

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

**A Monitoring Report**

Submitted by

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## EXECUTIVE SUMMARY

1. **BACKGROUND:** In Rwanda, only 57% of the population has access to safe drinking water within a 30-minute walk from their homes. To address this, Water Access Rwanda (WAR) launched the INUMA™ Safe Water Mini-Grids, aimed at providing safe water throughout rural and peri-urban areas. This report is the second installment in a three-phase evaluation to assess the long-term effectiveness of these mini-grids.
2. **METHODOLOGY:** This study employed a stratified random sampling to gather a representative sample (N=355) from those with access to the Mini-Grid for over a year and those with less than a year of access. The study used structured household surveys (N=355) across the regions served by INUMA. For comparative analysis, it used Chi-Square tests, with a significance threshold set at  $p < 0.05$ .
3. **KEY FINDINGS:**
  - Long-term users of INUMA water have a higher trust in its safety, with 64.1% fully trusting the water compared to 55.7% of short-term users, a statistically significant difference ( $p < 0.01$ ). Conversely, uncertainty about water safety was notably lower among long-term users at 2.3%, versus 11.5% for short-term users.
  - Long-term users have a higher reliance on INUMA water compared to short-term users and consume more INUMA water daily, leading to higher overall daily expenses. Although there are slight variations in the price per unit, with long-term users paying marginally more, both groups pay similar rates for a standard 20-liter jerrycan when accounting for other factors. Consequently, it seems that the higher daily cost for long-term users is primarily due to their increased water consumption rather than an elevated price per unit.
  - Long-term users have generally affordability concerns, which are due, among other things, to their personal financial constraints as they generally reside in underprivileged and low-resources area of the country. Despite their financial challenges, a significant portion (44.2%) of long-term users are willing to pay more if necessary to maintain INUMA services. This contrasts sharply with only 15.0% of short-term users, highlighting the strong trust and reliance on the water services among those who have used them longer.
  - While trust in INUMA water's quality is widespread among both groups— with many households choosing to drink directly from the source— approximately 20% still boil the water before consumption, and there is no significant statistical discrepancy between long-term and short-term users. This indicates a dichotomy where trust in water safety coexists with precautionary measures. Further investigation is necessary to uncover the underlying reasons for this behavior, which could provide insights into cultural habits, residual health concerns, or knowledge gaps regarding water safety.
  - Positive socioeconomic impacts were observed across both user groups, including improved school attendance, increased participation of women in income-generating activities, and the creation of new economic opportunities.
4. **CALL FOR ACTION:** While the findings were mostly statistically significant, some aspects require further exploration:
  - 20% of users continue to boil INUMA water before consumption, despite expressing high trust in its safety. Further research is needed to understand the underlying reasons for this precautionary behavior.
  - Evidence suggests an improvements in school attendance and women's economic participation linked to INUMA water access. To clearly distinguish these effects from other factors such as regional development or seasonal changes, a focused analysis is needed to ensure that attributed benefits are accurately understood and effectively addressed in future strategies.

## I. INTRODUCTION

Access to safe drinking water remains a challenge for many communities in Rwanda, with only 57% of the population having access within a 30-minute walk from their homes. In response to this issue, Water Access Rwanda (WAR) has introduced the INUMA™ Safe Water Mini-Grids, with the objective to provide reliable, cost-effective, hygienic, and convenient water access across rural and peri-urban areas of the country.

This report is the second installment of a three-phase rigorous impact evaluation of WAR's INUMA™ Safe Water Mini-Grids. It builds upon the baseline report, which established the initial conditions, identified challenges, and outlined the immediate benefits and ongoing issues associated with the INUMA™ Safe Water Mini-Grids' operations. The baseline report identified several positive impacts of the INUMA™ Safe Water Mini-Grids, particularly in improving water accessibility and reducing the time community members spend fetching water. It revealed that INUMA water sources have increased the convenience of water access, thereby reducing the daily burden on households, especially for women and children. Additionally, the report highlighted improvements in water safety, with a decrease in water-related illnesses and an increase in community satisfaction.

Despite the promising outcomes outlined in the baseline report, there remains a need to fully comprehend the enduring impact of INUMA Mini-Grids on the communities they serve. While anecdotal evidence and internal ad hoc data analyses suggest that INUMA™ Safe Water Mini-Grids provide lasting benefits, there is a notable lack of comprehensive, documented evidence to robustly support these claims. Thus, a pivotal question arises: Is the positive impact of the mini-grids sustainable over time, or does the quality of service degrade as the mini-grids age?

Furthermore, it is essential to explore whether the duration of access to INUMA Mini-Grids has led to WAR's intended social and community outcomes. Specifically, do communities with long-term access exhibit better health, economic, and social outcomes due to their prolonged exposure to safe and reliable water? Conversely, do communities with newer access experience unique challenges or a temporary decline in service quality during their initial adjustment period? Finally, how has access to INUMA water influenced educational outcomes, particularly the attendance and performance of school-aged children in these communities, given that less time fetching water could translate into more time for study?

This report aims to address these and many other questions by comparing the experiences of those who have had access to INUMA Mini-Grids for over a year and those who have been recent recipients within the past year. It is hoped that the results of this report will not only shed light on the sustainability and effectiveness of the INUMA Mini-Grids but will also guide future initiatives and interventions.

## **II. METHODOLOGY**

### **2.1. Study Design**

The primary objective of this monitoring study was to address questions arising from the baseline study, as summarized in the introduction. This comparative study aimed to assess the impact of INUMA Mini-Grids on various dimensions by contrasting households with access to INUMA water for more than one year against those with less than one year of access. The selection of these groups was based on the hypothesis that prolonged access to improved water sources enhances outcomes related to safety, reliability, affordability, financial sustainability, and other social and cross-cutting impacts in the communities. A representative sample from both groups was recruited to enable robust comparisons.

### **2.2. Data Collection**

Data were collected through a structured household survey designed to engage 400 respondents across regions where INUMA operates. However, due to various factors, data from only 356 respondents were ultimately obtained. This survey was conducted through face-to-face interactions to gather detailed information on critical indicators, including service reliability, water safety, affordability, and the environmental and social impacts of the water service.

### **2.3. Sampling Strategy**

The study employed a stratified random sampling method to ensure comprehensive coverage across all regions where INUMA operates. This approach provided equitable representation of both the treatment and control groups, reducing sampling bias and enhancing the external validity of the findings.

### **2.4. Analytical and Statistical Approach**

The analysis employed both descriptive and inferential statistics. Descriptive statistics involved calculating measures of central tendency and dispersion for quantitative survey data related to water usage. Qualitative data, such as responses regarding water safety and service reliability, were analyzed by evaluating their distribution to assess perceptions.

For comparative analysis, chi-square tests were chosen due to their suitability for analyzing categorical survey data. This non-parametric method does not require a normal distribution, which is advantageous for the current data set. Chi-square tests were utilized to examine differences across several dimensions, including water quality, water supply reliability, and socio-economic impacts. Each survey question was analyzed separately to determine the statistical significance of observed differences, with a significance threshold set at  $p < 0.05$ . A custom Python software developed by the authors was employed for all statistical analyses.

### III. FINDINGS

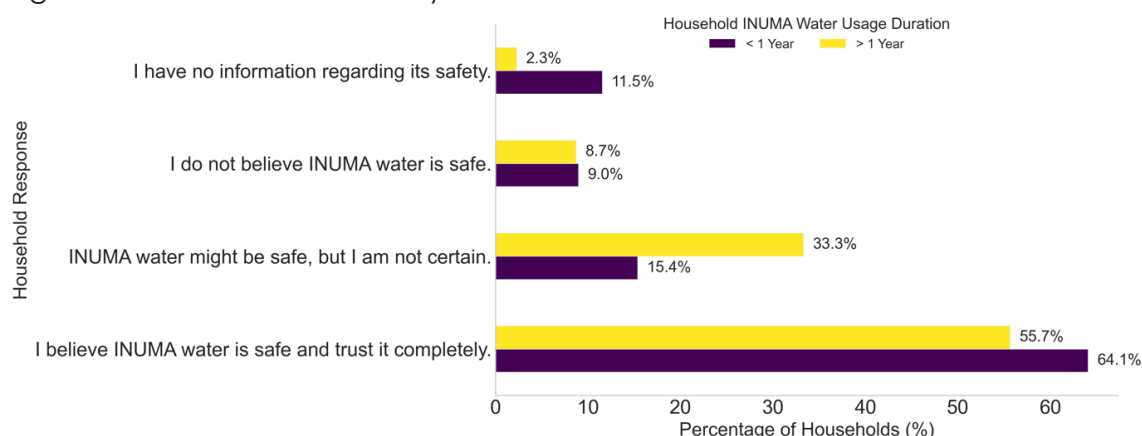
#### 3.1. General findings

This monitoring study aimed to evaluate the long-term effects of access to INUMA Mini-Grids by comparing the experiences of households with more than a year of access to those who have joined within the past year. The assessment explored a range of outcomes, including water access, safety, reliability, affordability, and socioeconomic impacts, to ascertain whether the quality and impact of service remain stable over time and to assess the broader implications of INUMA Mini-Grids.

The findings indicate that long-term access to INUMA Mini-Grids correlates with enhanced perceptions of water safety, increased satisfaction with service, improved social outcomes, and noticeable economic advantages. Additionally, other indicators such as the incidence of waterborne illnesses, reliability of water supply, affordability, and adherence to environmental practices showed no significant differences between the two groups, underscoring consistent service quality regardless of the duration of access.

#### 3.2. Water Quality and Safety

The study revealed a notable difference in the trust levels regarding water safety between long-term and short-term users of INUMA Mini-Grids. A higher percentage of long-term users, defined as those with over one year of access, reported complete trust in INUMA water's safety (64.1%) compared to only 55.7% of short-term users with less than one year of access (Figure 1). This statistically significant difference ( $p < 0.01$ ) suggests that prolonged use of INUMA water correlates with higher levels of trust in its safety.



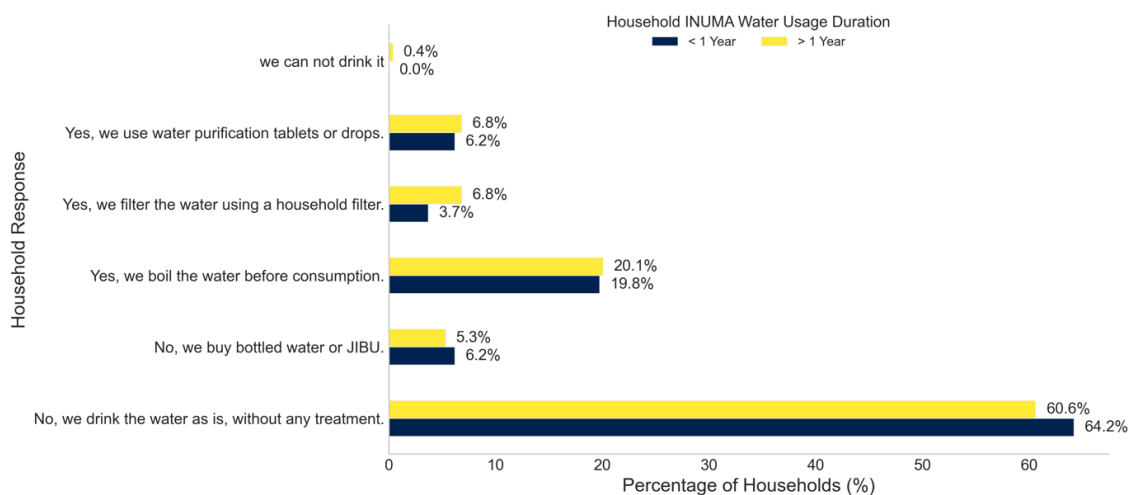
**FIG 1:** Trust in INUMA Water Among Long-Term and Short-Term Users of INUMA Mini-Grids

Furthermore, the data indicates that a considerably smaller proportion of long-term users (2.3%) expressed uncertainty about INUMA water's safety compared to short-term users (11.5%). This finding potentially indicates that extended exposure to INUMA water increases users' knowledge and confidence in the efficacy of the treatment processes employed.

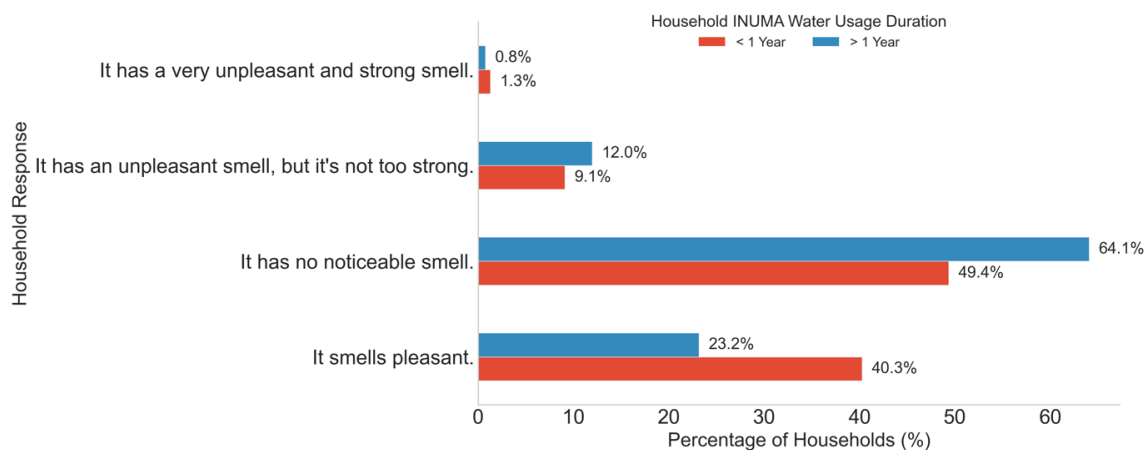
Despite these variations, there was no statistically significant difference ( $p > 0.05$ ) in concerns about the water's potential health impacts between the two groups. This suggests that the length of time households have used INUMA water does not

significantly influence their perceptions of its health safety, indicating a general agreement on the safety of the water, regardless of usage duration.

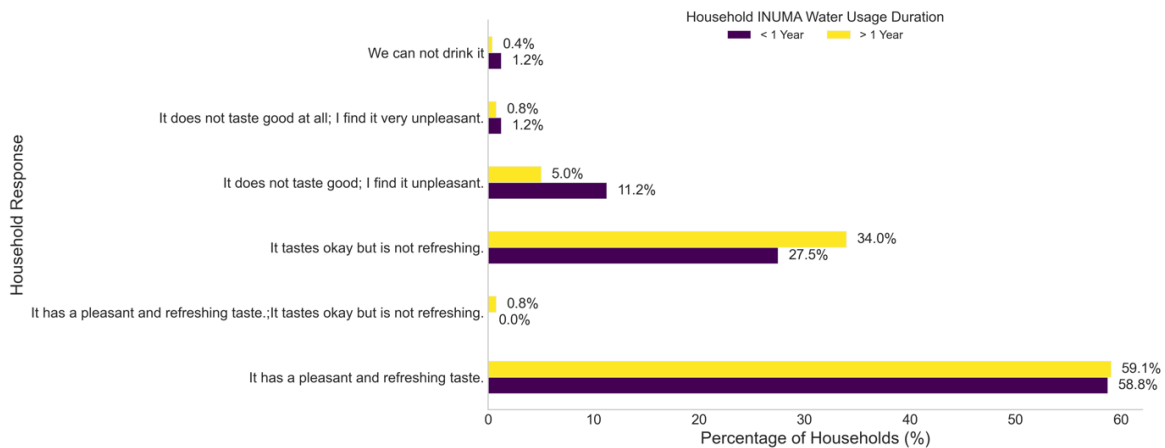
While trust in INUMA's water quality is prevalent among households, with many opting to consume the water directly from the source, as shown in Figure 2, approximately 20% of respondents still choose to boil the water before consumption, and there is no significant statistical discrepancy observed between the two groups. This behavior may imply a dichotomy where trust in the safety of the water exists alongside precautionary practices. Further investigation is warranted to understand the underlying reasons for this behavior, which may reveal insights into cultural habits, residual health concerns, or knowledge gaps regarding water safety.



**FIG 2:** Percentage of Households reporting treating INUMA water before drinking.

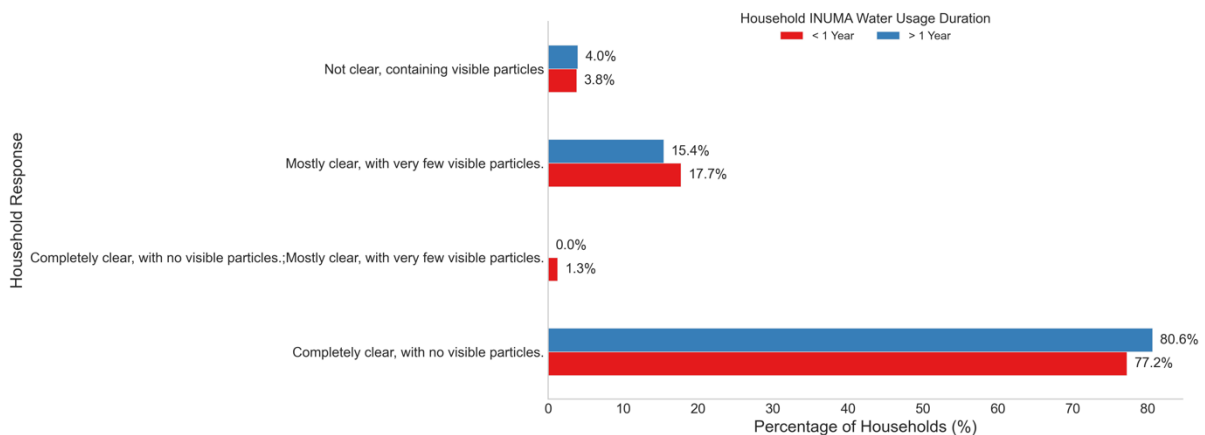


**FIG 3:** Perception of INUMA Water Smell Among Long-Term and Short-Term Users of INUMA Mini-Grids



**FIG 4:** Opinion on the taste of INUMA water Among Long-Term and Short-Term Users of INUMA Mini-Grids

Regarding the water's appearance, taste, and smell, most respondents across both user groups reported no noticeable odor (Figure 3), generally found the taste pleasant and refreshing (Figure 4), and described the water as clear and containing no visible particles (Figure 5).



**FIG 5:** Perception of Water Cleanliness and Transparency Among Respondents

Interestingly, when it comes to odor, long-term INUMA users tended to find the smell of INUMA water less unpleasant compared to short-term users ( $p < 0.05$ ), potentially due to increased familiarity over time. However, there were no notable statistical differences in perceptions of taste or clarity of the water between the two groups ( $p > 0.05$ ). Qualitative studies examining user experiences, analyses of waterborne illness data, and longitudinal investigations tracking the evolution of trust over time could provide valuable insights into the drivers behind these observed trends.

### 3.3. Reliability of Water Supply

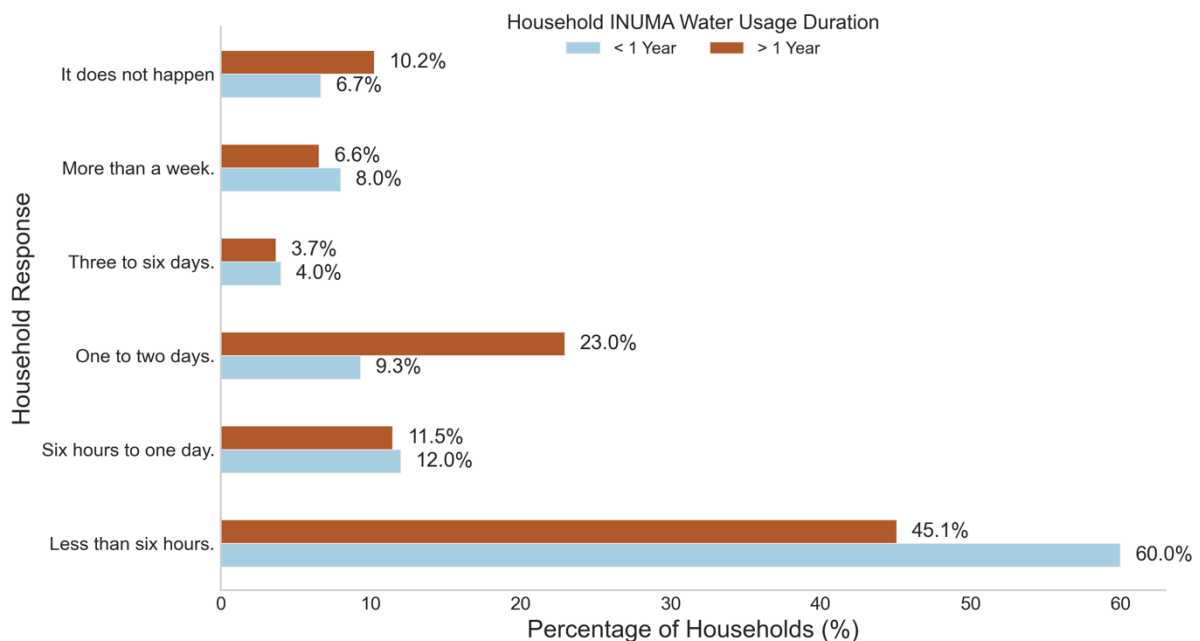
Both groups agreed that the INUMA water supply was acceptably reliable. There was no statistically significant difference between the frequency of water supply interruptions between newer users and those with prolonged access ( $p > 0.05$ ), suggesting that reliability in terms of interruption frequency is consistent across varying durations of service.



However, a notable divergence emerged regarding the perception and awareness of the causes of these interruptions ( $p < 0.05$ ). Longer-term users demonstrated a greater understanding of the reasons and specific issues ( $p < 0.01$ ), such as infrastructure maintenance and other factors, that led to water supply disruptions.

When surveyed about the frequency of water shortages due to service interruptions, a high percentage of users in both groups—92.7% of long-term users and 88.0% of short-term users—reported they never or rarely experience water shortages (Figure 6). This data statistically significant ( $p < 0.05$ ) consensus across both user groups further affirms that the duration of service usage does not impact the frequency of encountering water shortages and underscoring consistent reliability among different durations of service users.

Nevertheless, although not reaching statistical significance ( $p = 0.09$ ), and while it is not an impactful nor enduring problem (Figure 7) there is an observed trend indicating that long-term users of INUMA water might face slightly longer disruptions compared to their short-term counterparts (Figure 6). During instances of service interruption, 56.6% of long-term users reported that water supply was restored within one day, in contrast to 72.0% of short-term users who experienced quicker restoration within the same timeframe. This disparity warrants further exploration to confirm if longer disruptions are a concern for long-term users or if their expectations differ from newer users, and to definitively determine the impact of service duration on disruption recovery times.



**FIG 6** Comparison of Restoration Duration Following Interruptions to INUMA Water Service

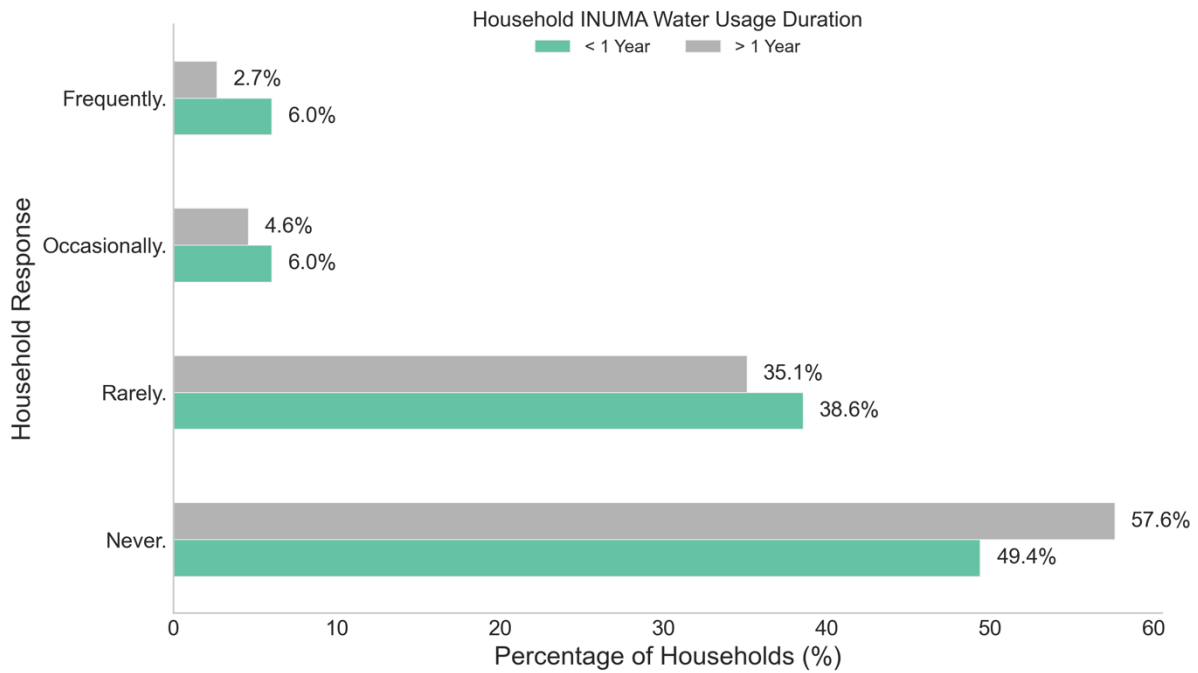


FIG 7: Opinion on the Frequency of Water Shortages Experienced by Households with INUMA Water Access

### 3.4. Economics and Affordability

Strong statistical evidence ( $p < 0.01$ ) suggests that long-term users of INUMA water tend to incur higher daily expenses, even when adjusted for variations across different geographic locations. As depicted in Figure 8, 56.5% of long-term users spend at least 150 RWF per day on INUMA water, compared to just 13.8% of short-term users. Conversely, a smaller proportion of long-term users (11.7%) spend between 50 and 100 RWF daily, versus 41.2% of short-term customers.

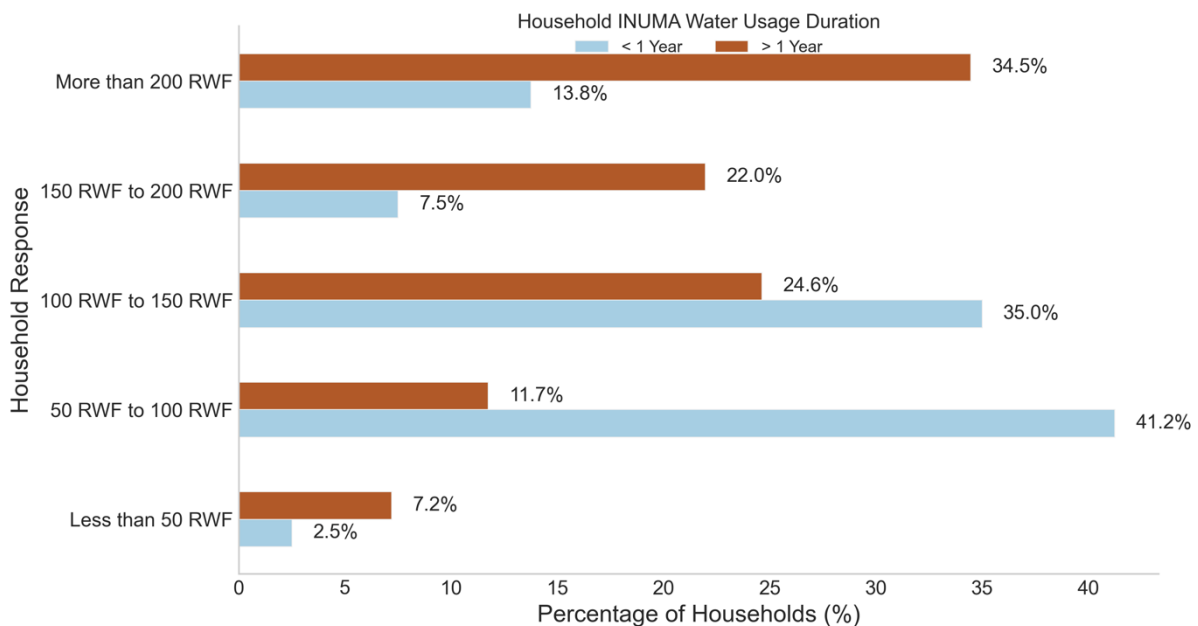
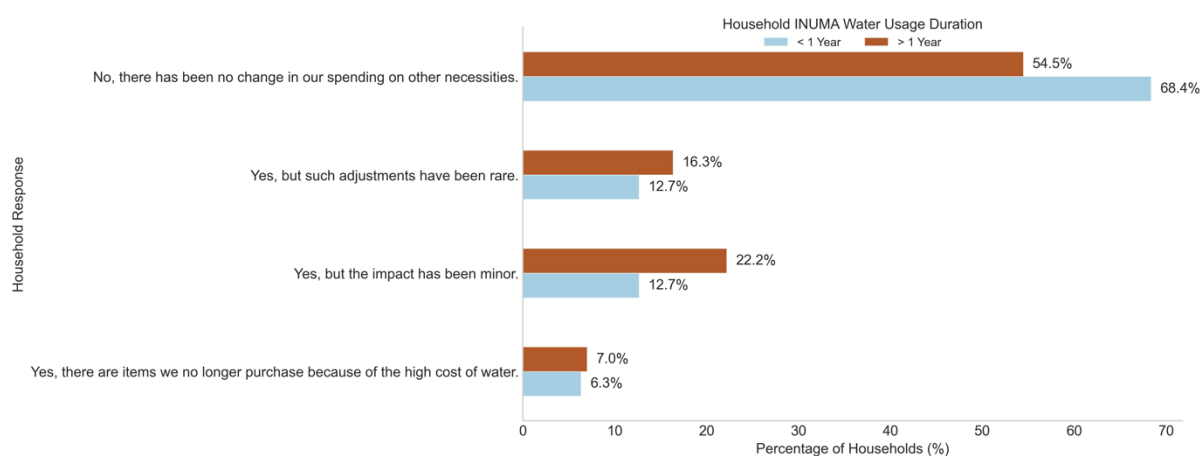


FIG 8 Comparison of daily household spending on INUMA water between short and long-term customers

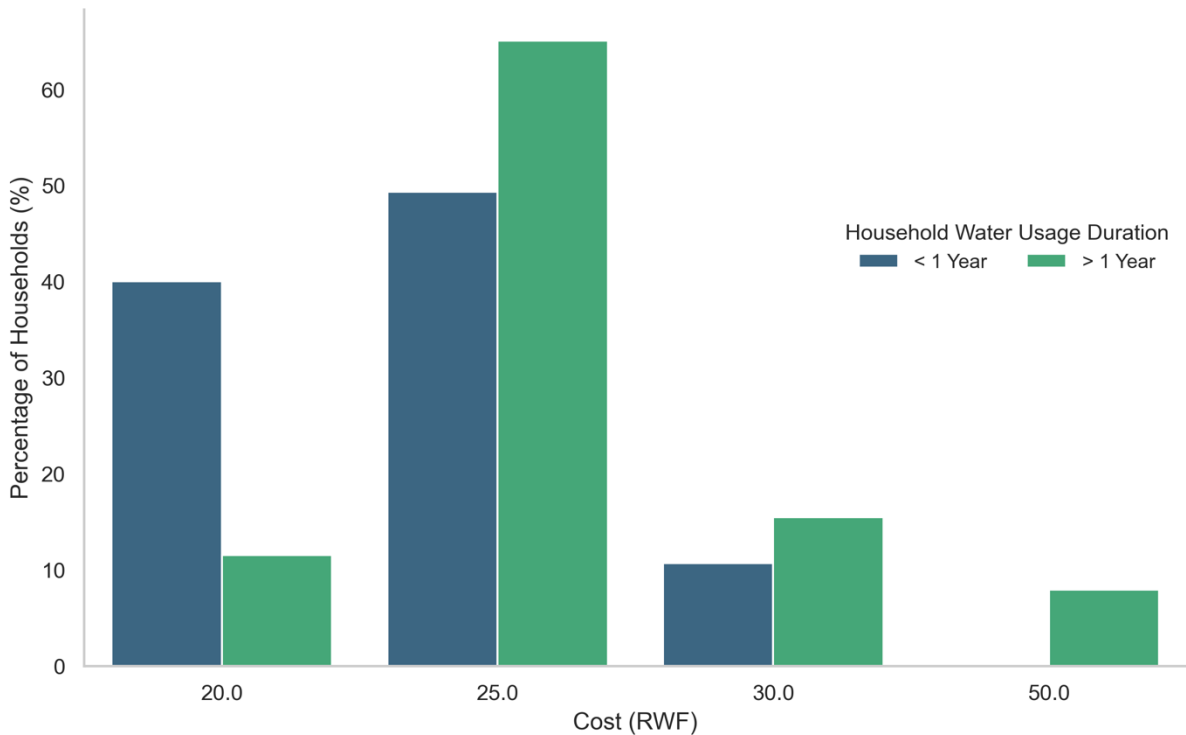
Interestingly, while not statistically significant, the data suggests that longer-term customers may increase their water consumption over time, potentially attributed to higher reliance on INUMA water as it becomes an integral part of daily life.

The higher cost incurred by long-term customers is further substantiated by the fact that they tend to pay more for a standard 20-liter jerrycan of INUMA water, as depicted in Figure 8. Indeed, while the majority (57.4%) of users pay 25 RWF for a 20-liter jerrycan, long-term users are typically charged a higher rate, a discrepancy that is statistically significant ( $p < 0.01$ ). The reasons behind this pricing variation remain unclear and warrant further explanation, especially since pricing should be consistent across all INUMA Mini-Grids. However, as part of WAR's endeavor to extend its operating hours beyond normal working hours, prices are slightly increased before 6 PM and after 6 AM to provide overtime compensation to the INUMA Kiosk attendants. This practice may partially explain the observed fluctuations in pricing.

Regardless of the underlying causes, it appears that long-term INUMA users are more likely to adjust their spending on other necessities due to the cost of water, a trend approaching statistical significance ( $p = 0.07$ ). As indicated in Figure 9, when queried about whether they have adjusted their spending on other necessities due to the cost of water, long-term users frequently reported such adjustments. This may be influenced by several factors, including the fact that long-term users often reside in remote and economically disadvantaged regions, which compounds their financial constraints, particularly amid the ongoing general inflation. Moreover, this pattern is not statistically significant, with the majority (54.5%) reporting no change in their spending due to water affordability.

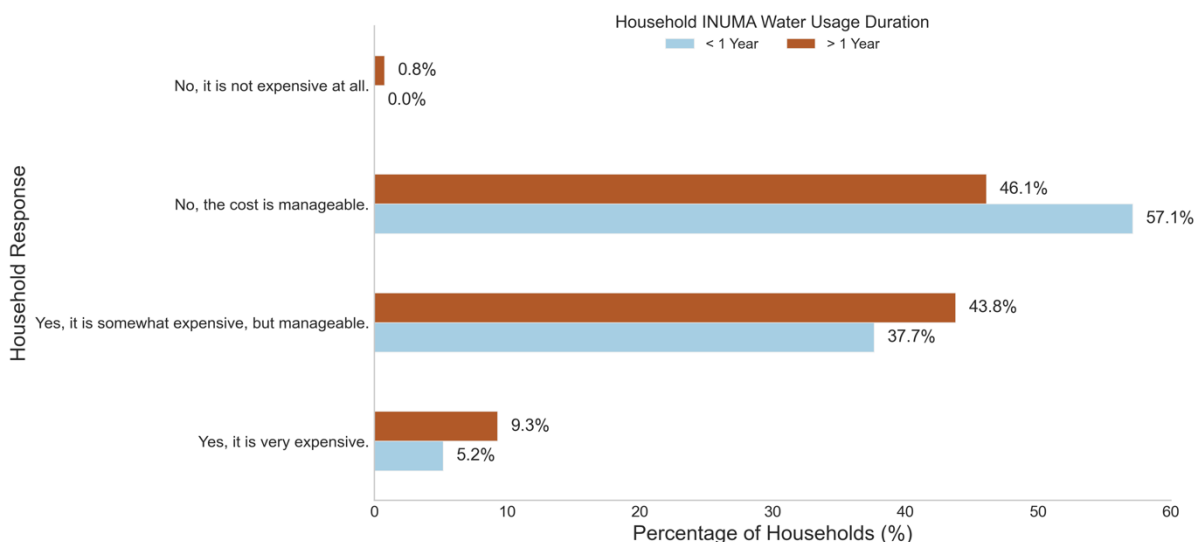


**FIG 9:** Respondents' adjustments to other household spending due to INUMA water costs.

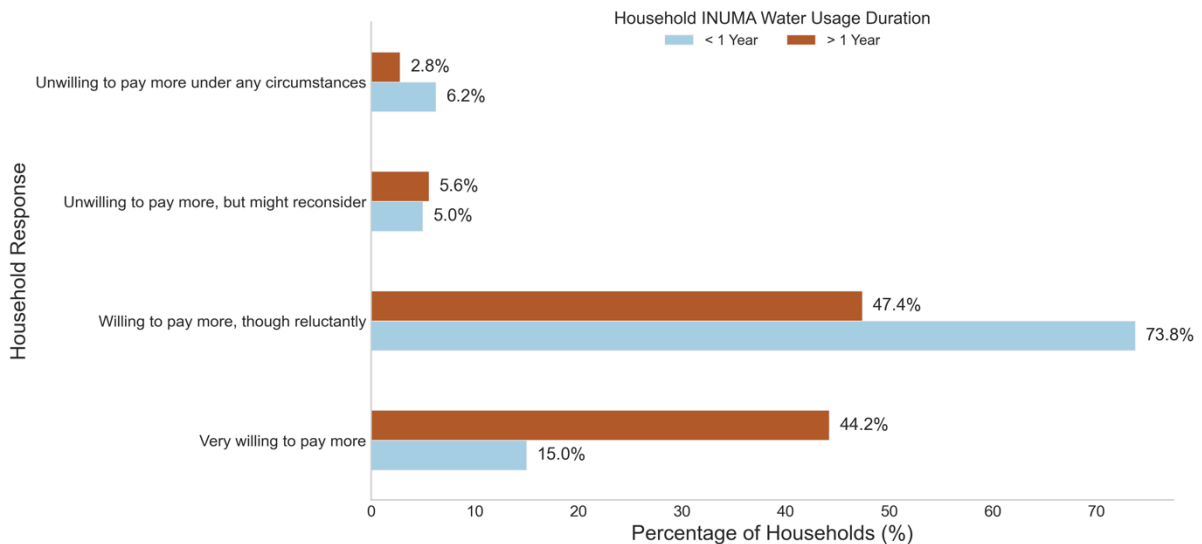


**FIG 10** Average Cost of a 20-Liter Jerrycan of INUMA Water Between Long- and Short-Term Users

However, as depicted in Figure 10, the affordability concerns do not necessarily contradict the general acceptance of the pricing but instead highlight the nuanced challenges faced by long-term users as they balance cost against the essential nature of the service. In fact, when participants were asked about their willingness to pay more if it were necessary for the price of INUMA water to increase to keep INUMA operational, long-term users overwhelmingly indicated they would pay more ( $p < 0.01$ ) to ensure the service's continuity (Figure 11). This response reflects strong community support for INUMA water and a recognition of its benefits.

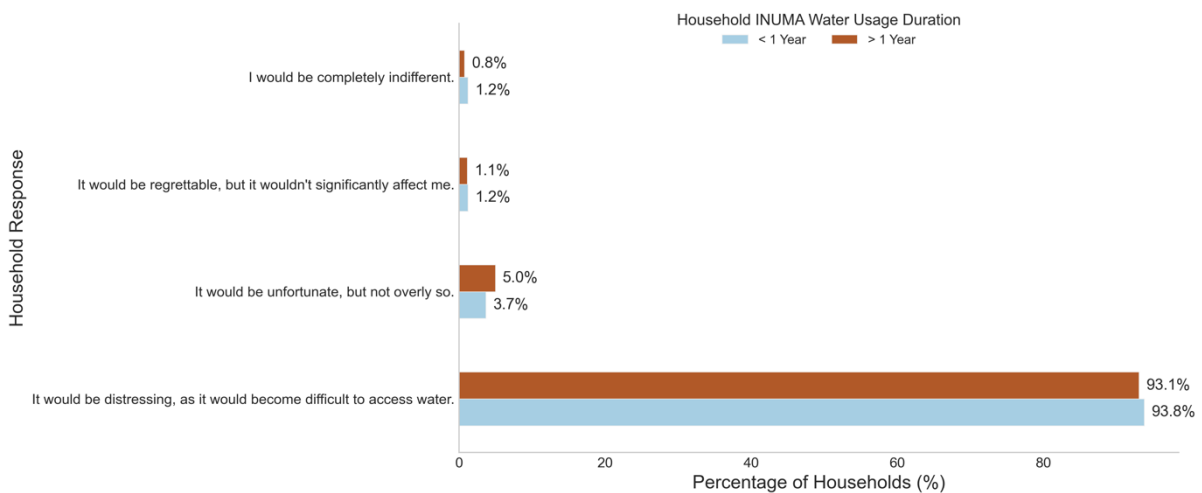


**FIG 11:** Comparison of the perception of affordability of INUMA water between long-term and short-term customers



**FIG 12:** Community Willingness to Pay More for INUMA Water to Ensure Service Continuity

Finally, all groups agreed that INUMA Mini-Grids are a vital component of their communities. When asked how they would manage if INUMA Mini-Grids were to suddenly shut down and cease operations, virtually all respondents expressed that it would be distressing, as accessing water would become difficult. The majority also indicated that such a discontinuation of INUMA services would significantly disrupt the community's daily routines and activities (Figure 12).



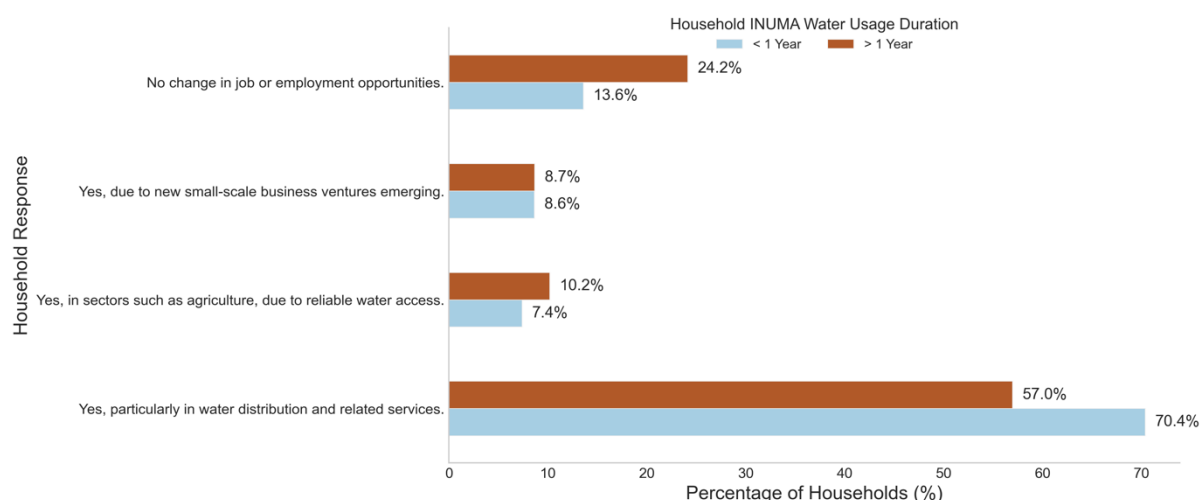
**FIG 13:** Reaction of the respondents if INUMA Water were to suddenly shut down and cease operation

### 3.5. Social and Cross-Cutting Impact

While some findings require further investigation to confirm statistical significance, evidence suggests that INUMA Mini-Grids have had significant positive impacts on various aspects of community life, including education, women's empowerment, and a more equitable distribution of responsibilities within households.

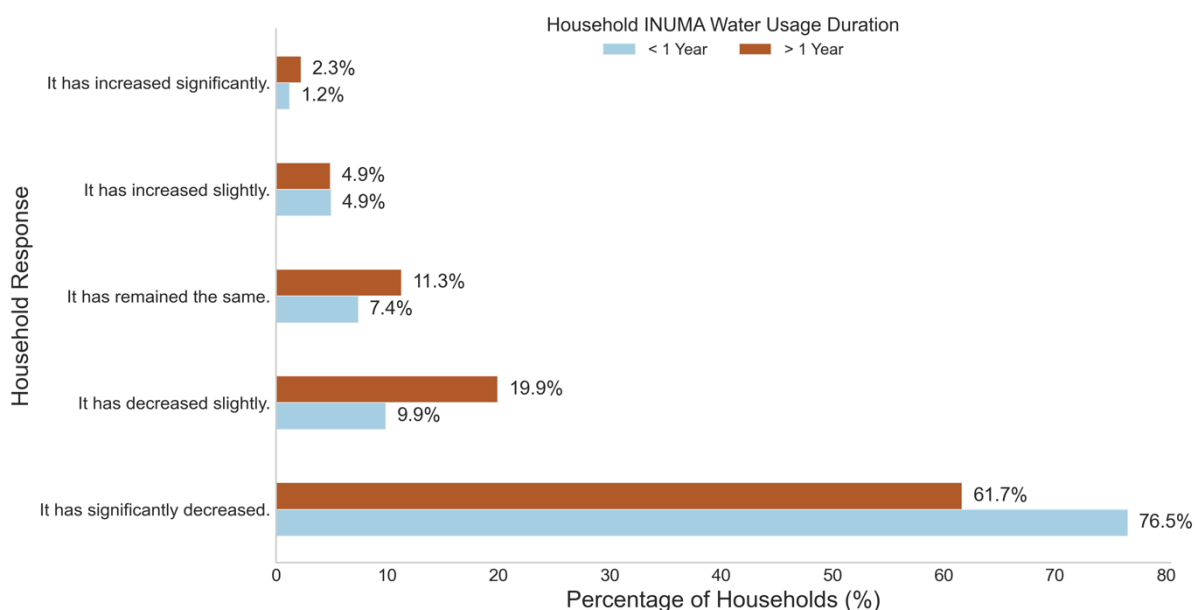
In general, both groups expressed that the introduction of INUMA Mini-Grids has led to the creation of new economic opportunities, including the establishment of new enterprises and job creation. However, there was no observable difference between the groups in this regard (Figure 13), suggesting that either (1) the jobs created were

directly linked to INUMA Mini-Grids, and there were no adjacent job opportunities or enterprises outside the water sector, or (2) the creation of employment opportunities may be influenced by various factors beyond the duration of water access, such as local economic conditions and the diversity of opportunities across different areas.



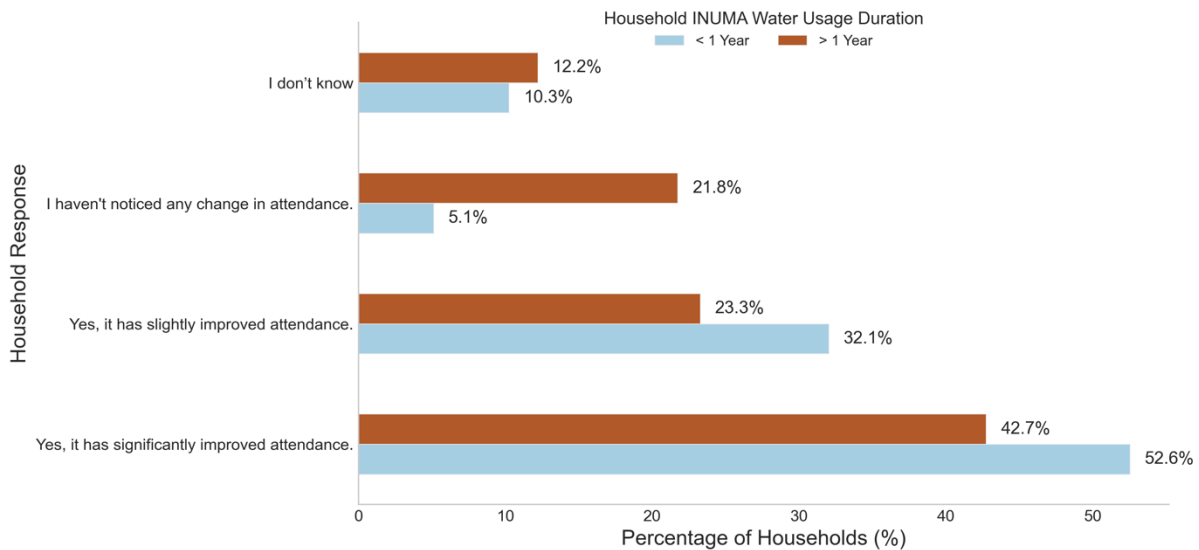
**FIG 14:** Business ventures and job creation resulting from the availability of INUMA water

Regarding changes in the time spent collecting water, both groups reported a decrease in the time dedicated to fetching water (Figure 14). However, this reduction was more pronounced among short-term customers, although the difference was not statistically significant when adjusted for other variables.

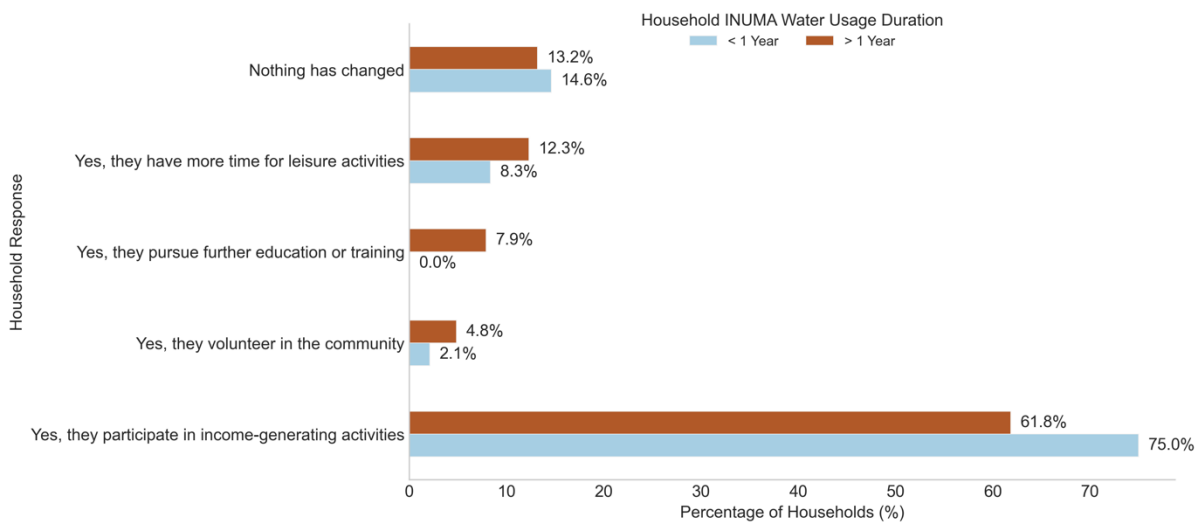


**FIG 15** Comparison of Time Spent Collecting Water Between Long-Term and Short-Term Customers

Finally, the INUMA Mini-Grids have positively impacted social dynamics and opportunities within communities. Notably, there has been an improvement in children's school attendance (Figure 15), likely allowing children to dedicate more time to their education rather than water collection tasks. Similarly, the increased availability of water has facilitated greater involvement of women in income-generating and leisure activities, as documented in Figure 16.



**FIG 16:** Perceived Improvement in School Attendance Since the Introduction of INUMA Water



**FIG 17:** Women's Participation in Income-Generating Activities Since the Introduction of INUMA Water

## IV. CONCLUSION AND HIGHLIGHTS

This monitoring report aimed to evaluate the long-term impacts of the INUMA Safe Water Mini-Grids initiative by conducting a comparative analysis between communities with prolonged access (over one year) and those with recent access (less than one year) in terms of various aspects such as water quality, reliability, affordability, and socioeconomic outcomes. In summary, the study sought to determine whether the positive effects observed in the baseline study persist over time and to identify areas for further improvement.

- The findings indicate that prolonged exposure to INUMA Mini-Grids correlates with enhanced perceptions of water safety, increased satisfaction with service quality, and improved social outcomes, particularly in education and women's empowerment.
- While the reliability and consistency of water supply were generally comparable between long-term and short-term users, long-term users

demonstrated a better understanding of the causes of service disruptions and potential infrastructure maintenance needs.

- Economic advantages were observed among long-term users, with higher water consumption potentially attributed to increased reliance on the service. However, affordability concerns were more prevalent in this group, highlighting the need for ongoing monitoring and potential adjustments to ensure equitable access.
- Although long-term users incur higher daily water costs, their willingness to continue paying these rates reflects a strong appreciation of the benefits, such as reduced time and effort in water collection.
- Across both user groups, there was a strong consensus on the vital importance of INUMA Mini-Grids for community well-being, with a willingness to support service continuity through increased pricing if necessary.
- Continued monitoring, qualitative studies, and longitudinal investigations are recommended to track the evolution of user experiences, address knowledge gaps, and inform data-driven decision-making for the long-term success of the initiative.