Rigorous Impact Evaluation of Water Access Rwanda's INUMA™ Safe Water Mini-Grids

A Baseline Report

Submitted by

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EXECUTIVE SUMMARY

BACKGROUND: Despite commendable progress, Rwanda faces a significant challenge in ensuring widespread access to safe drinking water, with only 57% of the population having such access within a 30-minute proximity to their residences. In response, Water Access Rwanda (WAR), a youth-led social enterprise, strategically developed and deployed water infrastructure, specifically targeting rural and peri-rural communities in Rwanda through its innovative INUMA™ safe water mini-grids.

While WAR has consistently demonstrated the positive impact of its services through internally conducted reports, an independent, rigorous impact evaluation is imperative to provide an unbiased assessment of the initiative's effectiveness. This report aims to serve such a purpose by presenting the results of an independent, rigorous impact evaluation conducted to assess the effectiveness of WAR's Mini-Grids in expediting the provision of safe drinking water, evaluating their dependability, affordability, and considering the intangible benefits and transformative influence within the communities.

METHODOLOGY: The evaluation employs a mixed-methods, integrating quantitative and qualitative methods. Quantitative data is derived from a household survey, while qualitative insights are obtained through in-depth interviews with community members. The study compares households primarily reliant on INUMA™ mini-grids for their daily water needs with those in communities where these mini-grids are yet to be installed. Initial data analysis in this baseline report focuses on summarizing data and identifying key patterns, with rigorous statistical analysis to follow in subsequent reports.

KEY FINDINGS: The analysis of WAR's INUMA™ Safe Water Mini-Grids reveals a positive impact on water access, safety, affordability, and broader societal outcomes across various dimensions:

I. **Water accessibility and time efficiency:** INUMA™ Mini-Grids significantly enhance water accessibility and time efficiency. For longer distances, communities with INUMA water access have a stark advantage, with only 1.3% requiring over 30 minutes compared to 60% in non-INUMA areas.

II. **Water Safety and Well-being:** INUMA™ Mini-Grids notably improve water safety and well-being, with 77% expressing confidence in water safety compared to 45% in non-operational INUMA areas. Regarding water-related illnesses in the last three months, 96% with INUMA water reported none, while only 48.95% without INUMA made a similar claim.

III. **Water Availability and Reliability:** There are indications of reliability issues with INUMA mini-grids. Responding to queries about water shortages due to service interruptions, a majority of INUMA customers reported reliability challenges, with 50.8% experiencing occasional interruptions, 28.6% facing frequent interruptions, and 11.7% dealing with permanent interruptions. While reliability issues are indicated, disruptions are shorter for INUMA customers, with 59.7% resolved within six hours.

IV. **Water Cost and Affordability:** INUMA-serviced communities consistently demonstrate lower water expenditures and affordability challenges are less prevalent compared to communities without INUMA water access.

V. **Broader Societal Impacts:** Beyond safe water provision, INUMA™ Mini-Grids potentially reduce carbon emissions, improve educational outcomes, and contribute to gender equality. Preliminary findings indicate positive shifts, including reduced water boiling, enhanced student performance, and more equitable gender roles in INUMA communities.

I. BACKGROUND AND CONTEXT

1.1. Background

The global landscape of access to essential drinking water and sanitation services has undergone a significant transformation since the turn of the millennium, as documented in a collaborative report issued in 2019 by the United Nations Children's Fund (UNICEF) and the World Health Organization (WHO)[1]. This report highlighted remarkable progress, with 1.8 billion individuals gaining access to drinking water and 2.1 billion to sanitation. However, the report also emphasized persistent disparities in accessibility, availability, and quality of safe drinking water, particularly in rural areas and least-developed countries, affecting approximately one-third of the world's population.

In Rwanda, the Global Water Partnership's Rwanda snapshot on water and climate highlights a picture of this progress[2]. By 2020, 83% of the Rwandan population had access to improved drinking water, up from 79% in 2015. Additionally, access to safely managed drinking water services increased from 7% in 2015 to 12% by 2020. Despite these advancements, particularly in comparison to neighboring countries, challenges remain, as emphasized by the WHO's report on sanitation and hygiene and the 2021 African Union data on the clean water and sanitation index in the African Region[3]. Notably, UNICEF Rwanda estimates that only 57% of the population has access to safe drinking water within a 30-minute distance from their homes[4]. This underscores the ongoing need for concerted efforts to ensure widespread access to safe water in Rwanda.

It is against this backdrop that Water Access Rwanda (WAR), a youth-led social enterprise committed to establishing reliable, cost-effective, hygienic, and convenient water infrastructure across Rwanda, has implemented strategic initiatives to address this challenge. At the heart of WAR's operational framework are the INUMA™ safe water mini-grids, which have played a pivotal role in providing safe, affordable, and dependable water to various rural and peri-rural communities.

1.2. Context and Rationale

The INUMA™ mini-grids have revolutionized access to safe water in peri-urban and rural areas, transforming a luxury previously reserved for the wealthy in urban settings into a reality for communities across Rwanda. The 2023 data from WAR indicates that these mini-grids have successfully provided piped water supply to 850 private homes and schools. Additionally, 36 public mini-grids have collectively delivered

[1] World Health World Organization (WHO) and the United Nations Children's Fund (UNICEF). (2019). Progress on household drinking water, sanitation and hygiene 2000-2017: Special focus on inequalities.
[2] Global Water Partnership. (2022). Rwanda snapshot on water and climate.
[3] World Heath Organization. (2023). Unsafe water , sanitation and hygiene are key drivers of epidemics in the African Region. Analytical Fact Sheet, June.
[4] Water, sanitation and hygiene. (2020). UNICEF Rwanda. https://www.unicef.org/rwanda/water-sanitation-and-hygiene

almost 200 million liters of safe water to its more than 48 thousand users in various communities throughout the country.

WAR's impact monitoring surveys consistently demonstrate the high affordability of its water services for users, resulting in both reduced instances of illness and significant time savings, particularly for women. Data suggests that these services have transcended improvements in hygiene and sanitation by also reducing expenditures on water purchases. Furthermore, customers report a decreased incidence of waterborne diseases, indicating a positive impact on health. This success has earned WAR's initiatives recognition through the receipt of numerous national and international awards over the years.

While WAR is confident in the positive impact of its services on customers and communities, the current evaluation heavily relies on internally conducted self-reported surveys and qualitative reports, often performed by its own personnel or affiliated individuals. This dependence on internal assessments raises valid concerns regarding the objectivity and independence of claims related to the speed, reliability, affordability, and sustainability of WAR's service delivery. To address these concerns, an impartial and independently conducted rigorous verification is essential to validate these claims.

This verification should specifically focus on assessing the effectiveness of WAR's Mini-Grids in expediting the provision of safe drinking water in remote regions. It should rigorously evaluate their dependability, affordability, and consider the intangible benefits it provides, including environmental preservation, suitability, relevance, and transformative influence within the communities. This approach will ensure a more robust and credible understanding of WAR's impact and underscore the commitment to transparency and accountability in its mission.

Consequently, WAR commissioned this impact evaluation to serve as an independent and unbiased assessment, functioning as both an internal assessment tool and a means of fostering transparent communication with WAR's stakeholders and potential partners. This aligns with WAR's mission to create scalable solutions for Africa's water scarcity challenge, emphasizing a commitment to addressing the critical issue with integrity and accountability.

II. OBJECTIVES AND SCOPE

2.1. Objectives

A comprehensive impact evaluation of WAR's INUMA™ Safe Water Mini-Grids will be conducted in multiple phases, encompassing three distinct reports: a baseline report, an interim progress report, and a final impact evaluation report.

This baseline report establishes a benchmark of the initial conditions, fostering a thorough understanding of the context within which INUMA mini-grids are operationalized. It identifies and analyzes challenges, opportunities, and emerging trends affecting their operations. Additionally, it contributes to refining the evaluation metrics employed to measure the impact of INUMA mini-grids, serving as the primary reference point for assessing both the intervention and control groups. Finally, the report provides informed preliminary data for the future direction of the project.

2.2. Scope

The impact evaluation will focus on exploring critical research aspects to systematically assess the effectiveness and impact of WAR's INUMA mini-grids on safe water provision. These research aspects will were guided by a comprehensive impact evaluation matrix and related research questions that will be addressed through a variety of data collection tools and methodologies.

(A) **Accelerating Safe Water Provision:** This aspect seeks to understand how INUMA™ Safe Water Mini-Grids contribute to expediting the provision of safe water in underserved communities. It will also explore the effectiveness of WAR's operations compared to existing mechanisms for obtaining water.

(B) **Safety and Reliability of Water Points:** With a focus on evaluating the safety and reliability of INUMA™ Safe Water Mini-Grids points, this research aspect provides an opportunity to assess the quality of the provided water against national and international standards. It will also explore how the availability of new water sources contributes to increased human water consumption, sanitation, and hygiene practices.

(C) **Financial Viability and Sustainability:** This aspect delves into the financial aspects of the implemented INUMA™ Safe Water Mini-Grids and their long-term sustainability. The assessment will include analyzing whether communities have the capacity to repair and maintain the water points, ensuring their sustainability in terms of both routine maintenance and longer-term replacement of the infrastructure required to operate the mini-grids.

(D) **Efficiency and Cost-Effectiveness:** Aiming to evaluate the efficiency and cost-effectiveness of establishing and maintaining the INUMA™ Mini-Grids, this aspect will explore elements such as cost savings compared to existing water solutions like WASAC. It will also consider time saved, indirectly measured through statistics on school enrollments and women's participation in activities beyond their household responsibilities.

(E) **Evaluation Metrics:** The comprehensive impact evaluation will meticulously scrutinize a spectrum of pivotal metrics, encompassing water accessibility, utilization, societal impact, financing, and profitability. While the baseline assessment is integral to the overall evaluation process, it will selectively address a subset of these metrics, honing in on specific facets of particular relevance to the initial phase of the project. The primary focus of the baseline will concentrate on water accessibility, safety and well-being, reliability, affordability, and time efficiency, as outlined in Table I.

Table I. Evaluation metrics and their corresponding indicators

S/N	Evaluation metrics	Indicator
1	Accessibility	Distance to water points, waiting time for water, frequency of water collection, and perceptions regarding convenience.
2	Safety and well-being	Water quality and contamination levels, as well as compliance with national and international safety standards.
3	Reliability	Downtime and instances of water shortages
4	Affordability	Cost of water provision to households and individuals, compared to other providers (e.g., WASAC).
5	Time efficiency	Educational attainment of children and drop-out rates, as well as the number of women involved in activities outside the core household responsibilities, will be assessed.

III. METHODOLOGY

The impact evaluation employs a mixed-methods approach, integrating quantitative data collection and qualitative insights. The baseline study entailed conducting surveys to address specific questions related to the accessibility, effectiveness, reliability, and efficiency of the water points. These surveys were administered to both the intervention group (those with INUMA Mini-Grids) and the control group (those without the INUMA Mini-Grids). Concurrently, exploratory interviews were conducted with study respondents during the survey. The objective of these exploratory interviews was to gather initial insights and perspectives for future phases of this report, such as the interim report.

3.1. Participants Selection

The selection process for the intervention and control groups carefully considered the following factors:

3.1.1. Intervention Group: The intervention group comprises communities and households where the Mini-grids are already operational. For a comprehensive analysis, the intervention group is divided into two subgroups based on the duration of Mini-grid operation:

- Recent Customers: This subgroup includes communities and households where INUMA™ Mini-grids have been operational for less than one year. Their inclusion allows for the assessment of early impacts and the identification of short-term trends in safe water provision.
- Established Customers: Communities with the Mini-grids operational for at least one year are considered in this subgroup. This duration is considered heuristically sufficient to capture statistically significant differences in impact, providing a deeper understanding of the long-term effects.

3.1.2. Control Group: The control group comprises communities (Figure 1) pre-selected by WAR for future Mini-grid installations. As the actual installation dates are yet to be determined, the control group is treated as a single entity in the evaluation and will not be further divided into private and public households.

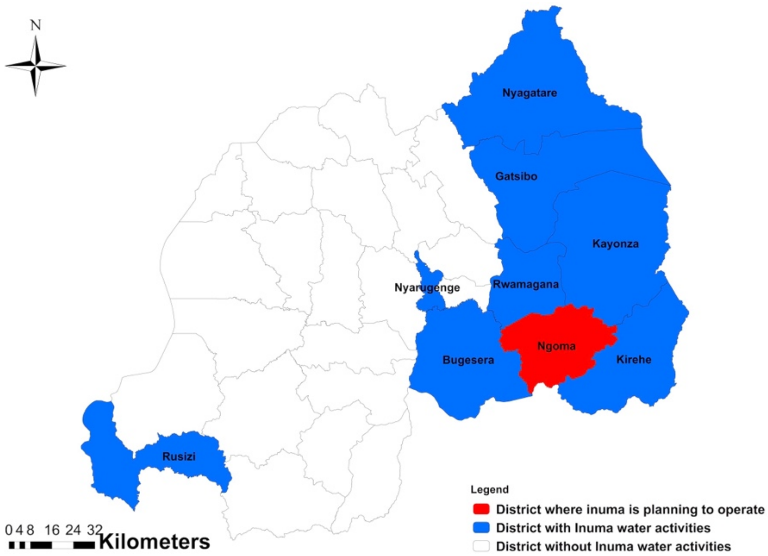


FIGURE 1 Map of the districts where the survey was conducted.

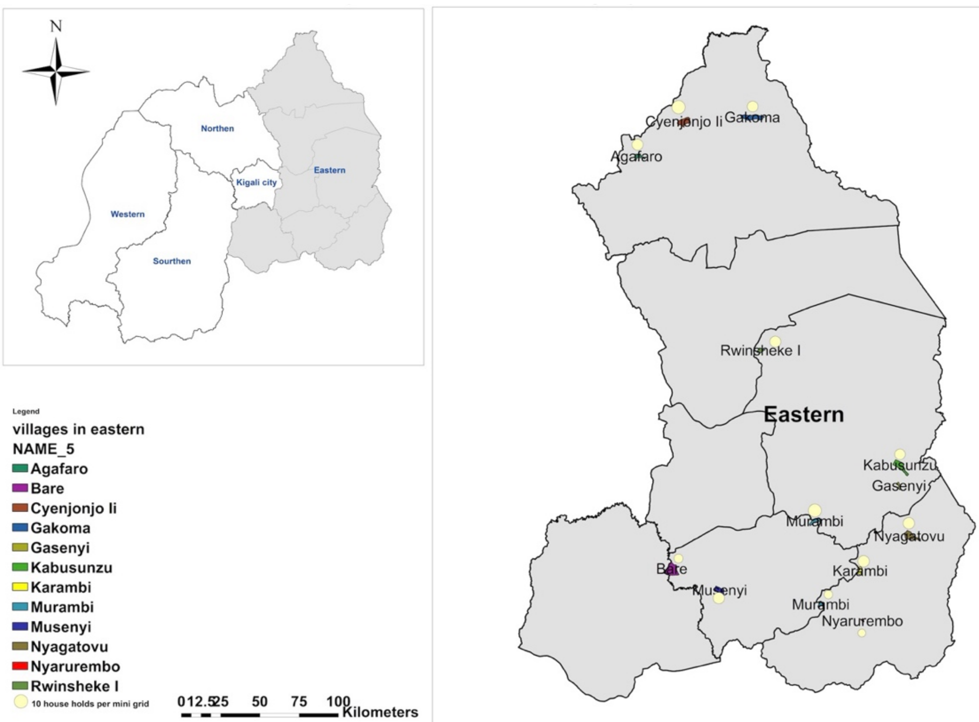


FIGURE 2 Village surveyed in the control group that does not have INUMA Water.

In all cases, efforts were made to ensure the representation of both rural and peri-urban regions in both the control and intervention groups. Careful consideration was given to selecting communities and households that are comparable to the intervention group in terms of geographic location and socioeconomic environment, minimizing potential confounding factors and ensuring a balanced comparison.

3.2. Population and Sample Size Selection

Based on preliminary data from WAR, there are currently 34 Mini-grids serving approximately 23,101 individuals. Theoretically, the study requires the participation of 382 individuals, evenly divided into two groups, to ensure a normal distribution with a probability of 50%, a margin of error of 5%, and a confidence interval of 95%.

For practical reasons, the baseline survey aimed to use a sample population of 640 households, chosen in communities shown in Figures 1 and 2. These households are divided into two groups: 240 in the control group (Figure 2) and 400 in the intervention group. Stratified random sampling ensures the inclusion of all communities, encompassing both rural and urban settings, and incorporating both private and public households. This approach considers various geographical and socioeconomic factors, capturing the diverse communities where INUMA™ Mini-grids are installed for a more accurate and representative evaluation.

While the household selection is heuristic, it is justified by several factors. Firstly, the study employs a rigorous random sampling methodology, ensuring that the selected participants represent the larger population in both rural and urban areas, across private and public households. Secondly, the homogeneity within the studied population, coupled with the focused nature of our research objectives, enables the potential capture of prevailing patterns and trends through this sample size. Finally, time constraints associated with this study necessitate a streamlined approach, and this sample size facilitates timely data collection and analysis.

Whenever possible, both intervention and control groups were selected from neighboring geographic locations to mitigate the impact of regional variations on results. Additionally, data collection for both groups occurred simultaneously to minimize the influence of seasonal variations and unintended errors on the evaluation outcomes.

3.3. Data Collection Strategy

The study employed a mixed-methods approach to data collection, encompassing a structured household survey and informal exploratory interviews. The household survey utilized a forced-choice questionnaire to gather quantitative data on various impact outcomes, including basic household information, water usage and accessibility, water reliability, safety and well-being, and water affordability. The survey was administered to households with installed INUMA™ Mini-Grids and communities without mini-grid access.

3.3.1. Survey Questionnaire

The development of the survey questionnaire was preceded by the formulation of an impact evaluation matrix. This matrix meticulously outlined the evaluation questions, data collection methods, and indicators that would be employed to assess the impact of the INUMA™ mini grids. The matrix was carefully crafted through a consultative process involving stakeholders from the government, private sector, and community. It clearly defined the specific impact outcomes to be assessed by the evaluation, along with the data collection methods and indicators that would be utilized to measure these outcomes. This comprehensive approach ensured that the evaluation was focused, rigorous, and capable of providing meaningful evidence regarding the impact of the INUMA™ mini grids.

3.3.2. Exploratory Interviews

To complement the quantitative data, the study conducted informal exploratory interviews with respondents in both communities. These interviews, conducted in a conversational format, utilized open-ended questions to gain a deeper understanding of participants' experiences, perspectives, and perceptions regarding the community's water challenges. While these interviews were inherently informal and susceptible to bias, they provided valuable insights into the nuances of participants' perspectives and helped identify emerging themes. This qualitative data will prove instrumental in refining the research questions and methods for the remaining surveys (interim and final) of this report.

3.3.3. Quality assurance

Data collectors were rigorously trained on the survey questionnaire and interview guide to ensure consistent and high-quality data collection. Training sessions covered the purpose of the study, the importance of data quality, and proper administration of the survey and interviews. Data collectors were also provided with detailed instructions and guidelines for recording and documenting their observations.

During data collection, field supervisors closely monitored the work of the data collectors to ensure adherence to the protocols, address any challenges, and maintain the quality of the data collected. Regular feedback and refresher training were provided to ensure data collectors maintained a high level of competency throughout the data collection period.

Several data quality control measures were implemented to ensure the accuracy and reliability of the collected data. These measures included, among others, data entry checks to identify any inconsistencies (e.g., someone reporting to be in the control group while he should be in the intervention group) and correct any errors.

3.4. Limitations

This baseline report serves as a foundational document, compiling initial data from both the intervention and control groups to inform subsequent interventions and recommendations. Thus, the report refrains from drawing causal inferences between the two groups, instead emphasizing the presentation of preliminary results through visualizations and tables.

Rigorous statistical analyses, including hypothesis testing, such as the Mann-Whitney U test and the Kruskal-Wallis test, will be deferred to future reports. These future analyses will delve into comparing water usage, accessibility patterns, reliability, and safety and well-being experiences between the intervention and control groups.

The exploratory interviews were intentionally designed to be non-rigorous in nature, aiming to gain a comprehensive understanding of local water challenges before transitioning to more structured data collection methods in future surveys. These interviews were designed to gather initial insights, generate hypotheses, and identify potential avenues for further investigation. This approach provided flexibility for exploring new ideas and perspectives without the constraints of predefined questions or structures. Rigorous interviews are planned for future reports to uncover patterns, themes, and relationships between the control and intervention groups, contributing to a more comprehensive understanding of the intervention's impact.

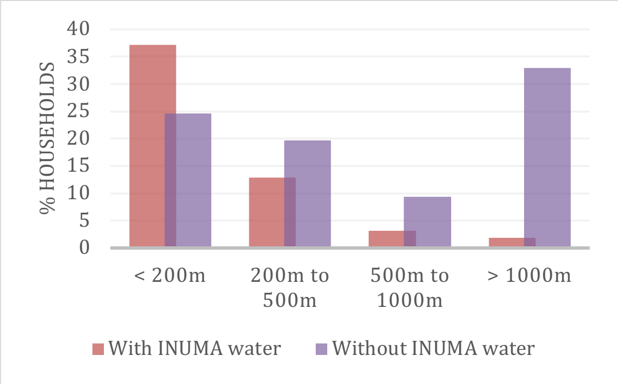
IV. KEY FINDINGS

The preliminary data of the impact evaluation of WAR's INUMA™ Mini-Grids has yielded a wealth of valuable insights that demonstrate their transformative potential. These findings can be concisely categorized into five key areas: (1) accessibility and time efficiency, (2) safety and well-being, (3) reliability, (4) affordability, and (5) broader societal impacts. These interrelated themes collectively align with and underscore WAR's overarching goal of providing reliable, cost-effective, hygienic, and convenient water access to communities across Rwanda.

4.1. Accessibility and time efficiency

While the available data is preliminary, overall, it is evident that the INUMA™ Mini-Grids are effective in improving water accessibility, time efficiency, and community perception of water point accessibility for households.

INUMA water mini-grids have had a positive impact on water accessibility in the communities. Figure 3 shows that the mini-grids have reduced the distance traveled to fetch water, especially for longer distances. Similarly, the duration of fetching water is significantly reduced for communities with access to INUMA water, especially for longer distances (Figure 4). This is particularly evident for longer distances where 60% of the communities without access to INUMA water travel more than 30 minutes to fetch water compared to only 1.3% of the communities with access to INUMA water.



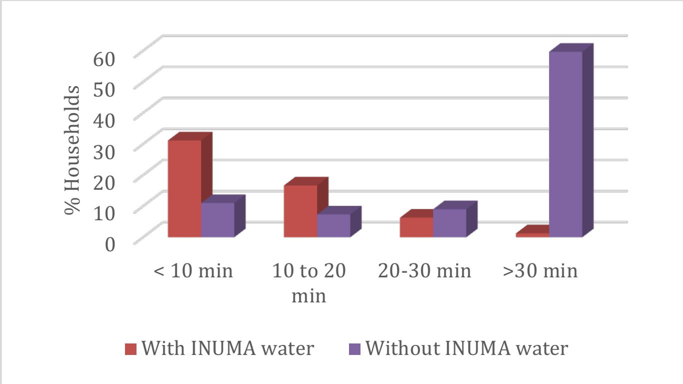
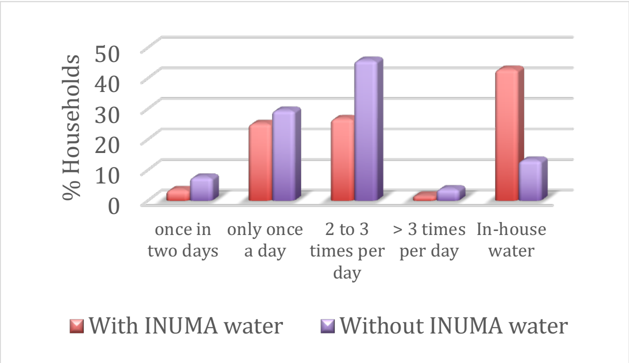


FIGURE 3: Average distance (in meters) traveled to fetch water

FIGURE 4: Average duration (in minutes) to fetch water



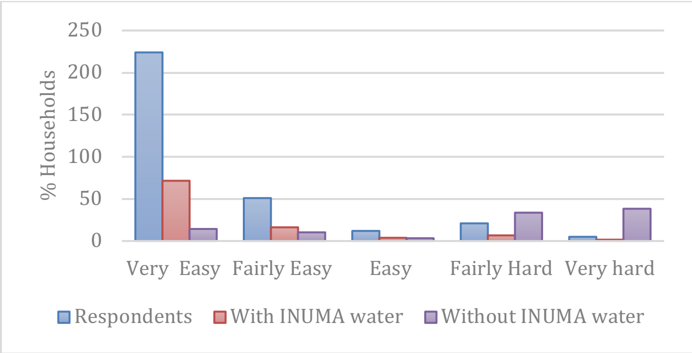


FIGURE 5 Frequency of water collection

FIGURE 6 Community perception of water point accessibility

4.2. Safety and Well-being

The availability of INUMA water has demonstrated a significant impact on the safety and well-being of communities, particularly in relation to perceived water quality, occurrences of water-related illnesses, and bathing habits, as illustrated in Figures 7, 8, 9, and 10.

- When respondents were queried about their confidence in the safety and potability of the water they utilize at home, a notable distinction emerged. A substantial 77% of individuals with access to INUMA expressed confidence in the safety of their water source, in contrast to 45% within communities where INUMA is not operational.
- Most households in both the control and intervention groups consume water directly from their source without any treatment. While there is no statistically significant difference in overall treatment practices between the two groups, those with access to INUMA water (66.67%) exhibit a higher level of trust in the quality of their water, opting to drink it untreated compared to those without INUMA (64.19%). However, a notable difference emerges when considering boiling water practices. Only 18.73% of those with INUMA water boil it, compared to 32.09% for those without INUMA. This suggests that those with INUMA water perceive their water to be of higher quality and do not feel the need to boil. Interestingly, respondents with INUMA water tend to purify water

with tablets or filter their water. This anomaly, while requiring further investigation, could be attributed to isolated instances where INUMA water was observed to be salty or contaminated by mud, as reported in some communities.

- Inquiries were directed to ascertain whether individuals within respondents' households had encountered water-related illnesses over the preceding three months. Notably, a substantial 96% of those utilizing INUMA water sources reported an absence of such illnesses. In contrast, merely 48.95% of individuals without access to INUMA water made a similar assertion. This discrepancy is not entirely unexpected, given that communities lacking INUMA water infrastructure typically resort to less sanitary water sources, including aquifers and groundwater (39.8%), rivers or lakes (24.4%), and rainwater (17.7%). In contrast, those with INUMA water sources seldom (7.7%) depend on these potentially unsafe water sources.
- On a broader note, a significant majority engage in daily bathing habits. Nevertheless, those with access to INUMA water hold a slight advantage (75%) in this regard compared to those without INUMA water (68%).

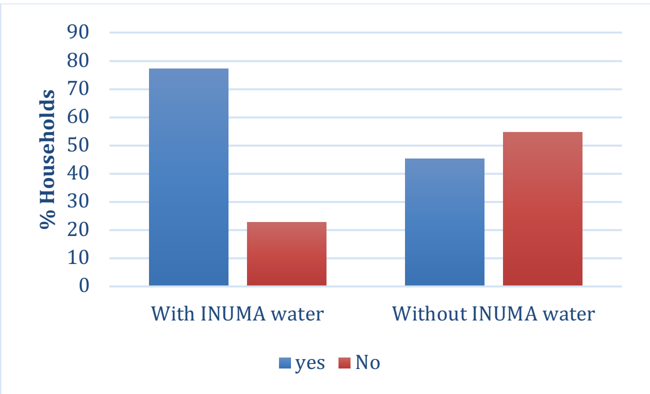


FIGURE 7: Perception of the readiness of water for drinking

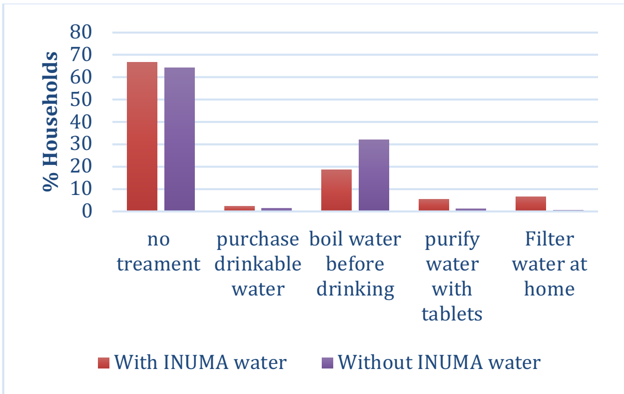


FIGURE 8: Common actions taken before drinking water

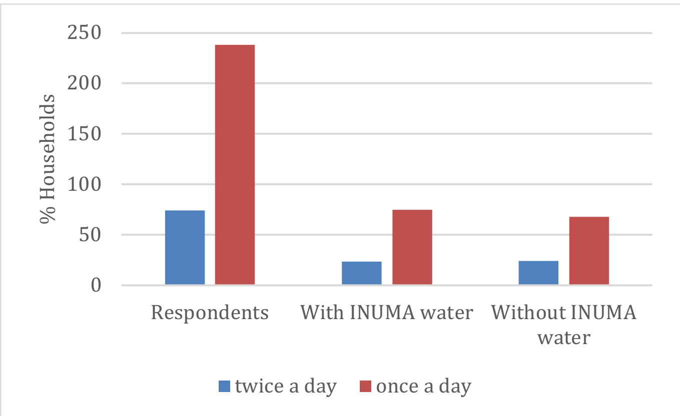


FIGURE 9: Bathing frequency among members of households

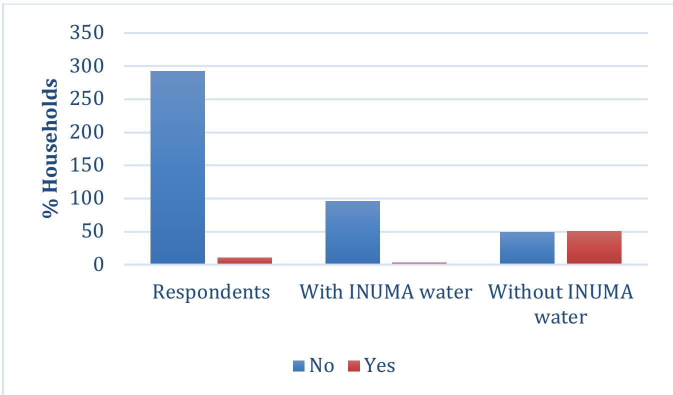


FIGURE 10: Prevalence of water-related illnesses

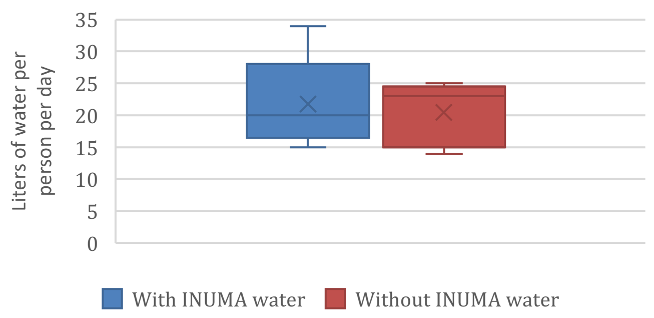


FIGURE 11: Average daily water consumption per capita

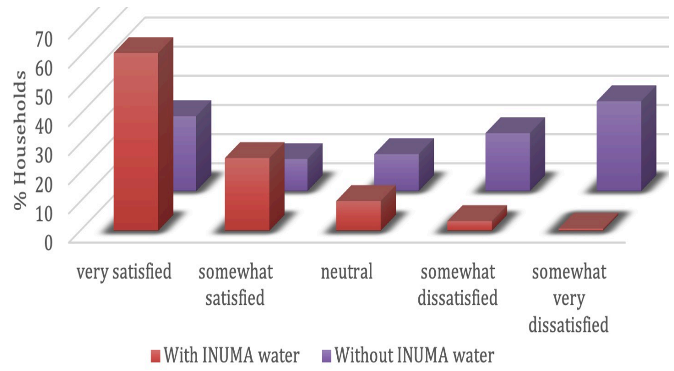


FIGURE 12: Satisfaction with the water's taste and odor

4.3. Water availability and reliability

While the available evidence is inconclusive, there appear to be reliability issues with INUMA mini-grids. When queried about the frequency of water shortages due to service interruptions, a majority of INUMA customers reported experiencing some reliability issues. Specifically, 50.8% reported occasional interruptions, 28.6% reported frequent interruptions, and 11.7% reported permanent interruptions.

Despite these disruptions, it is noteworthy that these interruptions are typical of shorter duration for INUMA customers. Approximately 59.7% of the water interruption incidents for INUMA-serviced communities were resolved within six hours, a notable improvement compared to those without INUMA water, where only 22.5% of interruption incidents were resolved within the same timeframe. Additionally, it is crucial to highlight that, in comparison to alternatives, INUMA water rarely experiences prolonged interruptions (6.4%), whereas those without INUMA often report protracted service disruptions (53.9%).

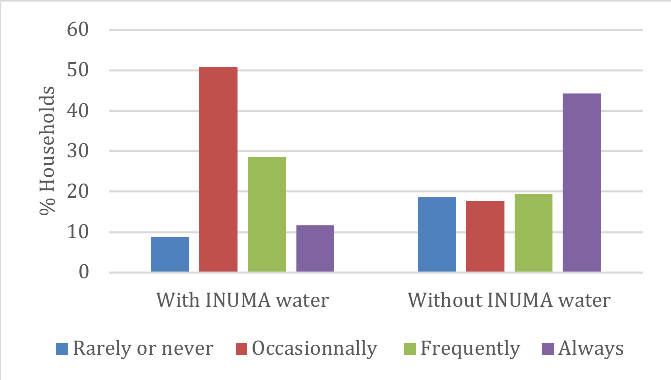


FIGURE 13: Frequency of water shortage or interruptions

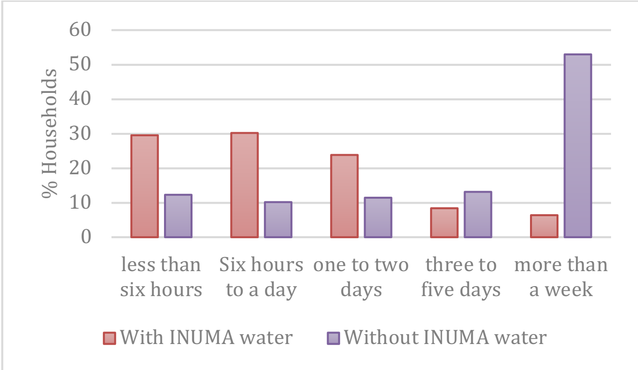


FIGURE 14: *Duration of water interruption*

Water shortages associated with INUMA water supply are attributed to several factors, including technical issues with the water source (48.0%), infrastructure maintenance (30.2%), and insufficient water at the distribution point (5.9%).

4.4. Water cost and affordability

Communities with access to INUMA™ Safe Water Mini-Grids consistently demonstrate lower water expenditures across all spending categories, highlighting the impact of INUMA in enhancing water affordability.

- A significant majority (94.6%) of residents in communities with INUMA water systems opt to purchase their water, compared to only 73.5% in communities without INUMA water, who obtain their water at no cost from unsafe sources such as lakes, wells, or rainwater. This disparity likely stems from the relatively lower water costs incurred by communities with INUMA water operations. Indeed, over half (54.4%) of residents in these communities pay less than 100 RWF per day for water, compared to only 26.5% of those without INUMA water. A similar trend is observed for those spending between 100 RWF and 200 RWF per day. Conversely, in communities without INUMA water, water costs are substantially higher, with 14.3% of residents spending between 200 RWF and 500 RWF daily, compared to only 3.5% of those with INUMA water access. This discrepancy is even more pronounced for those spending over 500 RWF per day, with 26.5% of those without INUMA water spending at least 500 RWF daily compared to only 5.4% of those with INUMA water access.
- Water affordability remains a persistent challenge for communities without INUMA water access. When asked whether they have ever had to reduce their water usage due to affordability concerns, respondents without INUMA water frequently (65.86%) reported doing so either frequently or occasionally, compared to only 28.2% for respondents with INUMA water. Similarly, 47.6% of households without INUMA water reported that water is expensive compared to their household income, while only 13.8% of households with INUMA water access expressed this concern.
- Despite rising global inflation prices, INUMA water prices have remained relatively stable. In the past three months, 44.0% of those without INUMA water reported an increase in water prices, compared to only 18.5% for households with INUMA water access.
- On a side note, as shown in Figure 15, some INUMA customers reported receiving their water free of charge, even though WAR charges all customers for its water. This aberration in the data might be explained by the fact that some customers received their water free of charge because a relative paid for it, and therefore they reported it as free.

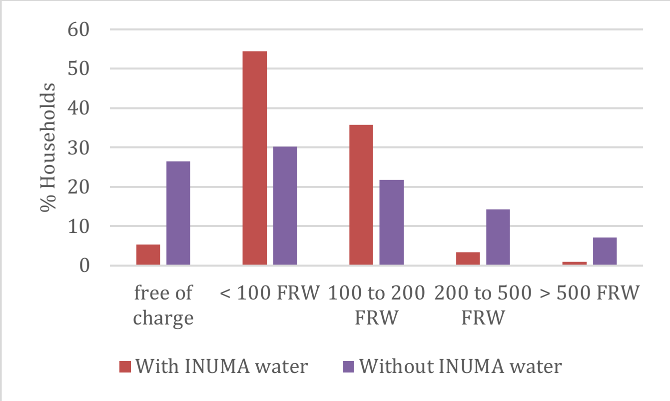


FIGURE 15: Household average daily water expenditure

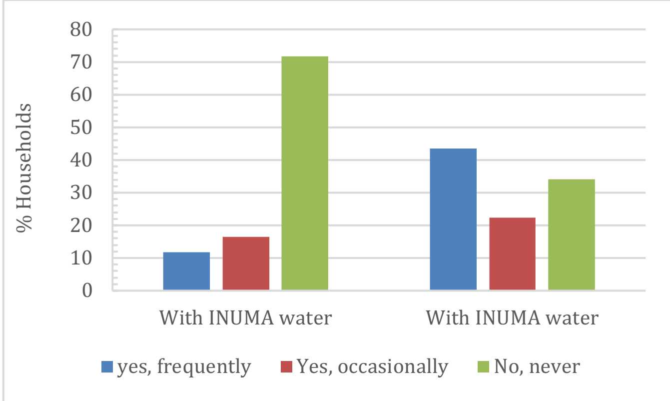


FIGURE 16: Households reporting water consumption reduction due to affordability concerns

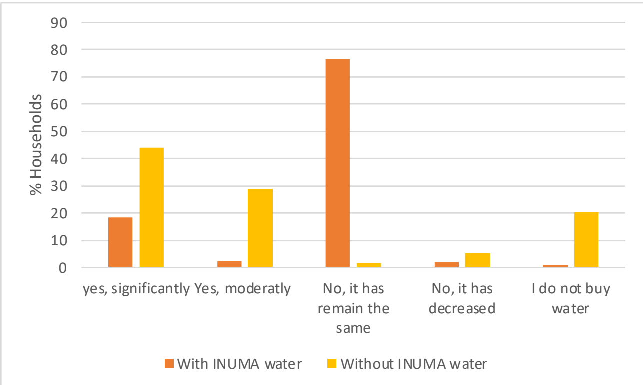


FIGURE 17: Households *perceiving a significant increase in water service costs over the past 3 months.*

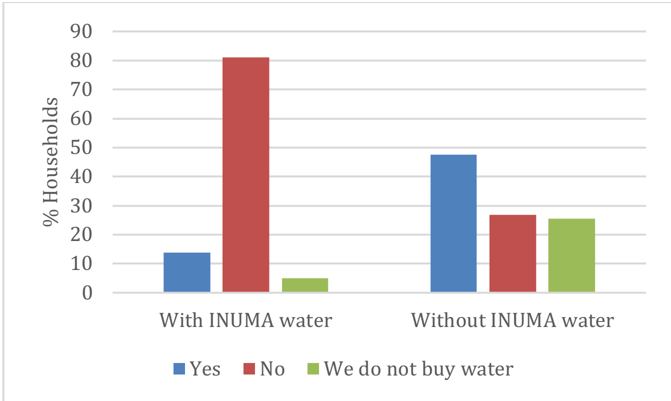


FIGURE 18: Households deeming the water cost reasonable relative to their household income.

4.5. Broader Societal Impacts

The introduction of INUMA™ Safe Water Mini-Grids has the potential to extend its positive impact beyond its primary objective of providing safe and accessible drinking water. To explore these potential benefits, we investigated the impact of INUMA water on carbon emissions, educational attainment of children, and women's engagement in activities beyond traditional household responsibilities.

4.5.1. Carbon Emissions Reduction

Preliminary evidence suggests that INUMA water may have contributed to a reduction in carbon emissions by mitigating the need for water boiling. In communities with INUMA water systems, only 18.3% of households reported boiling their water before drinking, compared to 32.1% in communities without INUMA water access. This reduced reliance on boiling suggests a potential decrease in greenhouse gas emissions associated with fuel combustion for water heating.

4.5.2. Enhanced Educational Attainment

While direct data on student performance in intervention and control groups was not independently analyzed, 71.5% of respondents in communities with INUMA water reported that the academic performance of students in their communities had significantly improved or shown some improvement on national examinations. This compares to only 51.4% of respondents in communities without INUMA water access. These findings suggest that INUMA water may have contributed to improved educational outcomes, possibly by reducing time spent on water fetching and providing more time for studying.

4.5.3. Promoting Gender Equality in Water Fetching

The introduction of INUMA water may have also fostered gender equality in water fetching responsibilities. Among respondents in communities with INUMA water, 81.8% indicated that both males and females are involved in water fetching, compared to only 54.5% in communities without INUMA water access. This shift towards shared water fetching responsibilities suggests that INUMA water may be contributing to a more equitable distribution of household chores. This finding is noteworthy, as our interviews revealed that, contrary to conventional expectations, when water sources are distant, males, including the male head of the family, are tasked with fetching water, while females focus on other household activities such as farming and tending to livestock. Our preliminary data seems to support this, with only 21.5% of men (both boys and adult males) involved in water fetching in communities where INUMA water is missing, compared to 32.0% in communities where INUMA is not in operation.

4.5.4. Empowering Women for Broader Engagement

INUMA water may have also empowered women to engage in activities beyond traditional household responsibilities. When asked whether women in their communities time for activities have outside of household chores, 75.8% of respondents in communities with INUMA water responded positively, compared to only 54.6% in communities without INUMA water access. These findings suggest that INUMA water may be contributing to increased opportunities for women to pursue personal interests and contribute to community activities.

4.5.5. Caveats and Future Research

It is crucial to note that the available evidence on the broader societal impacts of INUMA water is preliminary and may not be statistically significant. Further research with a larger and more representative sample is warranted to confirm these observations and draw definitive conclusions. Additionally, formal and rigorous statistical tests should be applied to the collected data to validate these anecdotal findings.

V. SUMMARY AND HIGHLIGHTS

5.1. Overall Summary

This baseline report for the Rigorous Impact Evaluation of Water Access Rwanda's INUMA™ Safe Water Mini-Grids serves as an initial examination of the WAR's initiative's effectiveness in addressing water access challenges in Rwanda. This study, conducted through a mixed-methods approach, meticulously explores the impact of INUMA water on various facets, including accessibility, affordability, and broader societal outcomes. The evaluation aims to inform future policies and interventions by providing evidence-based insights into the strengths and areas for improvement within the context of safe water provision.

While the available data is preliminary and no rigorous statistical analysis has yet been completed, the findings in this report reveal that INUMA Mini-Grids play a pivotal role in improving water accessibility and time efficiency, particularly in communities facing longer distances. The positive impact extends to enhanced safety and well-being, with individuals expressing increased confidence in the safety of their water sources and a significant reduction in water-related illnesses. Despite occasional reliability challenges, INUMA water interruptions are efficiently resolved, ensuring a higher level of reliability compared to alternative sources.

Affordability emerges as a key highlight, as communities with INUMA water consistently demonstrate lower water expenditures, offering a sustainable solution to address this longstanding concern. Furthermore, preliminary evidence suggests broader societal benefits, including potential carbon emissions reduction and improved educational outcomes, contributing to our understanding of the initiative's multifaceted impact.

5.2. Highlights

This study on the impact of WAR's INUMA™ Safe Water Mini-Grids has yielded a multitude of positive impacts on water access, safety, affordability, and broader societal outcomes. The key highlights of the study include:

5.2.1. Enhanced Water Accessibility and Time Efficiency

- INUMA Mini-Grids have significantly reduced the distance traveled and time spent fetching water, particularly for communities that previously faced long and arduous journeys to water sources.
- Communities with INUMA water systems experience substantially shorter water collection durations, demonstrating the initiative's effectiveness in enhancing accessibility and alleviating the burden of water fetching.

5.2.2. Positive Impact on Safety and Well-being

- Individuals with access to INUMA water express a significantly higher level of confidence in the safety of their water source compared to those without INUMA access. This enhanced perception of water quality stems from the consistent provision of treated and safe drinking water through INUMA Mini-Grids.

- Communities with INUMA water systems report a notable decrease in water-related illnesses, emphasizing the positive impact on community health and reducing the risk of waterborne diseases. This improved health status is attributed to the availability of clean and safe drinking water.

5.2.3. Reliability Challenges and Resolutions

- While INUMA customers may experience occasional service interruptions, the vast majority of these incidents are resolved within six hours, demonstrating efficient issue resolution and minimizing disruptions.
- Compared to alternative water sources, INUMA water experiences shorter and less frequent service disruptions, enhancing overall reliability and ensuring consistent access to safe drinking water.

5.2.4. Cost and Affordability

- Communities with INUMA water consistently demonstrate lower water expenditures across all spending categories, highlighting the positive impact on water affordability, despite the general rising global price inflation.
- Residents in communities where INUMA services are operational are significantly less likely to reduce their water usage due to affordability concerns, indicating the initiative's success in addressing financial barriers to adequate water access.

5.2.5. Broader Societal Impacts

- Preliminary evidence suggests a potential contribution to carbon emissions reduction by mitigating the need for water boiling, which typically relies on fossil fuels. This potential reduction in carbon emissions is attributed to the direct provision of safe drinking water through INUMA Mini-Grids, eliminating the need for boiling.
- INUMA water may have contributed to improved educational outcomes, with communities reporting enhanced academic performance among students. This potential improvement in academic performance is attributed to reduced time spent on water fetching and increased time for studying.
- Communities with INUMA water systems exhibit a more equitable distribution of water fetching responsibilities, with greater participation from both males and females. This shift towards shared water fetching responsibilities suggests a positive impact on gender equality in household chores.
- Women in communities with INUMA water report having more time for activities outside of household chores, suggesting a positive impact on their empowerment and opportunities for broader engagement. This increased time availability is attributed to the reduced burden of water fetching due to INUMA Mini-Grids.