WaterTRACS
*Testing, Research, and Capacity Strengthening Initiative*

*With funding from the Conrad N. Hilton Foundation, the Aquaya Institute has been coordinating longitudinal water quality monitoring in two target districts in Uganda since 2022. In February 2025, Aquaya conducted a sixth round of surveys and water quality testing at households, water points, schools, and healthcare facilities in Lira District.*

# WATER QUALITY IN LIRA, UGANDA

## *A FOCUS ON PIPED WATER SYSTEMS*

***February 2025***


## SUMMARY

Piped water systems are the second most common drinking water source in Lira, used by 29% of households in February 2025, with higher use in Lira City than the district.

Across all study visits, three-quarters of piped system taps had water available, with availability fluctuating over time due to closures, breakdowns, water shortages, and intermittent supply.

In early 2025, *E. coli* was found in 6% of public piped system tap samples, which represents better quality than at earlier visits.

Storing piped water in households worsened microbial quality, with *E. coli* presence rising from 18% to 83% for off-plot tap users and from 58% to 81% for on-plot private tap users.

While 94% of tap samples had detectable total chlorine in February 2025, half met the minimum recommended free chlorine residual (FCR). Free chlorine was consistently higher in the dry season.

About half of stored household piped water samples had sufficient FCR to protect against recontamination.

## DRINKING WATER SAMPLES TESTED IN LIRA

| Baseline (BL) | Follow-up 1 (F1) | Follow-up 2 (F2) | Follow-up 3 (F3) | Follow-up 4 (F4) | Follow-up 5 (F5) |
| --- | --- | --- | --- | --- | --- |
| **238** households | **137** households | **228** households | **231** households | **235** households | **229** households |
| **223** waterpoints | **184** waterpoints | **250** waterpoints | **275** waterpoints | **273** waterpoints | **283** waterpoints |
| April 2022 | September 2022 | March 2023 | March 2024 | October 2024 | February 2025 |
| **Season:** wet | **Season:** wet | **Season:** dry | **Season:** dry | **Season:** wet | **Season:** dry |

Across all sampling events, we tested *E. coli* presence in a total of 652 piped water samples. This included 226 from public standpipes, 108 from private (on-plot) taps, and 318 from stored household drinking water. Our sample was split between urban areas in Lira City (71% of the sample) and peri-urban and rural areas in Lira District (29% of the sample).

## BACKGROUND

This research brief focuses on **piped water systems**. Treated piped water is considered the safest source of drinking water by the World Health Organization. However, to deliver health benefits, it must be reliable, adequately treated, and not contaminated during transportation or storage.

Piped water is the second most common source of drinking water in Lira, used by 29% of households in February 2025 (F5). The use of piped water for drinking increased slightly from late 2022 to early 2025 (18%-29% of households) (Figure 1). All piped water users were from Lira City, where 40% of households used piped water for drinking in February 2025 (F5) and 42% used boreholes with handpumps.

In contrast, boreholes with handpumps were the most common source of drinking water Lira District and use increased over time (53% to 73% from 2022-2025). Sampled schools and healthcare facilities (all located in Lira District) also primarily depended on boreholes with handpumps. Nearly all schools (87%-96%, n=50) and healthcare facilities (82%-91% n=11) used boreholes with handpumps for drinking water while few used piped water.

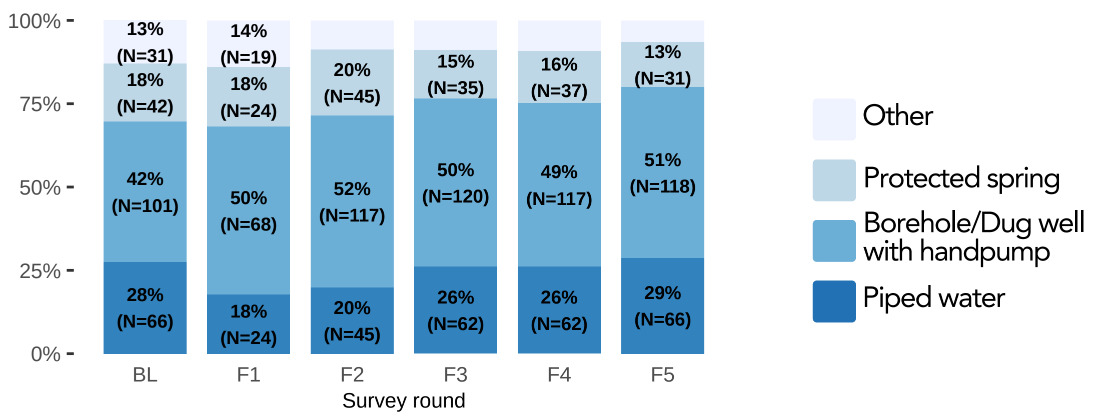


**Figure 1:** Current drinking water sources of surveyed households at each sampling time in Lira (including Lira City and Lira District), including piped water, boreholes and dug wells with handpumps, protected springs, and other source types.

# RESULTS

## WATER SERVICE RELIABILITY

Across all study visits, **three-quarters of piped system taps had water available** (n=316). Availability was highest in early 2022 (BL), when 94% of taps had water available (n=47), and lowest in early 2023 (F2) when only 55% had water available (n=53). About 40% of the time, water was not available because the waterpoint was closed or shut off, meaning either the caretaker was not present or the respondent was unaware of a specific reason. Breakdowns were responsible for 8% of tap closures and insufficient water for 22%, the latter being more pronounced (29%) during the dry season (F2, F3, F5). Other reasons for waterpoint closure included general problems with the utility or users not paying tariffs. Nearly a third of piped system taps (30%) were reported to experience dry season water shortages and **three-quarters had intermittent supply** (water being available some hours each day or some days each week).

In contrast, **89% of boreholes and protected wells with handpumps had water available** across all study visits (n=916) and handpump functionality was consistent over time (88–90%). Across all visits, breakdowns were the most common reason for water not being available from handpumps (82%). Further, 9% of handpumps experienced seasonal dryness.

## MICROBIAL WATER QUALITY

In Lira, piped water supplies have been among the safest waterpoint types at all sampling times. Microbial presence has varied between sampling events, from a low of 6% to a high of 74% of samples with *E. coli* present, with no straightforward correlation to seasons (Figure 2). In early 2025 (F5), **6% of piped samples collected directly from taps had *E. coli*** (n=50), which represents the best microbial water quality of all study visits.

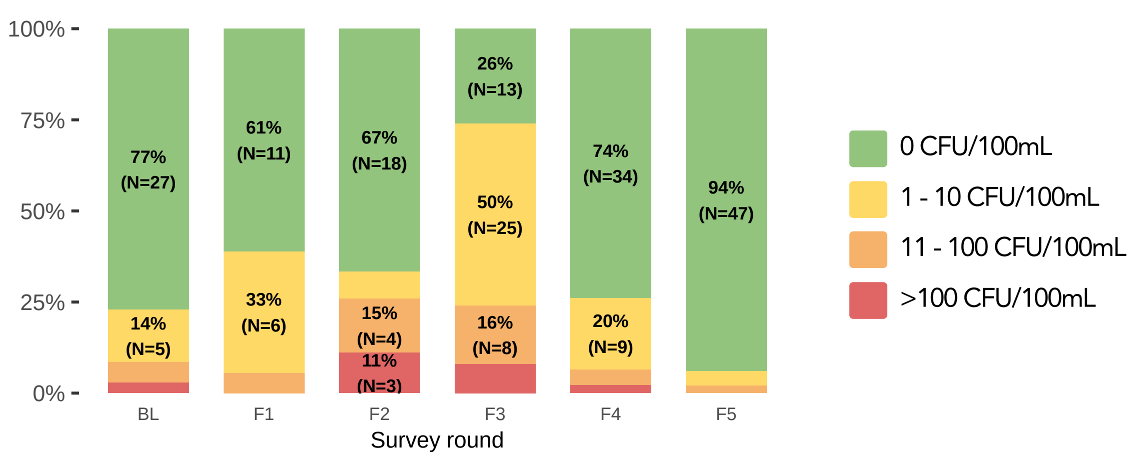


**Figure 2:** *E. coli* risk levels in drinking water samples collected at public piped system taps in Lira (including both Lira City and Lira District, n=226 across all visits).

## CHLORINATION



The presence of total chlorine residual (TCR) indicates that water was treated with a sufficient dose of chlorine to overcome the water's initial chlorine demand, while free chlorine residual (FCR) is the part that remains available to prevent further contamination. **Across all sampling times, free chlorine residuals were low to moderate – with 7% to 52% of sampled taps having the minimum recommended value** of 0.2 mg/L set by the Uganda national drinking water standard (Figure 3).

Adequate free chlorine was more likely in the dry season compared to the wet season (45% vs 17% with FCR≥0.2 mg/L), possibly due to lower levels of organic matter creating chlorine demand in the dry season. Most piped supplies were sourced from surface water, which would be impacted by runoff from precipitation.

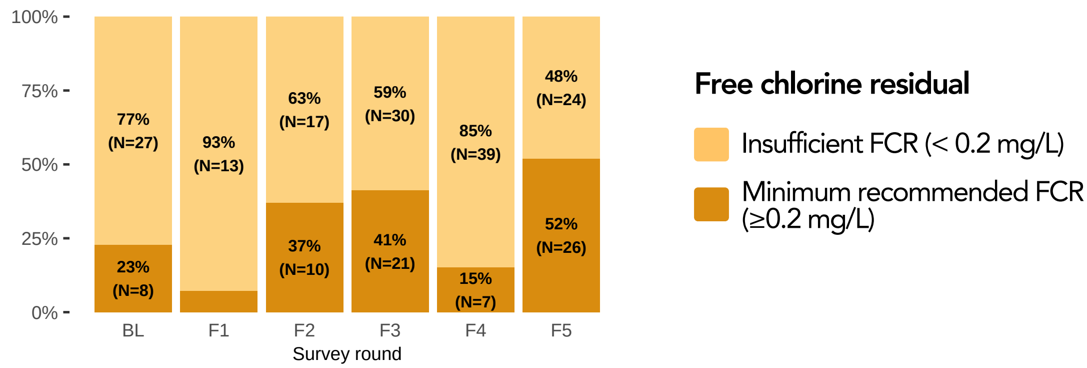


**Figure 3:** Free chlorine residual (FCR) of public piped water taps at each sampling time in Lira (including both Lira City and Lira District, n=223 across all visits).

In February 2025 (F5), 94% of piped water samples had detectable total chlorine (TCR ≥0.1 mg/L), indicating nearly all piped supplies were being treated with sufficient chlorine for some disinfection to occur. However, **only 52% had the minimum recommended FCR (≥0.2 mg/L), indicating that half had insufficient chlorine for continued protection** (n=50). At households with stored piped water, **53% of stored household samples had FCR ≥0.2 mg/L** (n=66) (Figure 4). This indicates **half of households' stored piped water was no longer protected against recontamination.**

The World Health Organization's Guidelines for drinking-water quality for small water supplies recommends a free chorine residual of 0.5 mg/L for public water supplies that will be transported and stored in households. Across all sampling rounds, 5% of samples from piped supplies met that recommended level.

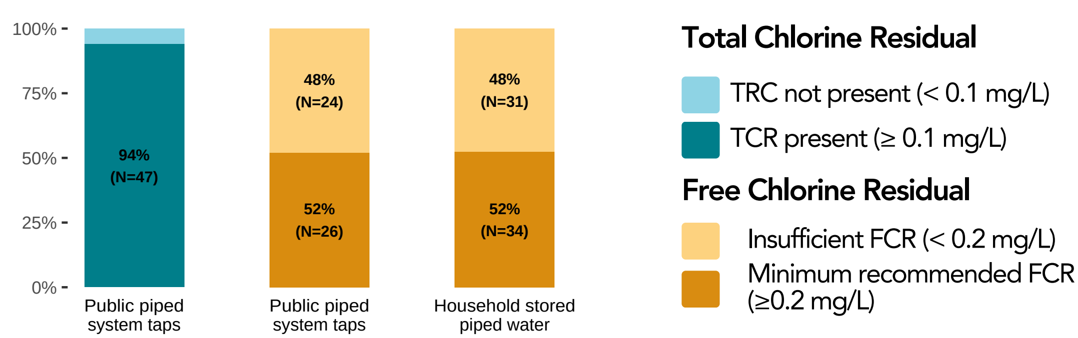


**Figure 4:** Piped system tap samples with detectable total chlorine (TCR ≥0.1 mg/L, left) and minimum recommended free chlorine residual (FCR ≥0.2 mg/L, center), along with minimum levels of free chlorine residual (FCR ≥0.2 mg/L) in stored household piped water (right). Samples were tested in Lira in February 2025.

## ON-PLOT PIPED WATER AND HOUSEHOLD STORAGE

**Across all sampling times, one in ten households (10%) had an on-plot piped water connection** and reported that as their current drinking water source. The vast majority of households drinking on-plot tap water (98%, n=108) still stored their drinking water in the home. This may be because piped systems don't always provide water at all times (across all visits, 75% of taps were reported to have intermittent supply and 25% of on-plot taps did not have water available at the time of sampling) or that households find having water inside the home more convenient (whereas taps are typically located in the yard).

**Storing piped water had a noticeable effect on microbial quality, particularly for off-plot taps.** For those using off-plot public taps, presence of *E. coli* increased substantially from 18% at the tap to 83% in household stored water (n=105 across all visits). For those using on-plot private taps, presence of *E. coli* was worse than at off-plot taps (58% with *E. coli*) and increased to a similar 81% in household stored drinking water (n=90, Figure 5).

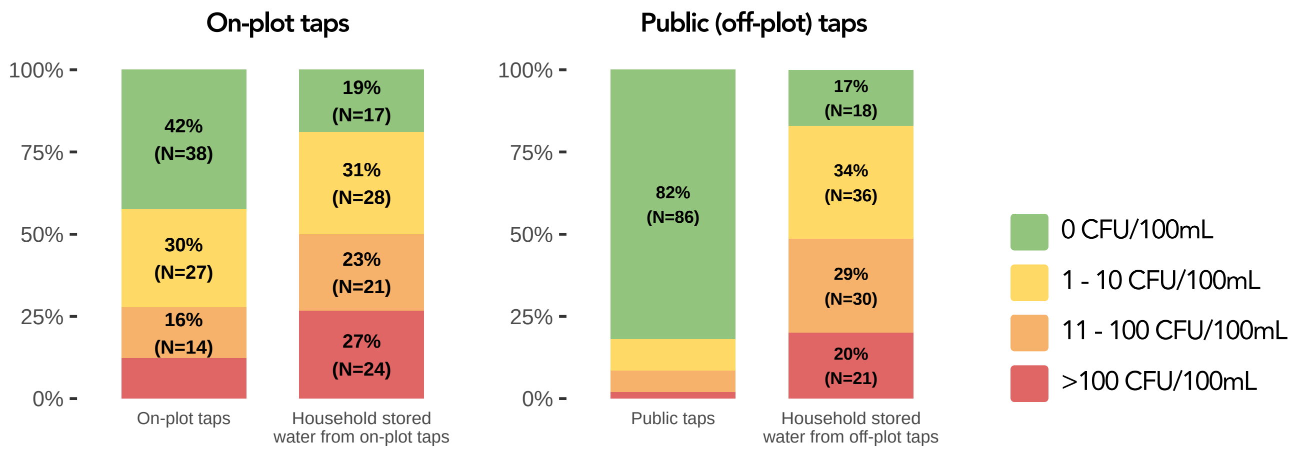


**Figure 5:** *E. coli* risk levels in drinking water samples collected from on-plot taps and household stored water from on-plot taps (left), and samples from public piped system taps and household stored water from public taps (right). Samples were aggregated for all study visits and reported only if household samples were matched to a specific waterpoint sample.

## RECOMMENDATIONS

Piped water service reliability should be improved such that water service be provided more regularly.

Chlorination should be done at higher levels to ensure free chlorine residual stays above 0.2 mg/L throughout piped networks, especially in the wet season.