparatively better meter reading and billing management than rural branches. However, no personnel had been assigned to manage NRW, and distribution flow meters were not properly installed. As a result, NRW management at the branch level was not sufficiently recognized. Although a system existed for reporting leaks, head office staff manually entered the data, and field plumbers who performed repairs did not know how to enter data, making it impossible to obtain accurate statistics such as leak response times.

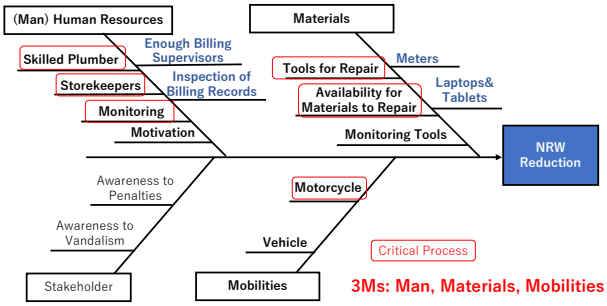


Figure 7: Cause-and-effect diagram of factors contributing to NRW at Kacyiru Branch

Given the high NRW rate (over 40%), the highest priority was placed on tackling visible (above-ground) leaks, with leak detection and repair identified as the most urgent tasks. On the other hand, establishing DMAs (District Metered Areas)[vi] was considered a lower priority at this stage, as it would require large-scale pipe replacements. Similarly, the installation of pressure-reducing valves was also deprioritized. Most pipelines in the area have very small diameters (mainly 25–40 mm), and installing such valves upstream would increase the duration of water outages for some customers, leading to complaints and eventually the discontinuation of the valves. Therefore, pressure management measures were deemed necessary only alongside pipe replacement and were given a lower priority.

In addition, the analysis revealed a lack of field personnel for leak repairs, as well as an absence of tools and transportation provided by WASAC. It was particularly difficult to deploy personnel or reach the sites during weekends or in remote areas.

Furthermore, the branch lacked material stock, and

the petty cash available at the branch was insufficient to purchase necessary materials. As a result, it often took several days to procure materials from the central warehouse after a leak occurred.

Based on this analysis, the key deficiencies in the field were summarized as the "three Ms": Manpower, Materials, and Mobility. An activity plan was developed accordingly.

(3) Corrective Maintenance Activities

As a priority issue, the branch introduced a responsive “Zone Management” approach, which involves assigning specific plumbers to each area with the aim of ensuring quick repair of visible leaks. Necessary repair tools and materials were procured, and a dedicated warehouse manager was appointed to organize and maintain the branch warehouse so that materials could be accessed immediately (Refer to the right side of the photo below).

NRW workshop in progress

Organized warehouse after material procurement

In addition, the "Leak Response Time"—the time from when a leak is reported (by customers or staff) until emergency shut-off measures are implemented—was identified as an important and manageable indicator and was adopted as a Key Performance Indicator (KPI).

To support this, tablet devices were provided and a simple data recording app was developed using free software, enabling plumbers in the field to log information in real time.

(4) Preventive Maintenance Activities (Small-Diameter Pipe Replacement)

Although small-diameter pipelines (160 mm or less), which are prone to frequent leaks, were under the jurisdiction of branch offices, the branches lacked both the capacity and budget to conduct planned pipe replacement. As a result, even for pipelines with high leakage rates, only reactive repairs were being made.

This activity therefore aimed to enhance branch capacity by budgeting and implementing pipe replacement as a means of NRW reduction. The pipe replacement area was selected in the lower elevation section of the Gisozi area (Gi4), where high water pressure had led to frequent leaks. Replacement work was carried out starting with the highest-priority sections, and within the project, a total of 13 km of pipeline replacement and customer reconnections were completed.

(5) NRW Reduction: Decrease in NRW Rate

As a result of these activities, the six-month average NRW rate decreased from approximately 41.4% at the baseline in November 2022 to 22.0% as of March 2025. After April 2025, due to the handover of

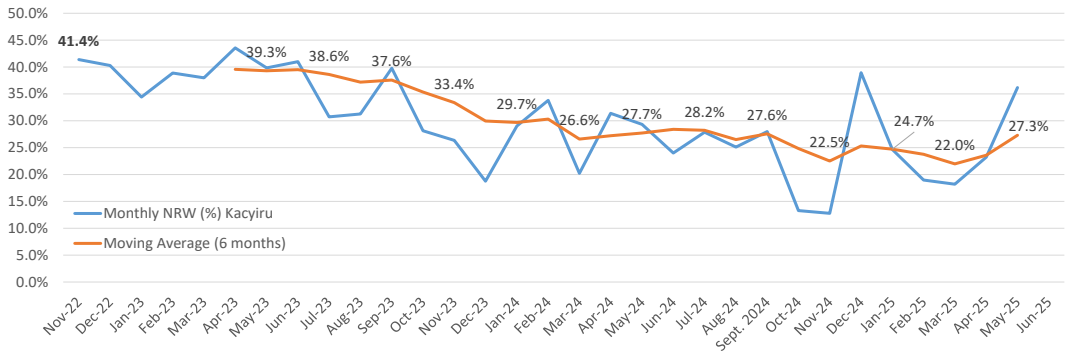


Figure 8 Trend of Non-Revenue Water (NRW) Rate at the Pilot Branch (Kacyiru)

Note: The baseline (November 2022) represents a single-month observation. Subsequent values are six-month moving averages, including the target month.

activities to WASAC, changes in personnel, salary issues, and temporary unavailability of transportation led to a temporary increase in average response time, leak repair time, and NRW rate (27.3% six-month average as of end-May 2025). Based on these challenges and experiences, efforts continue to emphasize the importance of activities and to establish them firmly.

(6) Cost-Benefit Analysis

The cost-benefit was calculated assuming activities continue for five years from project start, with annual maintenance investments sustained and NRW rate maintained at 26.8% (six-month average as of March 2024) from the baseline of 41.4%. Costs included only those for reactive maintenance activities, including on-site and annual recurring costs. Benefits were estimated by assuming the reduced NRW volume over five years is immediately supplied to customers and billed (reduced volume × average unit water tariff). As a result, using a financial discount rate of 6% per year (reflecting the cost of financing and the real interest rate), the benefit–cost ratio (B/C) was calculated at 4.1.

This corresponds to benefits of approximately RWF 2.2 billion (about JPY 240 million) against a present value of investment costs of approximately RWF 540 million (about JPY 59 million), indicating that continuing the activities for five years would generate financial benefits more than four times the investment cost (1 RWF = 0.11 JPY).

The number of customers in the pilot area is increasing, and stable water supply is being realized through prompt leak repairs. Reflecting this, water supply revenue has also increased due to NRW reduction, with an annual increase of approximately 650 million RWF (about 7.1 million yen), based on a comparison of total billed water from June to November in 2023 and 2024.

(7) Integration into the Five-Year Business Strategic Plan and Promotion of Stakeholder Understanding

Based on the above activities, necessary measures for NRW improvement, costs and roadmaps for expanding activities to other branches, and cost-benefit analyses were integrated into the five-year business strategic plan (Output 1) and summarized as project outputs.

The concept of "3M" and its importance were repeatedly presented by branch managers and JICA experts to senior management and stakeholders. As a result, meetings including the Ministry of Infrastructure (MININFRA) and other donors have called for consideration of financing packages, increasing sector-wide understanding of NRW countermeasures and investment momentum.

3.4 Activity Results Related to Output 4

(1) Investigation and Assessment of Water Treatment Plants

To identify inefficiencies in operation, the surveys were conducted at Nzove, Kimisagara, and Karenge water treatment plants to understand water source selection and maintenance status. Major issues related to operation and maintenance included "rising coagulant prices," "frequent changes and workload in selecting coagulants," and "frequent changes of WTP's operators." The team evaluated groundwater treatment plants (Nzove 1) and surface water treatment plants (Nzove 2 and New Nzove 1), finding that when raw water turbidity of the Nyabarongo River exceeds 2,600 NTU (rainy season), groundwater treatment costs are lower than surface water treatment.

(2) Development and Operation of SOPs for Optimizing Chemical Dosing at Water Treatment Plants.

Since no SOPs existed for optimizing chemical dosing, SOPs for each type of chemical were drafted. These drafts were then put into practical operation, and improvement points were identified. Finally, the SOPs were revised based on actual operational

results.

As a result, the quantifiable impact of adopting the SOP was a 4% reduction (47.7 mil RWF per year) in chemical dosing. This reduction was achieved without compromising water quality and while ensuring compliance with water quality standards.

(3) Scoping of Power Reduction Activities and Identification and Analysis of High-consumption Facilities

In implementing power consumption reduction activities, an overview of potential energy-saving measures applicable to water supply facilities was first shared, and a list of feasible actions was compiled. Given that inefficient facilities had not yet been clearly identified, a survey of actual power consumption and equipment specifications was conducted at selected pump stations, water treatment plants, and well fields.

Workshop for Pilot Facility Selection

Survey of Candidate Pilot Facilities

The survey results were compiled, key characteristics were identified, and the information was shared with staff and management at each water treatment plant. Specifically, by comparing the P/Q (power consumption per unit of water) of each facility, the actual power consumption and differences between facilities and systems were assessed. Examples include: (i) both the logically required energy for each facility's pumping equipment (design capacity at the time of facility planning) and the actual energy consumption were quantified; (ii) based on this data, the degree to which pump efficiency had deteriorated compared to the initial design values was numerically determined; and (iii) the extent of efficiency decline in the equipment was also quantified.

The characteristics of each proposed measure, along with the necessary components for implementation and related challenges, were first shared with C/P through a workshop. Through the workshop, the inline booster method was considered the most promising among several options. The inline booster method refers to a system in which a pump is inserted directly into the pipeline and boosts the pressure on the suction side of the pipe. In contrast, the conventional method stores incoming water in a distribution reservoir and then pumps it, which releases the residual pressure of the inflowing water at the reservoir, wasting this energy. The inline booster method avoids wasting this energy and only supplements the insufficient pressure with the pump, thereby reducing the required pumping power compared to the conventional system.

The potential degree of energy savings varies greatly depending on each facility, so the overall effect cannot be calculated. In general, systems with transmission and distribution pipelines requiring large booster facilities, as in Rwanda, often have surplus residual pressure at each receiving point.

The current inline booster method utilizes this surplus residual pressure, and up to 11 facilities could potentially adopt this system. However, calculating the reduction effect requires detailed on-site surveys and is highly influenced by pipeline losses. Therefore, the applicability of this method must be assessed considering future transmission and distribution volumes.

(4) Investment in Energy Efficiency through Pilot Installation of VFD Equipment at Existing Pump Stations.

Based on the results of the above workshop, Birembo Pump Station in the City of Kigali was selected as the pilot site, where a common understanding was reached that the inline booster system is a promising measure capable of reducing energy consumption

through improvements in mechanical and electrical equipment. The necessary equipment for the inline booster system was subsequently procured and installed.

As a result, the Birembo pumping station increased water transmission by an average of 20%, reduced electricity cost per cubic meter by approximately 26%, saving about 28,000 USD annually, with a payback period of about three years. WASAC identified at least six similar pumping stations in Kigali where inline boosting could reduce electricity consumption. Follow-up will focus on strengthening senior management's understanding of the importance of energy efficiency and promoting energy-saving investments.

(5) Final Workshop for Presenting the Results of Output 4 to WASAC Management Officials.

Final workshop was held for WASAC management and all branches, focusing on the adopted measures (such as the chemical dosing SOP and in-line pumps), the background behind their adoption, and the quantitative effects of their implementation. In the workshop, staff from each water treatment plant explained to management, in their own words, how they optimized chemical dosing at the plants, where they had received training and what effects were observed.

Through these activities, treatment plant staff gained the confidence to explain the optimization of coagulant dosing. This serves as a response to questions that may arise in future discussions regarding necessary tariff increases or investment in facility improvements—such as "Are existing resources being used as efficiently as possible?" It is considered that these efforts contributed to strengthening accountability within WASAC's management and supported sound management practices.

4. Lessons Learned in Project Implementation

4.1 Efficient Reduction of Non-Revenue Water

In the past technical cooperation projects on NRW reduction, efforts focused on promoting utilities' understanding of the importance of NRW management, developing advanced technical skills through the application of Japanese technologies, and implementing pilot projects in small-scale DMAs (approximately 1,000–3,000 connections). However, it proved difficult to scale up these activities across the entire utility and achieve a substantial reduction in the overall NRW level.

Based on these lessons learned, the project built on the institutional understanding and human resource base developed through previous initiatives and implemented more efficient NRW reduction measures that were better aligned with on-site operational challenges. As a result, NRW reduction was successfully achieved at the branch level—using a large operational management unit of approximately 28,000 connections—and this contributed to a reduction in WASAC's overall NRW rate from 45% in June 2022 to 37.8% in June 2025.

This experience suggests that clearly demonstrating both effectiveness and cost-effectiveness to the implementing agency's management can facilitate the rollout of high-impact activities that generate broader spillover effects and contribute to overall management improvement.

4.2 Strengthening WASAC's Ownership through Participatory approach

Traditionally, WASAC had a culture of relying on external consultants for planning and had limited experience in formulating plans on its own. To address this, a participatory approach was adopted, where all stakeholders collaboratively developed the Five-Year Strategic Business Plan through workshops. This process fostered WASAC's sense of ownership and initiative.

4.3 Proactive Information Sharing Domestically and Internationally

Efforts were made to enhance information dissemination through presentations at a symposium hosted by the Ministry of Infrastructure (MININFRA), participation in international conferences such as organizing a workshop at the IWA Development Congress in December 2023, and collaboration with other development partners' projects. These activities helped deepen the Ministry of Infrastructure's understanding, sparked discussions on new funding opportunities, and enhanced the international communication skills of participants. Outreach was also conducted in Japan at water-related events to raise awareness and interest.

4.4 Systematic Capacity Development and Ensuring Sustainability

In this project, emphasis was placed on preparing manuals and reference materials to ensure continuity despite staff turnover, thereby promoting capacity development for each activity. To contribute to sustainability, internal procedures that tended to stagnate were facilitated, and proactive engagement was encouraged through the early handover of pilot activities.

4.5 Revising Capacity Development in Response to Organizational Restructuring and Utilizing Remote Meetings and Local Staff

Due to delays in organizational restructuring, the appointment of managers and clarification of roles remained incomplete. In response, the focus of capacity development and monitoring was shifted toward responsible officers and senior staff. Furthermore, local advisors were fully utilized, particularly in activities such as tax training and drafting financial SOPs, providing essential support and information sharing—especially during periods when Japanese experts are not on site.

4.6 Contribution to Strengthening WASAC's Capacity to Implement the Master Plan through the Project

In relation to the construction of water treatment plants identified as priority projects in the Kigali Water Supply Master Plan, which was implemented with JICA's support, the Government of Hungary expressed its intention to provide a loan in November 2021, almost concurrently with the completion of the Master Plan, and a loan agreement of approximately USD 52 million was subsequently signed with the Rwandan side in July 2023. This support represents the Hungarian government's first loan project in Rwanda, and both WASAC and the Hungarian government noted that the high quality of the Master Plan, supported by JICA, contributed to the swift loan decision.

In addition, for other priority projects identified in the Master Plan, namely the development of transmission and distribution facilities, loan agreements were concluded with the Saudi Fund for Development in October 2023 (approximately USD 22 million) and the OPEC Fund for International Development in November 2023 (approximately USD 21 million).

Thus, this project, which aims to enhance WASAC's capacity for planning and implementing the water supply master plan, serves as a good example of how project activities have facilitated the mobilization of development funds from other development partners.

4.7 Contribution to Sustainable Management through Management Improvement and Climate Change Measures

This project is implemented with the objective of contributing to the sustainable management of WASAC's water services and ensuring a stable supply of safe water.

Output 4, which covers activities related to the efficient operation of facilities, contributes to improved electricity efficiency and energy conservation, thereby reducing electricity-related costs and improving WASAC's financial situation.

As a climate change measure, it serves as a mitigation action by reducing Greenhouse Gas (GHG) emissions through energy savings.

Moreover, Output 3, which focuses on activities aimed at reducing NRW, contributes to reducing leakages through improved water distribution, thereby lowering NRW rates. This enhances financial performance by increasing revenue and reducing operation and maintenance costs. From a climate change perspective, these activities contribute both to mitigation, through GHG emission reduction, and to adaptation, through sustainable water resource management.

In this way, the project's activities that contribute to management improvement and climate change measures ultimately support WASAC in providing a sustainable water supply.

4.8 Gender-Sensitive Project Activities

According to the Gender Gap Index 2025, Rwanda ranks 39th in the world (compared with Japan, which ranks 118th), indicating that attitudes toward women's participation in society are more deeply established than in Japan. Many women have advanced to management positions at WASAC, and there is a highly progressive mindset toward gender equality. In implementing project activities, care has been taken to ensure that female staff from WASAC are included in project participation wherever possible.

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[i] WASAC Group Annual Report 2023/2024 and the Water Supply Master Plan for the City of Kigali (Project for Water Supply Master Plan for the City of Kigali)

ii WASAC Group Annual Report 2023/2024 and the Water Supply Master Plan for the City of Kigali (Project for Water Supply Master Plan for the City of Kigali)

iiiNational Institute of Statistic of Rwanda (2025) EICV7

iv A surcharge on the basic electricity bill imposed by the utility company when electricity is used inefficiently and not charged based on power consumption

[v] Matsubara, K. (2025), Journal of Water Environment Society, Vol. 48 (A), No. 3, pp. 82－

[vi] DMA stands for District Metered Area and refers to a divided distribution zone where the water supplied to the area is measured and managed using flow meters.