Turning Water Losses into Service Gains: Lessons from Rwanda's Rural Water Operators

Isoko y'Ubuzima Learning Paper

A consortium learning paper from the Isoko y'Ubuzima Project (2021–2026). ***Authors: C. Ndungutse, L.P. Habimpano, S. Mugabo, I. Ndagijimana, and A. Libey. Version: June 2026***

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Table of Contents

Table of Figures

1. Executive Summary

Non-Revenue Water (NRW) is one of the most persistent and destabilizing constraints on the long-term sustainability and resilience of rural water supply systems across Rwanda. High levels of water loss directly erode the financial revenues of operators, effectively stripping them of the capital needed to maintain aging infrastructure or expand services to new areas. This challenge is further exacerbated by the context of rapid population growth, increasing climate variability, and constrained public financing, which makes every drop of wasted water a critical economic loss.

Recognizing the severity of this issue, the Isoko y'Ubuzima Project, implemented by Water for People jointly with VEI, IRC, and CARE International, in close collaboration with WASAC, Districts, the Regulatory Authority, and Private Operators (POs), established NRW reduction as a flagship intervention. This initiative was not designed as a temporary fix but as a structural transformation to prove that rural water service providers can operate efficiently.

Before the Isoko y'Ubuzima interventions, NRW levels in rural systems were largely unknown because no measurement tools were available to confirm otherwise. This lack of data meant that both physical losses from underground leaks, burst pipes, and overflowing reservoirs, as well as commercial losses caused by theft or billing errors, were unknown.

The flagship was grounded in a central performance hypothesis:

Operator Performance = Capability × Incentives × Accountability

The three factors are mutually reinforcing, and all are needed for performance to last, though operators usually build them up over time rather than all at once. This framework was used to interpret variation in NRW outcomes across systems and over time.

Our theory of change for NRW reduction follows this pathway:

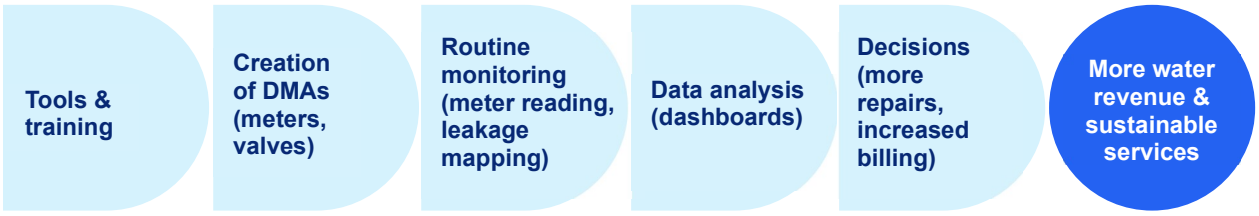

Figure 1. *Theory of Change for NRW reduction in the Isoko y'Ubuzima Project*

Rather than treating NRW as a purely technical issue to be solved with hardware, the project adopted a systemic approach that combined institutional strengthening, operational tools, data-driven decision-making, and behavioral change. Over the course of implementation from 2022 through 2025, the project tested whether rural water operators often perceived as too small or resource-constrained could successfully apply best-practice NRW management techniques such as District Metered Areas (DMAs), customer database cleaning, targeted meter replacement, and minimum night flow analysis. Ten rural water supply systems were selected for intensive piloting, supported by structured capacity building, multi-stakeholder task forces, and business-focused performance analysis.

The results were significant. Across the piloted 10 water supply systems, average NRW declined from approximately 69% at baseline to a low of 29% by September 2024, before stabilizing at 38.7% by September 2025 following a period of sector restructuring and management transitions. These reductions translated into substantial financial gains, improved service continuity, and stronger operator confidence. A cost-benefit analysis of four systems demonstrated that investments in NRW reduction achieved full payback within approximately two years, confirming NRW reduction as one of the highest-return investments available to rural water utilities.

The causes of high NRW varied, and the project's diagnostics made them visible for the first time. Commercial losses were dominant in many systems: in 2023, 79% of 6,707 surveyed customers did not receive bills regularly, 35% of meters were in poor condition, and 85 illegal connections were identified. Physical losses were driven less by aging assets alone than by accidental damage and vandalism, which together accounted for half of the 206 leaks logged in one district-wide analysis. Each operator that succeeded in reducing NRW first diagnosed its own loss profile and then matched interventions to it: billing and metering improvements where losses were commercial, and leak repair and pressure management where losses were physical.

Key achievements include:

- Establishment and operationalization of District Metered Areas (DMAs) in all pilot systems, enabling routine water balance analysis and targeted interventions.
- Replication of the DMA approach by several Private Operators beyond the initial project-supported systems, demonstrating ownership and scalability.
- Increased billed water volumes and additional revenues generated from water savings achieved through leak repairs, meter replacement, and improved billing accuracy.
- Improved continuity of service, including longer daily supply hours and reduced frequency of unplanned outages.
- Strengthened coordination between Private Operators, Districts, and WASAC Branches through regular NRW task force meetings and structured reporting.

Crucially, performance varied across systems. Where operators could use data, incentives aligned with revenue recovery, and accountability enforced through district and WASAC oversight, NRW reductions were sustained. Where one or more of these conditions weakened, particularly during transitions to new youth-led operators, gains slowed or temporarily reversed.

This paper documents the design, implementation, results, and lessons of the NRW program. It is intended as a learning product for policymakers, utilities, development partners, and practitioners seeking to scale cost-effective NRW reduction in rural settings. The evidence demonstrates that with the right institutional conditions, NRW reduction is not only feasible in rural systems; it is also foundational to sustainable service delivery.

2. Introduction & Background

2.1 National Context

Rwanda's rural water supply sector has undergone significant, transformative reforms over the past decade, with a focus on the professionalization of service delivery through delegated management models. Initially, this transition was led by established Private Operators (POs), who assumed management from community committees, bringing a higher level of technical capability to the sector.

More recently, the sector has evolved further with the introduction of youth-led companies that took over the contracts of established operators in 2024, as part of the government's drive to professionalize rural water management while reducing unemployment among the youth. Importantly, these transfers happened where existing arrangements were already struggling, so the youth-led companies generally inherited the systems with the highest starting losses. Comparisons of NRW between youth-led and established operators, therefore, reflect the condition of the systems each was given as well as the operators themselves. Furthermore, WASAC's mandate, which was limited to urban water service delivery, has been extended to cover the rural water service provision. These reforms aim to improve operational efficiency, service quality, and financial sustainability, ensuring that rural populations receive the same standard of care as urban residents.

Despite these progressive structural changes, WASAC and the District authorities continue to face challenges in providing adequate oversight of these dispersed systems. The national performance target for rural systems is 25% NRW, but most systems have not yet met it. Within this evolving institutional arrangement, NRW management emerged as a shared but weakly coordinated responsibility among the national institutions responsible for water service provision.

It was frequently constrained by limited technical skills among field staff, fragmented data systems that hindered tracking, and insufficient incentives for operators to invest their own capital. The lack of a unified approach meant that while the governance structures were improving, the physical and commercial efficiency of the networks lagged.

2.2 Rwanda's private water operators

In Rwanda, rural water private operators (POs) are locally registered service companies responsible for the day-to-day operation of piped water systems in rural areas and small towns. They are typically small to medium-sized enterprises, operating with lean teams that include a manager, technicians (such as plumbers or pump operators), meter readers, customer care staff, and basic accounting personnel. While some operators manage a single water supply scheme, others oversee multiple systems or clusters, serving populations ranging from a few thousand to tens of thousands of users.

To operate, a private operator must be formally established under Rwandan company law and obtain a service provision license from the Rwanda Utilities Regulatory Authority (RURA). Operators are competitively selected and contracted for five-year terms by WASAC, which now holds ownership of rural water infrastructure assets and serves as the contracting authority. Districts participate in the contracting process as witnesses, while also playing an important role in local oversight and coordination. Under this arrangement, private operators function strictly as service providers, with clearly defined responsibilities but without ownership of the infrastructure they manage, so they are not counted as utilities under Rwandan law.

In practice, private operators are responsible for all operational, commercial, and routine maintenance functions. Their duties include operating water abstraction, treatment, and distribution systems; conducting preventive and corrective maintenance; detecting and repairing leaks; reading meters; billing and collecting revenues; and managing customer relations. Their performance directly influences service reliability, water quality, and the financial sustainability of the systems.

In terms of capacity, most operators combine practical technical skills with basic commercial and financial management skills. They are generally well-versed in routine system operations, minor repairs, and revenue collection. However, more advanced competencies, such as hydraulic modeling, asset management, and data-driven performance analysis, are often limited and have been the focus of ongoing capacity-building and professionalization efforts within the sector.

Private operators operate within a structured institutional framework. They report contractually to WASAC, which provides technical oversight and ensures compliance with national service standards. At the same time, they are regulated by RURA in terms of licensing, tariffs, and service quality. Districts remain key stakeholders at the local level, supporting coordination, monitoring service delivery, and facilitating engagement with communities.

Overall, private operators form the operational backbone of rural water service delivery in Rwanda, ensuring that infrastructure investments translate into reliable services for end users. Their presence across the country reflects a mature and increasingly professionalized service delivery approach, with ongoing efforts to strengthen their technical and managerial capacity.

2.3 The Isoko y'Ubuzima Project

Isoko Y'Ubuzima[1] is a five-year project funded by the US Government, running from July 2021 to July 2026. This initiative is implemented by a consortium led by Water for People and CARE International, with the participation of IRC, VEI, and AEE. Its primary aim is to enhance WASH service delivery. The project's broader objective is to expand and sustain equitable access to safe drinking water and sanitation services, ultimately reducing the health, economic, and social challenges faced by families due to inadequate WASH services. To achieve its mission, Isoko Y'Ubuzima focuses on three interconnected strategic goals:

- Strengthening decentralized WASH governance.
- Enhancing rural drinking water services.
- Improving rural sanitation and handwashing services and products.

[1] https://rwanda.waterforpeople.org/isoko-yubuzima/

3. Overview of Interventions Provided

The NRW flagship under the Isoko y'Ubuzima Project was implemented through five integrated intervention packages addressing the behavioral, commercial, technical, data, and institutional drivers of water losses. Rather than relying on isolated activities, the approach combined mutually reinforcing actions to establish NRW management as a core and sustainable business function within rural water service delivery.

3.1 Capacity Development and Behavior Change

This package focused on transforming how NRW is understood and managed by sector actors and communities. At the start of the project, many stakeholders perceived water losses as inevitable, which limited proactive action. To address this, the project delivered structured training programs covering NRW concepts, water balance analysis, and practical techniques for reducing both physical and commercial losses. These training courses targeted Private Operators, WASAC branch staff, and District personnel to ensure a shared technical foundation across institutions.

Beyond formal training, the project emphasized continuous learning through refresher sessions and practical application of concepts in daily operations. At the community level, awareness campaigns were conducted to sensitize customers on the importance of protecting water infrastructure, reporting leaks, and discouraging illegal connections. Operators were supported to engage local leaders and organize community discussions, effectively extending NRW management beyond technical teams to the broader public. This combination of professional capacity building and community engagement helped shift both attitudes and practices, creating a shared responsibility for reducing water losses.

Figure 2: *Participants following the training on hydraulic modeling of water distribution networks.*

3.2 Commercial and Financial Performance

This package aimed to strengthen the financial performance of operators by addressing commercial losses and demonstrating the economic value of NRW reduction. A key entry point was supporting operators to translate water losses into monetary terms, allowing them to clearly understand how NRW affects their revenues and profitability. This was reinforced through detailed cost-benefit analyses conducted in pilot systems, which showed that investments in NRW reduction could be recovered within a relatively short timeframe, thereby providing a strong business case for action.

To improve billing and revenue collection, the project supported the deployment of the Customer Management System for Rural Water Supply Services (CMS-RWSS). This involved not only installing the system but also working closely with operators to clean and update customer databases, ensuring that all active connections were properly recorded and billed. Finance staff received hands-on training to use analytical tools, including Excel-based dashboards, to detect irregularities such as inactive accounts, abnormal consumption patterns, or sudden drops in usage. These analyses often revealed issues such as faulty meters or unauthorized consumption.

In addition, the project introduced meter testing practices to assess the accuracy of customer meters, many of which were found to under-register consumption. By enabling operators to systematically test and replace inaccurate meters, this intervention helped recover previously unbilled water. Altogether, these efforts significantly improved billing efficiency and revenue collection, while reinforcing the perception of NRW reduction as a financially sound investment rather than an operational burden.

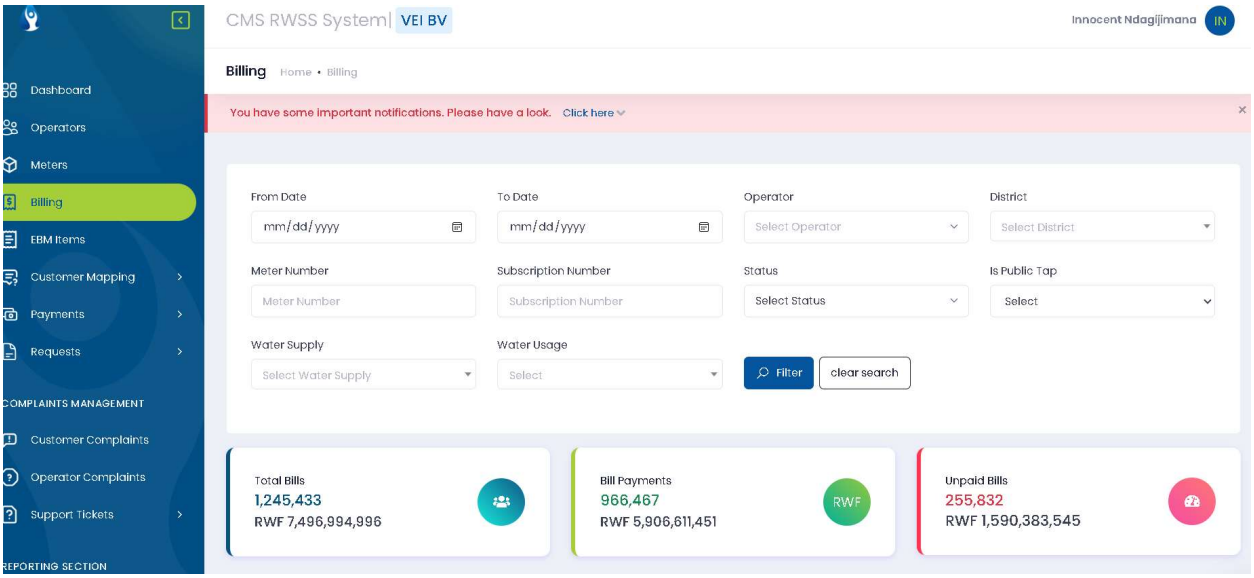

***Figure 3**: Customer Management System (CMS) for the improvement of billing and collection efficiency. Source: VEI*

3.3 Technical Loss Reduction and Infrastructure Package

This package addressed physical water losses by improving network management and targeting critical infrastructure weaknesses. A central component was the establishment of District Metered Areas (DMAs), which involved dividing large distribution networks into smaller, manageable zones equipped with bulk meters and control valves. This segmentation allowed operators to monitor water flows more precisely by comparing the volume of water entering a zone with the volume billed to customers within that area, thereby identifying zones with high losses.

To complement this zonal approach, the project supported comprehensive house-to-house surveys that went beyond routine meter reading. These surveys involved verifying every connection, identifying illegal connections, detecting faulty or unreadable meters, and correcting inconsistencies in customer records. The data collected through these surveys provided a detailed understanding of both physical and commercial loss drivers.

Based on the findings from DMAs and field assessments, targeted rehabilitation works were undertaken, focusing on high-impact assets such as leaking reservoirs and critical sections of the network. By prioritizing interventions where losses were greatest, operators were able to achieve significant reductions in water losses with relatively limited resources. These improvements also translated into better service delivery, including increased system pressure and more reliable water supply, demonstrating the tangible benefits of NRW reduction to both operators and customers.

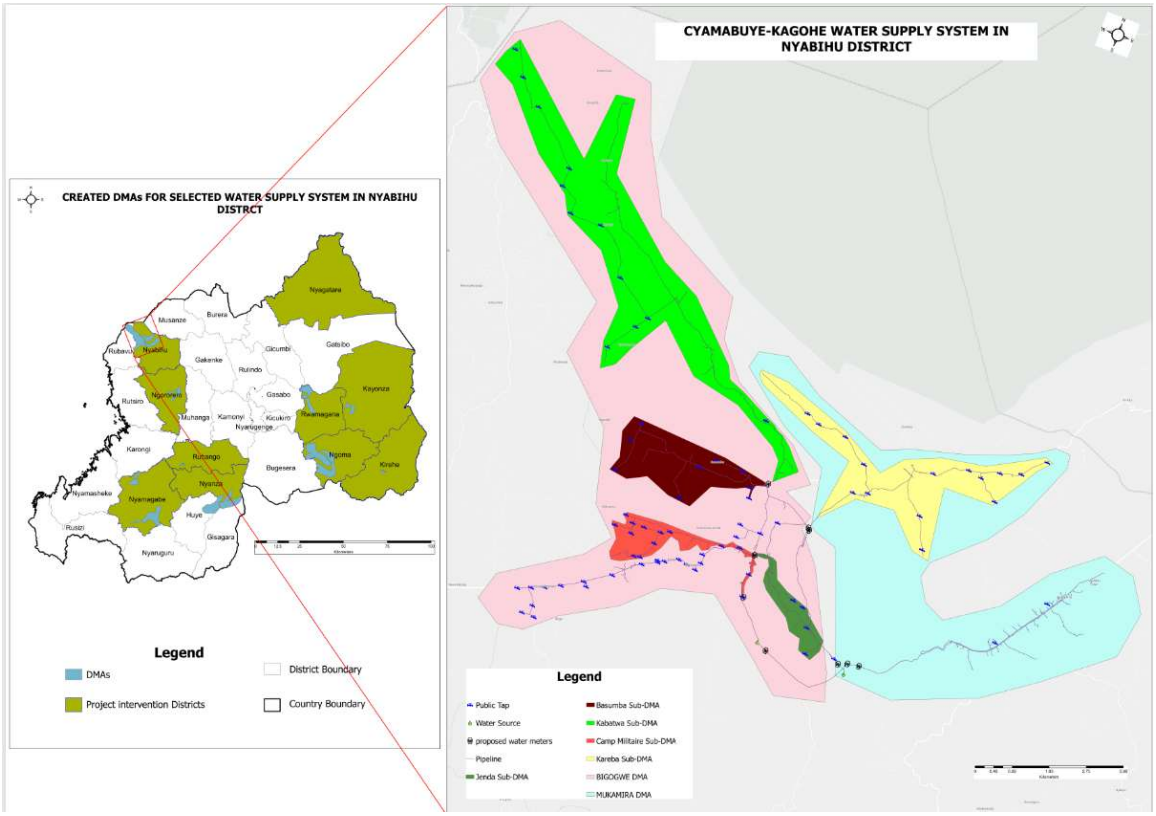

***Figure 4**: Mapping of five (5) sub-DMAs designed on the Cyamabuye-Kagohe Water Supply System in Nyabihu District. Source: VEI*

3.4 Data, Monitoring, and Decision-Support Package

This package strengthened the ability of operators to manage NRW through reliable data and analytical tools. The project developed and introduced user-friendly monitoring systems, particularly Excel-based dashboards designed to track key performance indicators such as water production, consumption, billing efficiency, and NRW levels. These tools were tailored to the operational context of rural water systems, ensuring that they could be easily adopted and maintained by operator staff.

Training was provided not only on how to input data but also on how to interpret results and use them for decision-making. Operators learned to analyze trends over time, identify anomalies, and link data insights to operational actions, such as prioritizing leak detection efforts or investigating sudden revenue declines. The dashboards effectively provided a continuous performance overview, allowing managers to detect and address issues before they escalated into major problems.

Dashboards built accountability, as operators and districts were able to see the same information. Additionally, billing officers knew that their performance was being tracked daily, which incentivized them to ensure accurate meter readings and timely bill distribution. The tool allowed management to compare the performance of different zones, creating healthy competition among staff to reduce commercial losses. It also facilitated better communication of performance within organizations and with external stakeholders, supporting transparency and accountability in NRW management.

3.5 Governance, Accountability, and Institutionalization Package

This package ensured that NRW management was embedded within sector institutions and sustained beyond the project's duration. Multi-stakeholder NRW task forces were established at the system level, bringing together Private Operators, WASAC branch representatives, and District staff to regularly review performance data and coordinate actions. These meetings created a structured platform for discussing challenges, agreeing on corrective measures, and tracking progress over time.

The task forces also played an important role in strengthening accountability, as operators were required to present their performance and justify their results before peers and regulators. This fostered a sense of responsibility and encouraged continuous improvement. In parallel, each operator was supported to develop a five-year NRW reduction strategic plan, outlining priority actions, investment needs, and implementation timelines. These plans helped operators move from short-term, reactive interventions to more structured and forward-looking management.

To further strengthen institutional sustainability, the project actively engaged WASAC Branch Managers, equipping them with the skills and tools needed to supervise and support operators on NRW management. By integrating NRW oversight into existing reporting and supervision structures, the project ensured that NRW remains a routine management priority rather than a temporary project focus. This institutional anchoring is critical for maintaining progress and scaling up successful practices across the sector.

4. Results for non-revenue water reduction

Data was collected during the project across three main domains for analysis – household experiences of water reliability and customer satisfaction, the NRW rates of pilot water schemes in nine districts, and the performance of the targeted private operators.

4.1 Household experiences of water reliability

To illustrate the baseline challenge of NRW in nine districts, Isoko y'Ubuzima conducted house-to-house surveys in December 2023, 2024, and 2025 (n=6,707, 7,576, 9,213). The baseline findings revealed the depth of this crisis, identifying 364 unregistered or unbilled customers (out of 5,793 mapped connections), 85 cases of illegal connections, 1,936 meters that were unreadable, and 116 that were physically damaged, rendering accurate billing impossible. Without accurate data, operators were unable to determine whether their losses were due to a broken pipe or a broken process.

From 2023 to 2025, however, major improvements were seen at the household level. Customer growth and an increase in metering coverage meant sample sizes in the surveys increased by over a third. Households received more regular bills, more reliable service, and reported higher satisfaction, as shown in

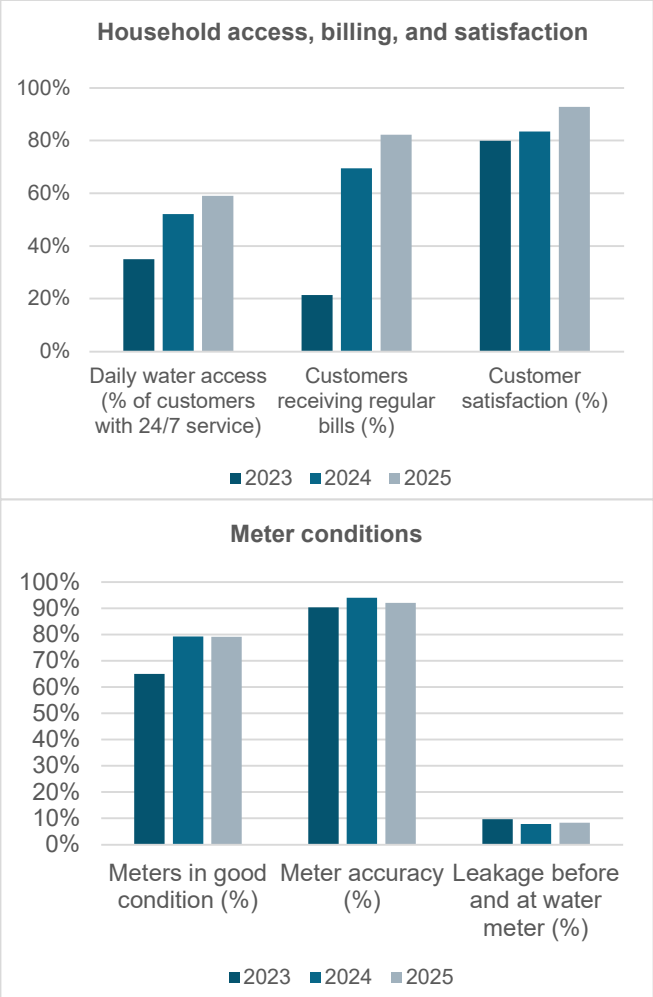

***Figure 5**: Top chart: Household water service reliability 2023-2025. (N=6,707, 7,576, 9,213). Bottom chart: Meter conditions, accuracy, and leakage at tested meters 2023-2025. Source: Household surveys (N=2,079, 2,125, 2,491).*

Household customer satisfaction reached a high of 93% in 2025. A sample of household meters was also tested for functionality and accuracy, and for any leakage before or at the meter location. At baseline, 35% or 2,348 meters were in poor condition, and this decreased to 21% in 2024 and stayed steady in 2025 after meters were replaced, suggesting damage and vandalism did not recur after meters were replaced. Accuracy levels were above 90% all three years. Leakage went down from 10 to 8%, suggesting this is still a significant source of leakage contributing to non-revenue water.

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(left chart) The increase from 21% to 82% in billing is especially stark.

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The consequences of this inefficiency were significant and widespread, affecting all stakeholders across the water value chain. Reduced revenues for POs meant they had limited funds for preventive maintenance, leading to a vicious cycle of infrastructure deterioration and further water loss. This operational weakness led to more frequent service interruptions and growing customer dissatisfaction, as customers were often billed incorrectly or received intermittent supply.

4.2 Pilot water scheme NRW results

Findings are shown for ten selected water supply systems where quarterly production, billing, and loss data were available from operators in ten different districts from 2023 to 2025. NRW levels varied widely across the ten systems, with a general trend of improvement over time.

At baseline (FY23), volume-weighted NRW was highest in Ruhango's Nyamyishywa-Mbuye-Buhanda system (85% of system input volume) and Nyamagabe's Mutengeri-Nyarwungo-Musaraba system (90%), while Kahene in Kirehe started at 28%.

Across all ten systems, NRW fell from 69% in Q1 FY23 (October to December 2022) to a low of 28.7% in Q4 FY24 (July to September 2024). It then rose sharply during the operator transitions and the stop-work period, peaking at 56.3% in Q2 FY25, before recovering to 38.7% by Q4 FY25 and holding at 39 to 42% through the first half of FY26 (Figure 5). The project, therefore, closed with average NRW roughly 30 percentage points below baseline, but still above the national target of 25%.

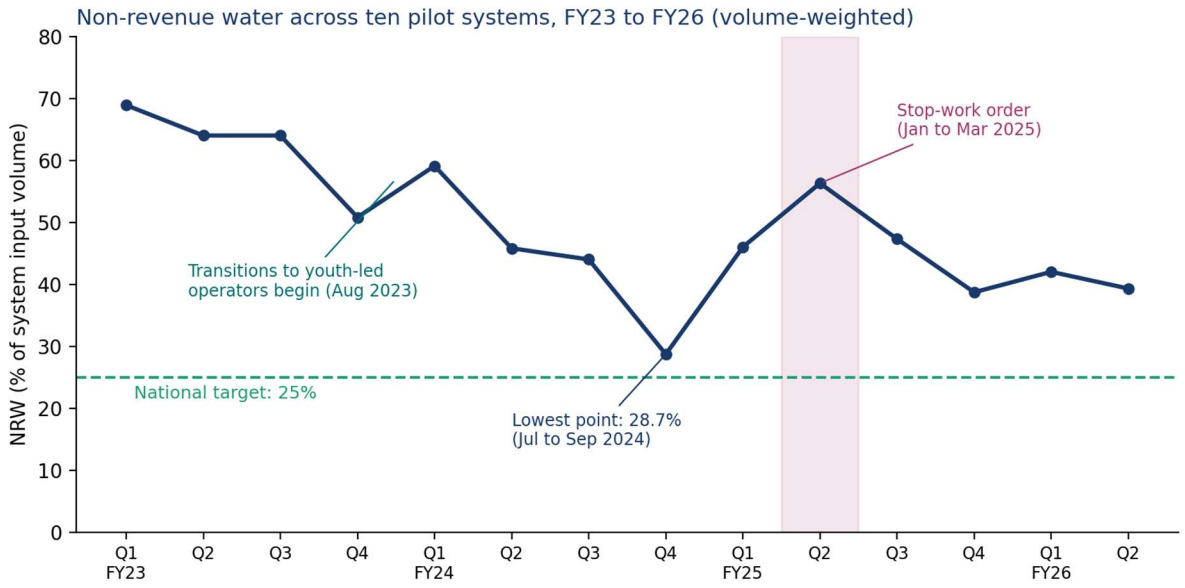


***Figure 6**: Quarterly non-revenue water across the ten pilot water supply systems, Q1 FY23 (October to December 2022) to Q2 FY26 (January to March 2026), expressed as the volume-weighted share of system input volume that was not billed. Source: operator production and billing reports compiled in the Isoko y'Ubuzima NRW monitoring dataset (2021 to 2026).*

***Table 1:** Non-revenue water in the ten pilot water supply systems by operator and period. NRW is volume-weighted (total unbilled volume divided by total system input volume) within each period. Endline covers Q3 FY25 to Q2 FY26. Quarters reported counts quarters with non-zero production and billing data out of the 14 quarters between Q1 FY23 and Q2 FY26. The national target for NRW is 25%. Source: Isoko y'Ubuzima NRW monitoring dataset (2021 to 2026).*

Water supply system	District	Private operator (2026)	Operator type	NRW FY23 (%)	NRW FY24 (%)	NRW endline (%)	Quarters reported (of 14)
Fumbwe-Gahengeri	Rwamagana	Ubuzima Bwiza MKM Ltd	Established PO	48	41	19	14
Kahene	Kirehe	Ayateke Ltd	Established PO	28	28	24	13
Ngabwe-Ryarubondo	Nyamagabe	Nibwobuzima Ltd	Established PO	40	49	25	14
Cyamabuye-Kagohe	Nyabihu	REDEC Ltd	Established PO	58	45	48	14
Karongi	Kayonza	WASAC Kayonza Branch	WASAC branch	48	28	34	9

Gasetsa-Sake-Jarama-Rukumberi	Ngoma	WASAC Ngoma Branch	WASAC branch	59	67	45	9
Nyarushishi-Ngororero	Ngororero	WASAC Ngororero Sub-branch	WASAC branch	71	no data	64	6
Ruhashya-Ntyazo	Nyanza	Aqua Management Ltd	Youth-led PO	87	no data	53	9
Mutengeri-Nyarwungo-Musaraba	Nyamagabe	Axion Water Solution Ltd	Youth-led PO	90	no data	56	9
Nyamyishywa-Mbuye-Buhanda	Ruhango	NG&WS Ltd	Youth-led PO	85	no data	76	5
All systems				61	44	42	

Reporting completeness is itself a performance indicator. The four systems run by established Private Operators submitted production and billing data in nearly every quarter of the project. By contrast, the three systems that transitioned to youth-led companies submitted no usable data for any quarter of FY24, the year of the handovers, and again reported nothing during the stop-work quarter (Q2 FY25). The three WASAC-managed systems had the largest cumulative gaps. Where no data exists, no water balance can be calculated, and no targeted intervention is possible; the blank cells in Table 1 mark precisely the periods and places where NRW management lapsed. Nonetheless, those water supply systems still saw NRW reductions from baseline to endline.

Figure 7 shows the absolute reductions in NRW from baseline to endline for each water supply system.

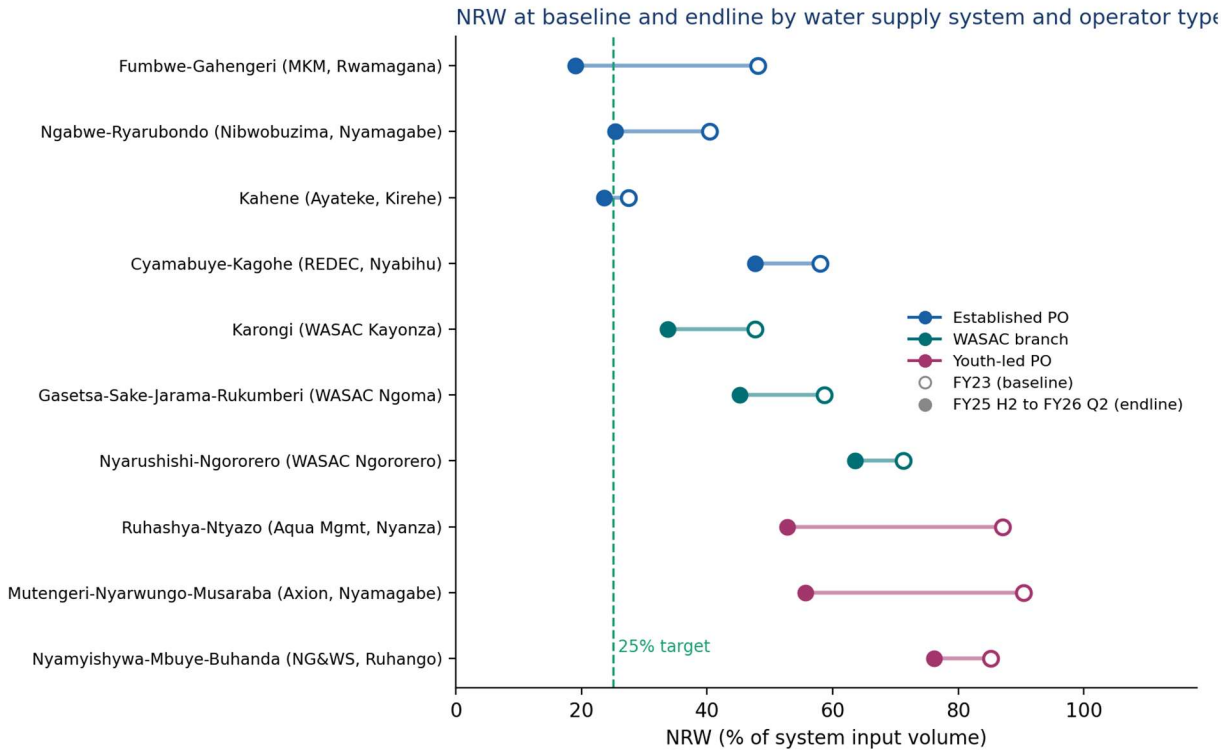


Figure 7: *NRW at baseline (FY23) and endline (Q3 FY25 to Q2 FY26) for each pilot system, grouped by operator type. Hollow markers show baseline; solid markers show endline. Source: Isoko y'Ubuzima NRW monitoring dataset (2021 to 2026).*

4.3 The causes of non-revenue water in rural Rwanda

Non-revenue water has two fundamentally different sources: physical losses (water that leaves the network through leaks, bursts, and overflowing reservoirs) and commercial losses (water that reaches customers but is never billed because of broken or inaccurate meters, missing customer records, billing failures, or illegal connections). The remedies differ entirely. Physical losses call for leak detection, pipe repair, and pressure management; commercial losses call for clean customer databases, functioning meters, and billing enforcement. Community engagement is effective at both reducing illegal connections and unpaid bills. At baseline, no operator in the pilot could determine their specific causes of NRW, so investments risked being misdirected. The project's diagnostic tools (DMAs, minimum night flow analysis, house-to-house surveys, meter testing, and digital leak logging) made the composition of losses visible for the first time. The evidence they produced challenges the common assumption that rural NRW is primarily an infrastructure-age problem.

Commercial losses: water delivered but never billed. The house-to-house surveys revealed how much loss was administrative rather than physical. In 2023, 5,273 of 6,707 customers surveyed (79%) did not receive bills regularly, 2,348 meters (35% of those surveyed) were in poor condition, 202 of 2,079 tested meters (10%) recorded inaccurately, and enumerators documented 85 illegal connections. The FY23 customer mapping found 364 connections receiving water that appeared on no billing list. Meter under-registration was a quiet but large drain: when REDEC Ltd replaced meters at 23 high-consumption connections, 13 of which had been recording zero consumption, billed volumes at those connections rose from 1,240 to 4,575 cubic meters per month. Water that had been flowing for years was simply never measured. By 2025, the surveys showed the commercial picture transformed: customers not receiving regular bills fell to 1,641 of 9,213 (18%), illegal connections fell from 85 to 8, and customer satisfaction rose from 80% to 93%.

Physical losses: where and why the network leaks. The most detailed evidence on physical losses comes from Home Praise Ltd in Ngororero District, which logged every repaired leak in mWater between December 2024 and September 2025 (n=206, Figure 8). Aging infrastructure, often assumed to be the dominant driver of rural losses, accounted for 39 leaks (19%). Accidental third-party damage was the single largest recorded cause (63 leaks, 31%, though field classification was often uncertain), followed by vandalism (40 leaks, 19%) and bursts from high pressure (30 leaks, 15%). Substandard pipes, fittings, or installation together accounted for 13 leaks (6%). More than half of leaks (108 of 199 with recorded diameter) occurred on small distribution pipes of 32 mm or less, the lines closest to communities and most exposed to farming, construction, and tampering. Plumbers estimated 29,181 cubic meters lost across the 206 events, and the median leak ran for 20 hours before repair, underlining the value of rapid reporting and response.

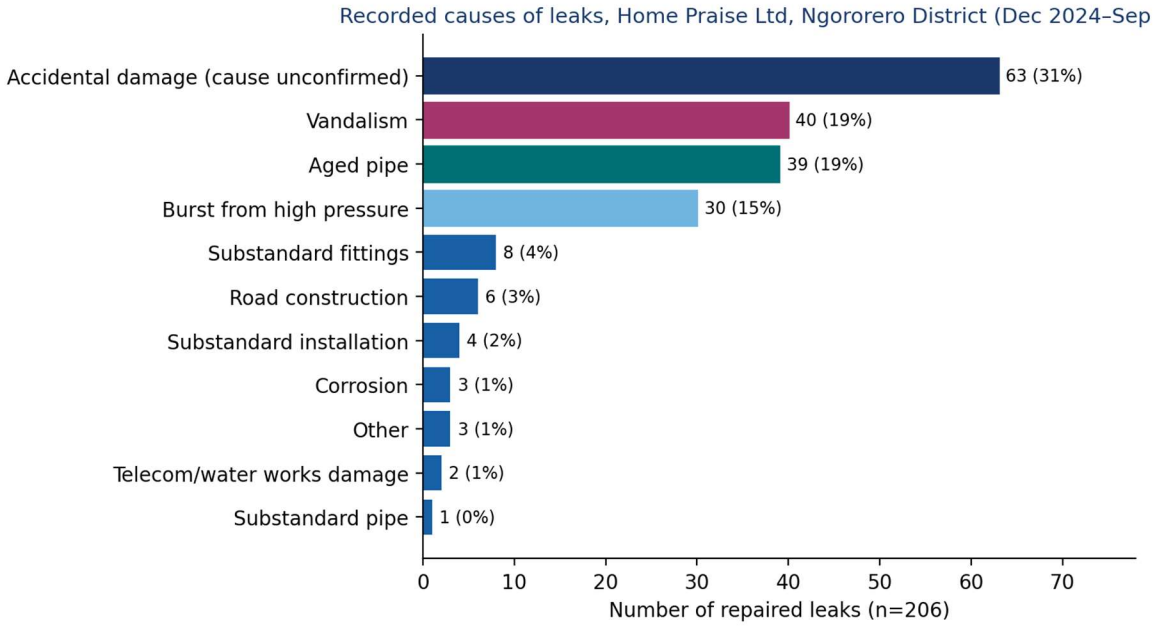


***Figure 8**: Recorded causes of the 206 leaks repaired by Home Praise Ltd in Ngororero District, December 2024 to September 2025. Causes are classified by the responding plumber; the largest category reflects accidental damage where the underlying cause could not be confirmed. Source: Home Praise Ltd leakage log, mWater (2024 to 2025).*

Two implications follow. First, in these rural systems, NRW is as much a social and institutional problem as a technical one. Vandalism, accidental damage, and illegal connections together rival every infrastructure-related cause combined, which explains why community engagement, Umuganda sessions, and house-to-house surveys produced loss reductions comparable to physical repairs. Second, where losses were genuinely physical, they were often concentrated and findable: minimum night flow analysis at MKM's Mununu sub-DMA traced a single hidden leak whose repair cut night flows from around 72% of zone input to under 10% (Section 4.7). A caveat applies: cause attribution depends on the plumber's judgment at the point of repair, and the largest category (accidental damage) signals that classification practice still needs strengthening. The one-district leak log is indicative rather than representative, and similar logging across all systems would allow the sector to test whether this pattern holds more widely.

Two further limits are worth stating. First, the data here do not allow a precise split between commercial losses, such as under-registration, illegal connections, unpaid bills, and physical losses from leaks and bursts. The leak log captures repair events well, but commercial losses are harder to observe. Second, operators are not fully responsible for every commercial loss. Some depend on the regulator providing and enforcing a reliable billing and metering framework, and on customers, including government and institutional users, paying their bills. Where those conditions are weak, even a capable operator cannot close the commercial gap on its own.

4.4 Private operator performance findings

Qualitative Information System (QIS) is a methodology applied to assess and enhance the management of water supply services. The Isoko y'Ubuzima project employed this methodology for every PO annually across different performance indicators grouped into 7 categories: technical, commercial, financial, procurement, Human resources, quality of service, legal and regulatory compliance, and training POs to improve their performance in those indicators. The 2025 average across the five operators that have been part of the project since the beginning (REDEC, Ubuzima Bwiza MKM, Nibwobuzima, Cowbe, and Ayateke) was 6.3 out of 10, up from 4.4 in 2022. Meanwhile, the eight youth-led companies that began participating in 2025 scored an average of 4.72 out of 10.

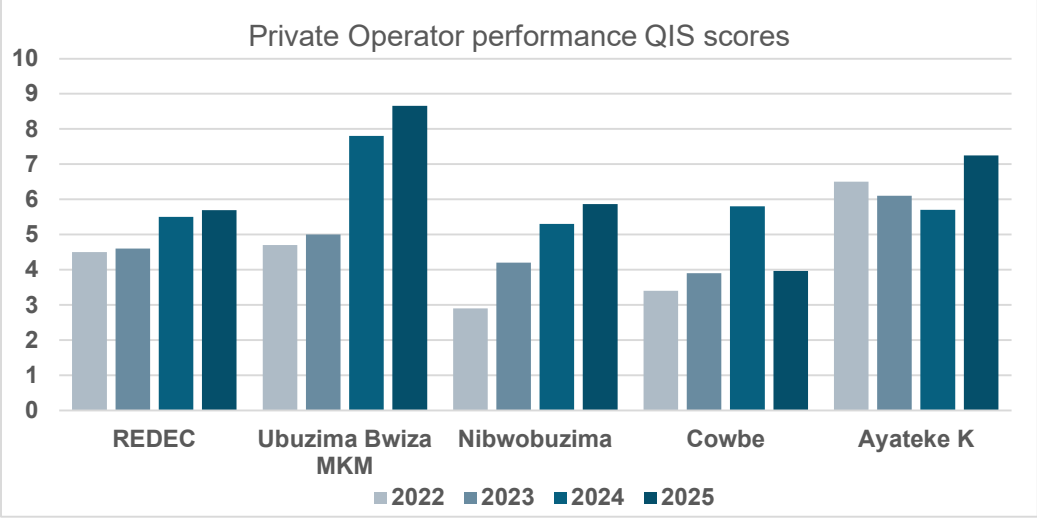


Figure 9. *Trend in water operator performance, four selected companies*

***Table 2**. Performance scores, all water operators (2025)*

QIS Category	Average Score across all Operators, out of 10 (2025)
Technical	5.9
Financial	6.4
Commercial	5.6
Procurement & Human Resources & Administration	2.1
Quality of service	5.9
Legal and regulatory framework	7.0

4.5 Explaining the differences in NRW reduction

The average NRW measurements over time reported in Section 4.2 conceal the most important finding of the flagship: performance diverged sharply across systems, and the divergence tracks the project's performance hypothesis (Operator Performance = Capability x Incentives x Accountability) more closely than it tracks hardware, geography, or starting conditions.

Operator type. Grouping the ten systems by who operates them (Table 1, Figure 7) shows three distinct trajectories. The four systems run by established Private Operators started at a volume-weighted 51% NRW in FY23 and reached 36% at endline, with two systems (Fumbwe-Gahengeri at 19% and Kahene at 24%), achieving the national target. The three systems transferred to youth-led companies were the worst performers at baseline (88% volume-weighted), which is not coincidental: the government replaced operators where systems were failing. In other words, the youth-led companies began with far higher losses than the established operators, so the gap in endline NRW reflects where they started as much as how they performed. The youth companies achieved the largest absolute reductions, around 32 percentage points, yet closed the project at 55% NRW because they started so far behind and lost the FY24 transition year entirely. The three WASAC-managed systems improved least relative to peers (60% to 49%) and submitted the least complete data.

Capability. Operator capability, as measured independently by the annual Qualitative Information System (QIS) assessment, tracks NRW outcomes closely. MKM Ubuzima Bwiza, the highest-scoring operator in 2025 (8.7 out of 10), achieved the lowest NRW (Fumbwe-Gahengeri, 19%). NG&WS, the lowest-scoring operator (3.6 out of 10), runs the worst-performing system (Nyamyishywa-Mbuye-Buhanda, 76%). The QIS trend also shows capability is buildable: the five established operators that completed the project improved from an average of 4.4 in 2022 to 6.3 in 2025, while the eight youth-led companies entered their first assessment in 2025 at 4.7, roughly where the established operators had been two to three years earlier. Capability gaps are therefore real but closable on a two-to-three-year horizon, provided support is sequenced from basics to advanced tools (Lesson 1). The cost of a capability gap was visible early: in several systems operators removed newly installed bulk meters, believing they reduced pressure, which erased the very measurements the program depended on until follow-up training corrected the misunderstanding.

Incentives. Reductions were fastest and most durable where operators captured the financial benefit of saved water. REDEC's billing rose from RWF 36 million to RWF 94 million in one year as NRW fell from 58% to 45%, and the company reinvested recovered revenue into further meter replacement without external funding. One operator bought smartphones for their plumbers so they could use the mWater leak-reporting tools. By contrast, operators with expiring contracts were less invested to participate (Lesson 5). Incentives, not training attendance, determined adoption.

Accountability. The stop-work order of January to March 2025 acted as an unplanned natural experiment in what happens when external accountability is withdrawn. Average NRW jumped to its FY25 peak (56.3% volume-weighted in Q2 FY25), several operators stopped reporting entirely, and task force meetings paused. Yet systems where data routines and task forces had been institutionalized (Fumbwe-Gahengeri) held or continued to improve through the same period. The pattern in the WASAC-managed systems points in the same direction from another angle: where the operator and the overseer are the same institution, the accountability loop is weakest, and these three systems combined slow improvement with the poorest reporting. This observation rests on only three systems facing other constraints as well, so it should be read as a hypothesis for the sector to test rather than a settled conclusion.

No single factor was sufficient. Youth companies received intensive capacity support but lacked incentives (pending licenses, no billing systems) and accountability (no task forces) during FY24, and lost ground. WASAC branches had formal accountability structures but weak internal incentives. The established operators that sustained the largest efficiency gains combined all three: they could analyze their own data, kept the revenue their efficiency created, and were held accountable for results in task forces they did not control. This pattern is the central empirical lesson of the project and the reason we argue that scale-up must invest in governance and incentives as much as in pipes.

4.6 Results from cost-benefit studies

Across the four supported districts with established POs (Kirehe, Rwamagana, Nyamagabe, and Nyabihu), Figure 10 shows the costs and benefits over time, with a clear transition from early negative or low returns to strong positive returns as the NRW intervention matured, with important variation by district.

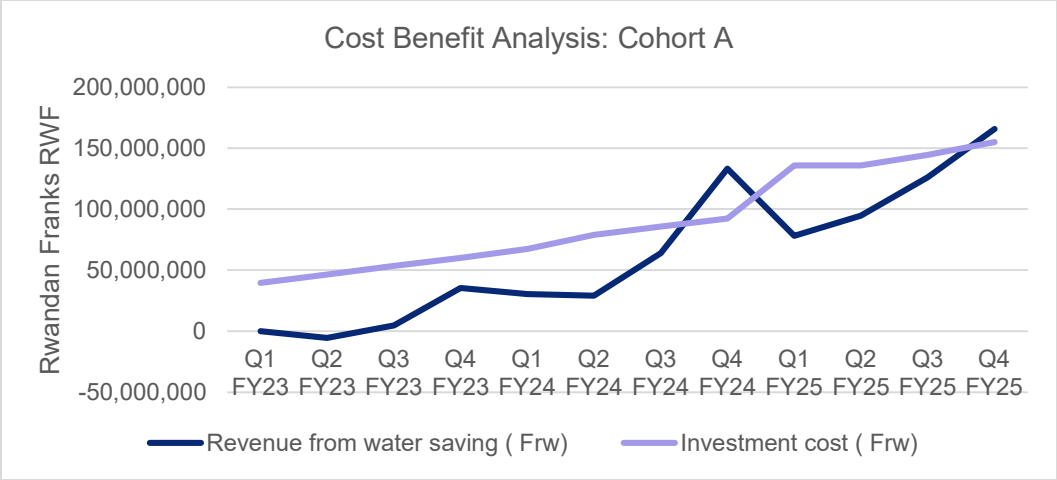


***Figure 10**: NRW Investment vs Cost in Kirehe, Rwamagana, Nyamagabe and Nyabihu districts (2023-2025)*

From FY23 to FY25, quarterly revenue from water saved rose from 0 RWF in Q1 FY23 to 165.9 million RWF in Q4 FY25, while cumulative investment increased from 39.6 million RWF to 155.0 million over the same period. By the end of FY25, accrued revenue had slightly exceeded accrued investment, yielding an overall net gain of roughly 10.8 million RWF, suggesting that the NRW package became financially justifiable over time. The strongest returns came from Rwamagana, which generated about 103.7 million in accrued revenue against 51.5 million RWF in investment by Q4 FY25, making it the best-performing district in financial terms. Kirehe and Nyamagabe also showed positive returns, though with a more moderate payback, while Nyabihu experienced early losses and volatility before recovering strongly and ending with a positive balance. This pattern suggests that NRW reduction is not an immediate-return investment; rather, it requires sustained implementation before savings materially outweigh costs.

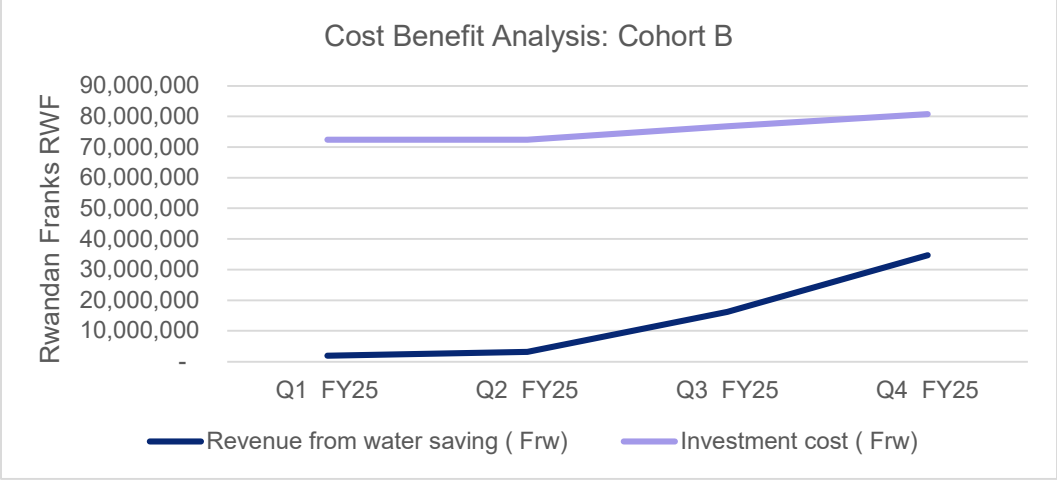


***Figure 11**: NRW investment vs Cost in Ruhango, Nyanza and Nyamagabe districts FY25*

In FY25, the three districts with youth-led POs (Ruhango, Nyanza, and Nyamagabe) presented a weaker short-term cost benefit result in Figure 11. Their accrued revenues from water saved increased from about 1.9 million RWF in Q1 FY25 to 34.7 million in Q4 FY25, but this remained far below accrued investment, which rose from 72.5 million RWF to 80.8 million RWF. In other words, by Q4 FY25, these districts had recovered only about 43% of invested costs, leaving a shortfall of roughly 45.4 million RWF. Among them, Nyanza was the strongest emerging performer, contributing nearly 28.0 million RWF in accrued revenue by Q4 FY25, when Ruhango and Nyamagabe remained comparatively low returns within the period observed.

***Figure 12**. MKM team member poses with a newly installed household water meter*

Therefore, the experience from the Isoko y'Ubuzima project is that NRW investments deliver uneven but potentially high returns when districts achieve sustained technical and operational improvements, especially where baseline losses are high, and follow-up implementation is consistent. The FY25 assessment revealed that late investment or investment in weak system volumes and slower operational uptake have not reached break-even within a single fiscal year, so future WASH programming should plan for a multi-year payback horizon, targeted district selection, and tighter sequencing between capital spending, field implementation, and performance monitoring.

Read together, the two cohorts describe a payback curve rather than a payback point: the four districts with established POs crossed break-even after roughly two full years of implementation, while the three youth-led companies that began operating in FY25 had recovered about 43% of costs (RWF 34.7 million of RWF 80.8 million invested) within their first year, a position consistent with where the early cohort stood at the same stage. The appropriate planning assumption for rural NRW programs is therefore a two-to-three-year payback horizon, with returns concentrated in systems that sustain implementation past the first year.

The returns on investment observed matter most for O&M and for reinvestment in loss reduction itself, and they strengthen the case a system can put to lenders. They are not a substitute for external capital. The investment needed to extend networks and reach unserved communities is far larger than the revenue loss reduction can free up, so recovered revenue complements external and commercial financing rather than standing in for it. Demonstrating these gains is valuable partly because it makes a system more bankable and better able to attract that additional investment

Operator Case Study: Recovering revenue through house-to-house surveys and targeted meter replacement

Rural Engineering and Development Contractors Company (REDEC) Ltd demonstrated that systematic customer surveys, combined with targeted meter replacement, can deliver rapid commercial gains with modest investment. In FY24, REDEC went door-to-door to identify inactive connections, billing discrepancies, and illegal connections across their network. Acting on this data, they replaced meters at 23 connections, prioritizing large consumers such as institutions, schools, barracks, and churches. Thirteen of the 23 connections had been recording zero consumption before replacement; billed consumption at these connections rose from 1,240 to 4,575 cubic meters per month, recovering roughly 3,300 cubic meters of previously unbilled water every month. The survey also enabled REDEC to clean their customer database, ensuring bills were reaching active users. Direct engagement with customers at the household level improved payment rates and reduced billing disputes. By reinvesting recovered revenue into further meter replacements, REDEC was able to sustain the intervention without additional external funding. The REDEC experience shows that commercial losses are often recoverable through low-cost, systematic fieldwork, and that prioritizing high-volume consumers maximizes the return on limited capital.

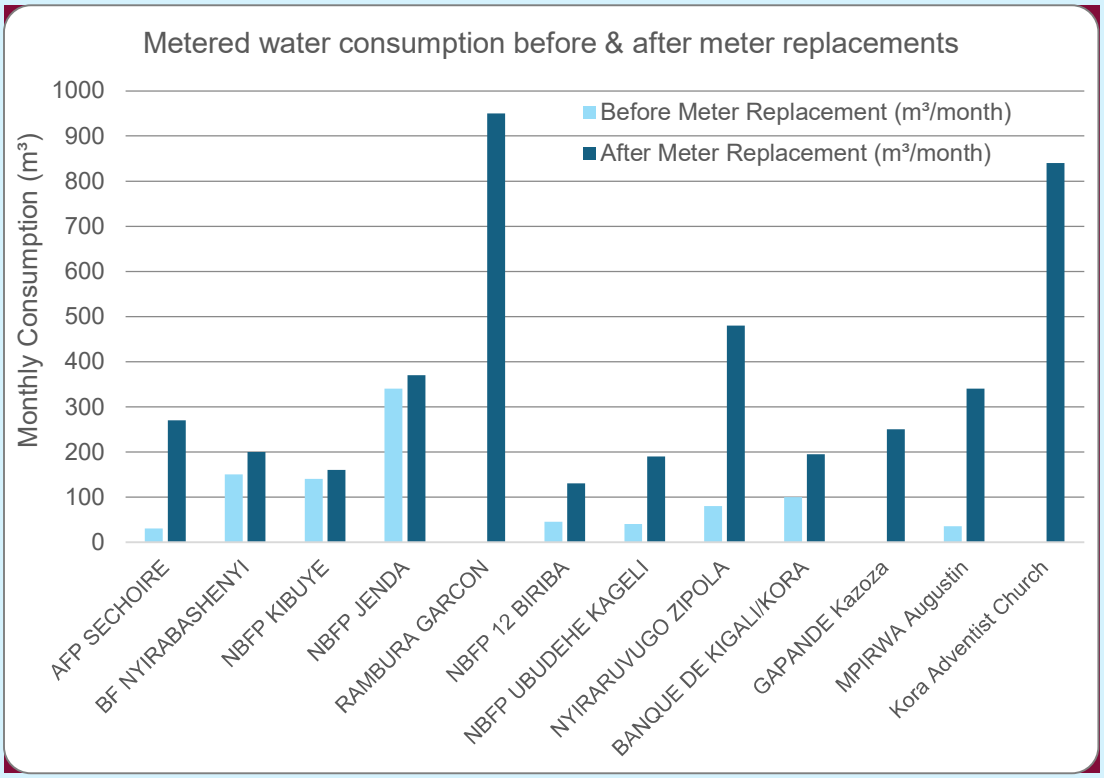
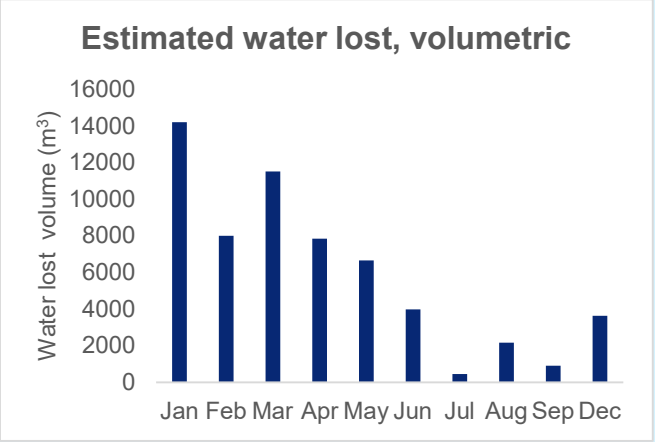
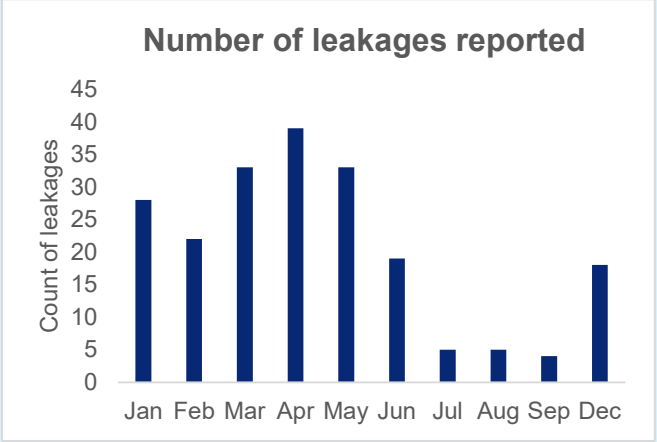


Figure 13. *Results from customer meter replacement by REDEC Ltd in Nyabihu district*

Operator Case Study: Digital twin for leakage detection in mWater

The application of mWater tools supported systematic leakage reporting and tracking for Home Praise Ltd, a newly established youth-led company. Despite their limited experience, the young team adopted these digital tools to map leakages across their network, allowing them to reduce response times and maintain system pressure. The mWater digital twin of its network served to log every repair and asset condition in the cloud. This data proved invaluable for planning maintenance and justifying budget requests to Ngororero District.





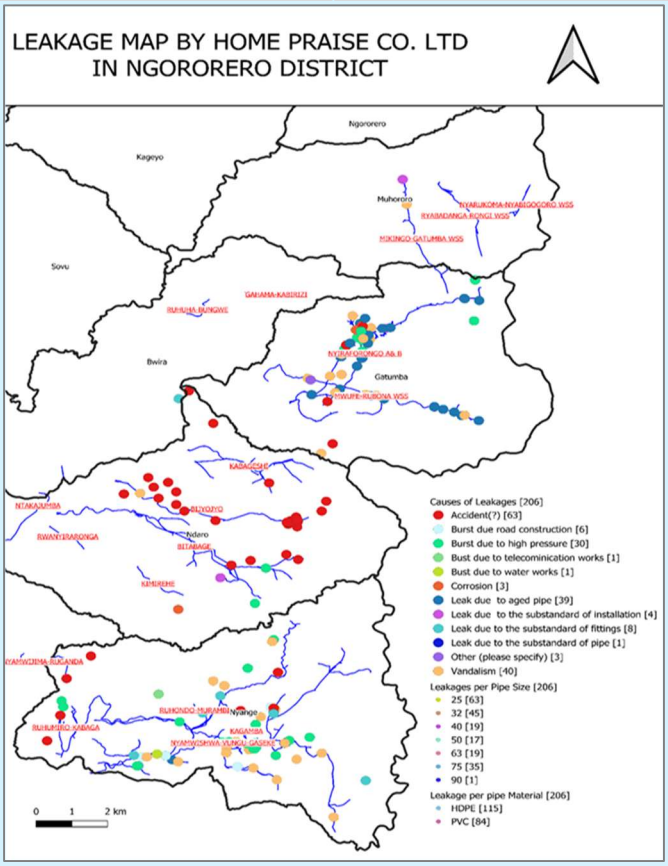


***Figure 14**. Top: Monthly water losses and leakage tracking data from the Home Praise Ltd. mWater Dashboard. Below: Map of Ngororero District water network and leakage data.*

Operator Case Study: Reducing losses with DMAs, dashboards, and pressure management

MKM Ubuzima Bwiza, operating in the Rwamagana cluster, achieved some of the strongest NRW reductions among pilot operators by combining data-driven diagnostics with consistent operational follow-through. They demonstrated how DMAs can be used to pinpoint high-loss zones and prioritize repair activities. They were able to direct repair crews to high-loss zones of their network and track whether interventions were working, shifting their approach from reactive maintenance to routine performance monitoring. Nightly flow data helped to identify bursts that were invisible during the day.

To address commercial losses, MKM adopted the NRW monitoring dashboard developed by the Isoko y'Ubuzima project, using it to identify discrepancies between production and billing, flag suspicious "zero-consumption" customers for field follow-up, and compare performance across zones instantly. As a result, quarterly billing improved from 11 million RWF in Q1 to 42 million RWF in Q4 of FY24.

For physical loss reduction, MKM Ubuzima Bwiza applied Minimum Night Flow (MNF) analysis, measuring flows between 2:00 and 4:00 AM when legitimate consumption is near zero, to quantify background leakage and distinguish it from commercial losses. Combined with pressure management in high-elevation zones identified through hydraulic modelling training, this contributed to minimum night flow in the Mununu sub-DMA falling from an average of 72% of zone input (February to May 2024) to 7 to 18% after the hidden leak was repaired (June to September 2024).

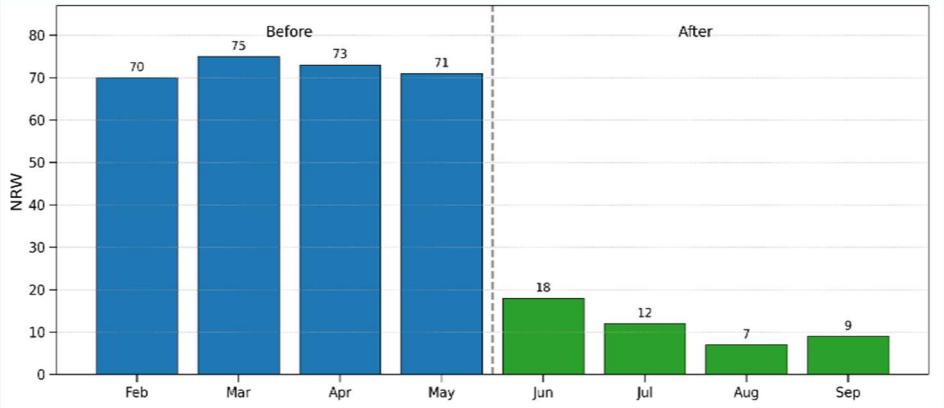


Figure 15: *NRW Before and After Fixing the Hidden Leakage Identified during MNF at MUNUNU sub-DMA, data from February to September 2024.*

MKM's willingness to adopt these advanced engineering practices set them apart as a leader among Private Operators. Their experience proves that complex hydraulic management is possible in rural systems when there is a commitment to technical excellence. This case study demonstrates that when rural operators are equipped with the right digital tools and the skills to use them, they can achieve levels of commercial efficiency comparable to urban utilities.

5. Assumptions, Challenges & Lessons Learned

The NRW program was implemented as a learning-oriented intervention, designed not only to reduce water losses but to test *why* some rural water systems can improve performance while others struggle. This section synthesizes the key assumptions underlying the intervention, the major challenges encountered during implementation, and the lessons that emerged from comparing performance across systems.

5.1 Assumptions

We analyze operator performance according to the following hypothesis:

$$\textbf{Operator Performance} = \textbf{Capability} \times \textbf{Incentives} \times \textbf{Accountability}$$

This framework was used to interpret variation in NRW outcomes across systems and over time.

Capability: The initiative assumed that rural operators can manage NRW effectively if they have:

- Stable and trained staff
- Access to basic tools (bulk meters, customer databases, dashboards)
- Routine data collection and analysis practices
- Practical skills in leak detection, pressure management, and billing analysis

The project tested whether targeted capacity strengthening—rather than long-term external technical assistance—was sufficient to build this capability.

Incentives: The project assumed that operators would prioritize NRW reduction if:

- Water savings translated directly into increased revenue
- Operators retained the financial benefits of efficiency gains
- NRW reduction was framed as a business investment, not a compliance exercise

This assumption was tested through cost-benefit analyses, integration of NRW targets into business plans, and direct engagement with operators' financial decision-makers.

Accountability: Finally, the initiative assumed that sustained NRW reduction requires:

- Regular performance review by Districts and WASAC branches
- Transparent reporting of NRW data
- Consequences—formal or informal—for persistent underperformance

The establishment of multi-stakeholder NRW task forces was designed to operationalize this accountability.

A fourth, implicit assumption deserves testing against the data: that household satisfaction rises when NRW falls. The household surveys broadly support it, but with an important nuance. Customer satisfaction rose from 80% of 6,707 respondents in 2023 to 93% of 9,213 in 2025, a period over which NRW fell, but satisfaction kept rising even through the FY25 quarters when system-level NRW temporarily spiked. What households appear to respond to is not the NRW figure itself but its service consequences: regular billing (which rose from 21% to 82% of customers surveyed) and continuous supply (24-hour access rose from 35% to 59%). NRW reduction earns customer trust indirectly, through reliability and fair billing, and with a lag. This matters for sequencing: operators should expect community goodwill to follow visible service improvements, not the loss statistics themselves.

5.2 Key Challenges Encountered

While the project achieved measurable results, implementation navigated a series of structural and operational challenges that shaped how interventions were designed, adapted, and sequenced. Several of these challenges prompted significant shifts in implementation approach.

Transition to youth-led operators: Capability and Continuity Gaps

From August 2023, the Government of Rwanda began replacing established Private Operators (Pos) with newly formed youth-led companies as existing contracts expired across multiple districts. In several systems in Nyanza, Ngoma, Ngororero, and Nyamagabe, these transitions took place before the incoming operators had obtained RURA licences, set up billing systems, or formed NRW task forces. As a result:

- NRW levels rose sharply at the start of FY25, increasing from a Q4 FY24 average of 29% to 45.5% in Q1 FY25, partly due to absent or non-reporting operators during the handover period.
- Youth companies initially lacked institutional memory, familiarity with the network, and established data routines. Several were unable to submit billing data for NRW reporting because their Customer Management System (CMS) licences from RURA were pending.
- O&M manuals developed for established POs could not be transferred, as the new companies lacked the skills to use them. This required the project to redesign capacity support, including dedicated O&M training for eight youth company engineers conducted in FY25.

This challenge prompted a significant shift in the implementation approach: rather than building on existing operator knowledge, the project had to restart foundational capacity work: developing new five-year NRW strategic plans, forming new task forces, and providing intensive on-the-job coaching from the ground up for each incoming company.

Interruption of monitoring and support: The Stop Work Order Period

The USAID stop work order (January to mid-march 2025) suspended routine monitoring activities across 13 systems. Its effects on NRW were immediate and measurable: The average NRW level rose from 45.5% in Q1 to 56.3% in Q2, as operators reverted to less rigorous data collection practices and task force meetings paused. Several Pos, including Ayateke in Kirehe, Waterways and Patto Water in Ngoma, Axion Water Solution in Nyamagabe, and NG&WS in Ruhango, failed to report meter readings at all during this period.

This period demonstrated the fragility of gains where data routines were not yet fully institutionalized. Systems that had achieved strong performance before the stop-work period (such as Fumbwe-Gahengeri, Kahene, and Cyamabuye-Kagohe) showed a 2.3% reduction in NRW even in Q1 FY25, reflecting the resilience of more embedded operational practices. In contrast, newer or less-supported systems deteriorated quickly, highlighting that external monitoring was still substituting for internal accountability in many cases.

Data Quality and System Fragmentation

Manual billing systems, inconsistent customer databases, and incomplete operational records limited the precision of water balance analyses throughout the project. The FY23 customer mapping exercise across 10 WSS identified 364 unbilled customers out of 5,793 mapped, a gap that had been generating commercial NRW invisibly. In systems such as Nyanza (Ruhasya-Ntazo), 242 out of 481 mapped customers were not on the billing list.

The FY24 house-to-house survey of 6,707 connections found 2,065 meters in poor condition and 85 illegal connections. 79% of customers surveyed reported not receiving bills regularly. These data quality gaps mean that operators in weaker systems could not distinguish between physical and commercial losses, leading to misdirected interventions, for example, investing in leak repairs when the primary driver was unbilled consumption.

Progress was made over the project period. By FY26, house-to-house surveys covered 9,213 customers, illegal connections dropped from 85 to 8, and customers not receiving bills regularly declined from 5,273 to 1,641. However, an estimated 1,192 customers remained unregistered in the CMS as of Q1 FY26, primarily in systems recently transferred from POs to WASAC in Kayonza, Ngoma, and Ngororero.

Resource constraints and capital-intensive interventions

Capital-intensive activities, including house-to-house surveys, creation of additional DMAs, and rehabilitation of aging infrastructure, remained constrained by limited financing throughout the project. Budget constraints prevented scaling DMA creation to additional systems beyond the ten pilot WSS, despite demand from districts and operators. Meter testing and replacement also faced persistent obstacles: a first tender for testing 3,600 meters was cancelled because costs exceeded budgets; subsequent procurement rounds spanned FY24 to Q1 FY26 before portable testing kits were finally delivered.

These constraints reinforced the project's reliance on high-impact, low-cost interventions such as bill list analysis, leak reporting templates, and community awareness campaigns. While effective, they also limited the pace of physical loss reduction in the most severely degraded networks, particularly in Ruhango and Nyanza, where NRW remained above 50% at the end of the project.

Persistent Weakness of Sector Monitoring Infrastructure

Despite significant investment in the Customer Management System (CMS-RWSS) and efforts to strengthen WASH MIS, sector-level monitoring remained fragmented. Some POs used the CMS inconsistently, as enforcement was limited. The integration of CMS with Electronic Billing Machines (EBM) required by the Rwanda Revenue Authority was unresolved by the project's end. These gaps meant that national-level NRW performance could not be tracked coherently, and regulatory oversight by RURA and WASAC depended heavily on project-funded data collection rather than operator-driven reporting.

5.3. Lessons learned

Over the past four years, the project uncovered important lessons about what really drives improvements in non-revenue water (NRW). We found that progress depends on three things working together: capability, incentives, and accountability. None of these alone is enough, but when they align, operators are able to sustain real change. The lessons below go beyond what worked; several record where our own assumptions proved wrong, and what we had to stop believing in order to adapt.

Lesson 1: Build basics before advanced tools. We learned that operators cannot jump straight into complex tools like GIS or hydraulic modeling without first mastering the basics. Early training on dashboards and modeling software didn't stick because plumbers and engineers lacked skills in meter reading, leak recording, and data collection. Once we sequenced training starting with basic O&M and meter reading, then leak detection, then data analysis, and finally modeling operators began using dashboards effectively. By FY26, all 13 private operators were actively applying them, something that was impossible just a few years earlier.

Lesson 2: Youth-led operators need tailored support. When youth-led companies took over in 2023, they faced unique challenges: no customer databases, no billing systems, and no institutional memory. Standard refresher training wasn't enough. We had to design onboarding packages intensive O&M training, strategic planning workshops, and close coaching. This slowed progress at first, but by FY25 these companies were on solid footing, narrowing financial gaps and joining task force meetings with confidence.

Lesson 3: Handovers matter as much as training. Transitions between operators often erased years of accumulated knowledge. Without structured handovers, new teams started almost from scratch. Developing O&M manuals and customer databases proved essential, but motivation dropped when operators knew their contracts were ending. The takeaway: handover protocols must be built into contracts early, not left as optional tasks at the end.

Lesson 4: Show the money, not just the leaks. Operators responded more strongly when NRW was framed as lost revenue rather than just a technical issue. Cost-benefit analyses and ROI calculations made the business case clear: investing in NRW reduction pays off. For example, REDEC Ltd boosted billing from RWF 36 million to RWF 94 million in one year while cutting NRW from 63% to 25%. This financial framing shifted behavior far more than compliance requirements ever did.

Lesson 5: Short contracts discourage investment. Operators with contracts nearing expiry had little incentive to invest in NRW reduction. Why commit resources if returns wouldn't materialize before the contract ended? In contrast, operators with longer contracts actively revised business plans and invested in infrastructure. The lesson is simple: contracts must be long enough, at least three to five years, to match the payback period of NRW investments.

Lesson 6: Task forces work when institutionalized. Quarterly task force meetings helped, but their real impact came when they were embedded in district governance structures. Where task forces were linked to DWASHB agendas and planning cycles, they drove action and budget commitments. Where they remained informal, they produced dialogue but little follow-through.

Lesson 7: Community engagement reduces vandalism. Illegal connections and vandalism dropped sharply when operators engaged communities through Umuganda sessions and house-to-house surveys. Customers were more likely to report leaks and pay bills when they felt involved. Structured engagement created social accountability that protected infrastructure and reduced losses.

Lesson 8: District leadership is the strongest predictor of success. The most consistent factor behind sustained NRW progress was active district leadership. Vice Mayors and WATSAN officers who championed NRW ensured budgets, oversight, and momentum. Where leadership attention waned, progress quickly unraveled even when technical tools were in place.

Lesson 9: Data tools only matter if acted upon. Dashboards transformed performance only when operators used them to make decisions, not just to collect data. Coaching helped shift behavior from passive reporting to active problem-solving. By FY26, most operators were using dashboards to prioritize repairs, flag unbilled consumption, and track response times turning data into action.

Lesson 10: Adoption follows demonstrated benefit, not training. Attendance at trainings never predicted uptake; visible returns did. Only five of the private operators that began the program completed it, and some attended every training while declining to change practice because, in their own words, the new systems had not yet shown them a profit. Adoption accelerated once benefits became tangible: after seeing survey results, two operators financed house-to-house surveys themselves; after seeing leak maps, two to three operators bought smartphones for their plumbers to use mWater; and operators began requesting refresher training unprompted. WASAC followed the same pattern at institutional level, populating the benchmarking and dashboard tools with real data only near the end of the project, once its commercial department saw their value, despite the project's assumption that uptake would follow within a month of training. The design implication is to lead with quick, visible wins that create demand, and treat training as a response to that demand rather than its source.

A reflection on the project's own role. Honest learning requires examining not only what partners did but what the project's way of working produced. The stop-work period revealed that, in many systems, project monitoring had been substituting for internal accountability rather than building it: when external follow-up paused, data collection and task force routines paused with it. The project's presence may also have oriented operators toward the project team, rather than toward WASAC and Districts, as the audience for performance. The most durable changes emerged where the project made benefits visible in operators' own revenue and then stepped back, and the least durable where compliance was performed for project timelines. Future programs should treat the planned withdrawal of project attention as a designed test of institutionalization, not an end-of-project risk.

Capability: Start with basics, tailor support for youth operators, and require structured handovers.

Incentives: Frame NRW as a financial issue and align contract lengths with investment payback.

Accountability: Institutionalize task forces, engage communities, secure district leadership, and ensure data tools drive decisions.

6. Recommendations for Scaling & Sustainability

A note of caution frames these recommendations. NRW is one lens on the performance of Rwanda's delegated management model, not a verdict on it. The model is new, still being operationalized nationally, and shaped by policy and governance factors that this paper does not evaluate. The recommendations below therefore, address how to scale NRW management within the current institutional arrangement, while flagging where contract design, oversight mandates, and financing rules themselves constrain what operators can achieve.

The project demonstrated that NRW reduction in rural systems is not primarily a technical challenge, but an institutional one. Sustainable results require the alignment of:

1. Operator capability
2. Financial incentives
3. Enforced accountability

Where these conditions were present, NRW reductions were rapid and sustained. Where one element weakened, progress slowed or reversed. Future scale-up efforts must therefore invest as much in governance, incentives, and data systems as in physical infrastructure.

For Policy Makers

- Policy makers should institutionalize NRW performance targets within national rural water service frameworks and monitoring systems. By making NRW a key performance indicator for the sector, the government can ensure that efficiency is prioritized alongside coverage. NRW reduction should also be recognized as a priority investment area for climate resilience, as it extends the life of water resources without new abstraction.
- National policies should incentivize efficiency by linking tariff adjustments or subsidies to NRW performance. This would provide a financial incentive for operators to invest in loss reduction. Furthermore, policymakers should champion the professionalization of the sector, supporting the transition to licensed, competent operators who are capable of managing complex networks.

For WASAC

- WASAC needs to integrate NRW monitoring and DMA supervision into routine branch-level oversight and performance reviews. The utility should act as the technical backstopper for the private operators, providing guidance and checking data quality. This requires strengthening the capacity of branch staff to understand and analyze NRW data.
- WASAC should also use the benchmarking tool to identify struggling operators early and intervene before systems collapse. By standardizing the reporting requirements, WASAC can create a transparent sector where performance is visible to all. Technical support should be particularly targeted during transitions in delegated management to prevent the loss of institutional knowledge.

For Districts

- Districts should use District WASH Boards to advocate for funding for priority NRW investments, such as pipe replacement. As asset owners, they should work closely with WASAC and private operators to keep systems functional and well maintained. They also need to provide active oversight that balances user needs with operators' capacity.
- Districts should further strengthen community engagement to protect infrastructure and encourage leak reporting. Local leaders can help deter water theft and vandalism. Aligning Imihigo (performance contracts) with NRW targets can also help ensure local government remains focused on improving water efficiency.

For Private Operators

- Private Operators must mainstream NRW reduction strategies into their annual business plans, budgets, and staff performance targets. Loss reduction cannot be a side project; it must be core to the business model. Operators should continue using the NRW Monitoring Dashboard to guide operational decisions and justify investments to lenders and shareholders.
- They should also invest in their staff, ensuring that plumbers and billing officers have the skills and tools they need to do their jobs. Regular house-to-house surveys should be institutionalized as a standard operating procedure to keep the commercial database clean. Operators who proactively manage NRW will ultimately be more profitable and secure in their contracts.

For Development Partners

- Development partners should prioritize the scaling of proven NRW approaches such as DMAs, house-to-house surveys, and task-force models rather than funding isolated pilots. The evidence base is now strong enough to justify large-scale implementation. Partners should support long-term capacity strengthening and institutional ownership to prevent regression when projects close.
- Funding should be directed towards systemic improvements, such as digital tools and benchmarking systems, that have a multiplier effect across the sector. Partners should also support the development of innovative financing mechanisms that allow operators to access commercial loans for NRW investments. Under Rwanda's Nationally Determined Contributions Plan 3.0, for example, investments for WASH By aligning their support with national priorities, development partners can help build a self-reliant water sector.

7. Conclusion

Five years of implementation demonstrate that relatively modest investments in capacity building, monitoring tools, and institutional coordination can unlock significant operational and financial gains in rural water service delivery. Across ten pilot systems, NRW fell from 69% of system input volume at baseline to under 40% at project close, billed volumes and revenues rose, and investments in NRW reduction paid for themselves within roughly two years where implementation was sustained. Just as importantly, the project showed why progress was uneven: capability, incentives, and accountability must hold simultaneously, and where any one weakened, through operator transitions, expiring contracts, or the withdrawal of oversight, gains slowed or reversed. The unfinished agenda is equally clear. Most systems remain above the 25% national target, the systems transferred to youth-led companies and to WASAC branches need several more years of structured support, and routine reporting is not yet self-sustaining.

The experience also speaks to debates well beyond Rwanda, and we close with the implications we consider most important for the wider water, sanitation, and hygiene (WASH) sector.

Efficiency is the new financing. External funding for WASH is unlikely to grow in the coming years. Countries will need to spend existing resources more efficiently and mobilize more domestic and private investment. NRW reduction sits precisely at this intersection: every cubic meter recovered is revenue that requires no new abstraction, no new donor commitment, and no new infrastructure. The cost-benefit results in this paper, payback within two to three years, make NRW reduction one of the most credible efficiency investments available to the sector, and a stronger basis for commercial lending to operators than coverage expansion alone. The sector's own diagnostics point the same way: finance was the weakest of Rwanda's WASH system building blocks at baseline (scoring 2.4 of 5 in 2022, rising to 3.8 by 2024), and the sector review identified reducing non-revenue water, alongside better billing and lower unit costs, as the principal route to making existing funds go further. The commercial-finance products developed for rural operators with Equity Bank and Bank of Kigali only become bankable when loss reduction puts operators on a credible revenue footing.

The constraint is data use, not data collection. The sector's monitoring challenge is less about collecting more data than about translating existing data into decisions, investments, and accountability. This project's clearest behavior changes came when data was made consequential: dashboards reviewed in task forces, billing lists checked against field surveys, cost-benefit results presented to the people who control budgets. Demand-driven data use of this kind remains rare in many countries; periodic assessments have limited value unless their findings are embedded in routine government planning and budgeting cycles, as the task force and DWASHB experience here begins to demonstrate.

Integrate systems rather than multiply them. National WASH information systems remain fragmented, and this project felt that fragmentation directly: the CMS, electronic billing machines required by the revenue authority, and sector MIS were never fully integrated, leaving national NRW performance impossible to track coherently. The priority for the coming years is integrating data across institutions rather than generating new parallel datasets. Digital tools (GIS, mWater, real-time dashboards) are becoming essential infrastructure for sector governance, but only where institutions own them and people are financed to maintain them. Sustainable data systems require long-term investment in institutions and capacity; without it, evidence becomes unreliable precisely when it is needed most.

Evidence should find who is left behind and move resources. Data is most valuable when it reveals who is being left behind, not when it reports averages. The averages in this paper conceal a threefold spread in performance across systems; the households on the Nyamyishywa-Mbuye-Buhanda network experience a fundamentally different service from those in Fumbwe-Gahengeri. Sector monitoring should be designed to surface such gaps and to direct resources toward them, and well-presented evidence of this kind can catalyze policy reform, as the project's benchmarking and tailored data presentations to WASAC and Districts began to show. Sensemaking, the translation of data into representations decision-makers can act on, is a skill the sector needs to fund as deliberately as data collection itself. The same logic applies to money. Per capita district WASH budgets across the ten project districts rose 42% on average between 2021/22 and 2024/25, but that average hides swings from a 79% fall in one district to a sevenfold rise in another, with mid-term gains often not sustained. Allocation figures alone mislead; monitoring should track whether budgets are stable, disbursed, and actually reaching the systems and households furthest behind.

Non-revenue water was long treated as an inevitable cost of rural service delivery. The Isoko y'Ubuzima experience shows it is better understood as a measure of whether the institutions around a water system are working: whether operators can act on their own data, whether efficiency pays, and whether anyone is watching. Reducing it is therefore not only feasible in rural systems; it is foundational to services that last.

8. Annex

Annex Table 1. QIS Ladder Indicators and Average Scores across all Private Operators (2025)

Category	Benchmark statement	2025 average
Technical	PO has a schedule and report for maintenance of a source catchment area	5.0
	PO has an adequate store of spare parts and essential tools for required maintenance activities	5.0
	PO has an ability to prepare and keep the records for operation and maintenance	5.4
	PO has qualified and enough staff to effectively carry out maintenance activities	7.7
	The PO performs water quality testing, and the results comply with the standard for drinking water	5.0
	PO has qualified staff responsible for water quality analysis	7.3
Financial	PO has a functional electronic billing system	10.0
	PO has a functional accounting system	0.8
	PO produces the financial statement reports	8.5
	PO has qualified staff in the field of accounting or finance	7.7
	PO prepares and avails the budget for operation and maintenances activities	3.1
	PO has developed and implement a sounding and bankable business plan	4.6
	PO complies with the tax requirement (including VAT, CIT…)	10.0
Commercial	PO installed bulk meters on the water sources	5.4
	PO has a good Billing efficiency	5.8
	PO has a good Collection efficiency	3.5
	PO has a good customer metering efficiency	9.2
	The PO has a good performance on NRW management	4.2
Procurement & Human Resources & Administration	PO has a clearly documented procurement guidelines	1.5
	PO has a human resource policy and guidelines	1.6
	The PO has a reasonable Staff productivity index	1.9
	PO has a Human resource information system	0.0
Quality of service	PO produces the customer satisfaction survey report	0.8
	The number of hours of water supply per day is enough	7.9

	The water service Coverage ratio within the service area is good	4.6
	The customer complaints are properly registered in a logbook and are well-handled	7.9
	The PO uses a reasonable response time to address the customer complaint	8.3
Legal and regulatory framework	PO fulfil his/her responsibilities for maintenance of WSS	6.5
	PO complies with the terms and obligations of the License as well as the regulations governing water service provision in Rwanda	6.2
	Overall Score	**5.5**