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EVALUATING WATER QUALITY ASSURANCE FUNDS IN KENYA: BASELINE ASSESSMENT

February 2024

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ABOUT USAID/REAL-WATER:

USAID Rural Evidence and Learning for Water (REAL-Water) is a five-year partnership that develops and evaluates strategies for expanding access to safe, equitable, and sustainable rural water services. REAL-Water supports policymakers, development partners, and service providers to make strategic decisions and implement best practices for water management through implementation research. It also ensures coordination with USAID programs contributing to the water, sanitation, and hygiene (WASH) and water resources management (WRM) knowledge base, in alignment with the USAID Water for the World Implementation Research Agenda. For further information about this and other aspects of the project, as well as to access our knowledge products, please visit globalwaters.org/real-water.

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STUDY RATIONALE

In rural Africa, over two-thirds of the population is estimated to consume contaminated drinking water. Monitoring water quality is essential to providing safe water and protecting public health, yet many rural water suppliers fail to conduct water quality tests regularly. Using an existing centralized laboratory for analysis may be a cost-effective option for expanding testing for many rural water suppliers, but these laboratories may be unwilling to work with rural suppliers due to non-payment risks. The Water Quality Assurance Fund is an innovative program with a financial mechanism developed to address these issues and encourage water quality monitoring in rural areas of Ghana, Kenya, and similar countries. A previous pilot within one district in Ghana found promising results, but a larger, rigorous evaluation trial is necessary to evaluate the impacts and quantify the cost-effectiveness of the Assurance Fund program.

ASSURANCE FUND INTERVENTION

The Water Quality Assurance Fund allows existing professional laboratories to expand regular water quality testing to small rural water suppliers without taking on additional financial risks that would otherwise deter them from working with these systems. It relies upon a third-party nongovernmental organization to guarantee payment to the laboratory if a rural water system is unable to pay for water testing services on time. The Assurance Fund program can remove water systems if they default on payments multiple times. Additionally, the Assurance Fund can serve to channel subsidies for water testing when needed.

The Assurance Fund implementation model includes capacity-building and engagement components to increase water safety knowledge and to promote responses to the test results. These components include (1) monthly or quarterly meetings to discuss test results, (2) technical assistance to improve water treatment at the request of water operators or local government authorities, (3) community engagement activities, and (4) online dashboards for visualizing water quality test data and payment compliance to foster accountability and competition among participating water systems.

STUDY DESIGN

This report summarizes baseline data collected in Kenya before the launch of a two-year impact evaluation of the Assurance Fund implementation model. This evaluation consists of a randomized stepped-wedge trial, which allows for measuring impacts rigorously while rolling out the intervention gradually. The evaluation in Kenya includes 32 piped water systems randomly assigned to one of three groups successively entering the Assurance Fund program at six-month intervals. At baseline, we measured the same indicators that we will measure subsequently over the course of the stepped-wedge trial: chlorine residual and *E. coli* concentrations in water samples (the primary outcome indicators for the trial) as well as water treatment practices, water quality knowledge of water system operators and local government officials, consumer awareness of and perceptions of water safety, and consumer willingness-to-pay for increased water treatment and testing. We are likewise evaluating the effects of the Assurance Fund program in Ghana using a similar stepped-wedge randomized trial with 21 randomly assigned water systems.

DATA COLLECTION METHODS

We collected baseline data between June to August 2023 from 32 water systems, 656 residential customers (20 per water system), 42 focus group discussions with community members, 30 community leader interviews, and 6 local government interviews. We primarily measured water system characteristics, community and household water practices, and water quality perceptions and knowledge. We also measured water quality from up to five standpipes per water system and household water quality, based on samples from private taps or stored household water, in a subset of households.

SUMMARY OF BASELINE FINDINGS AND IMPLICATIONS

The baseline results identified several areas of improvement in water safety management that the Water Quality Assurance Fund program may address:

- **WATER QUALITY KNOWLEDGE:** Water system operators and area managers had some knowledge of sources of contamination; what makes water safe, including chlorination; and regulations and standards related to water quality. However, they had little knowledge about types of contaminants or pathogenic microorganisms. These findings suggest that monthly water quality testing and debrief meetings may improve water quality knowledge among water system operators and decision makers. We hypothesize that improved knowledge could lead to better water treatment, system management, and source protection practices.

- **WATER TREATMENT:** Most water samples had chlorine concentrations below the recommended level of at least 0.2 mg/L free chlorine residual (90 percent of water samples), providing insufficient treatment or protection against recontamination during transport and storage. Microbial water quality was sometimes good at the point of collection (45 percent of standpipes and private taps had no *E. coli* in 100-ml water samples), but often poor at the point of use (*E. coli* was present in 70 percent of stored household water samples). These findings indicate that the information from monthly water quality test results and technical guidance on remedial actions may encourage water operators to improve their water treatment practices. We hypothesize that there will be improvements in chlorine residual and reductions in *E. coli* at the point of collection due to these activities.

- **COMMUNICATION AND CONSUMER PERCEPTIONS:** Water providers rarely communicated water quality information with communities. Regular community engagement activities may improve community members' awareness of water quality testing, treatment practices, and water safety levels. We hypothesize that with adequate community engagement, water systems will be able to increase their tariffs to fund improvements in water safety management.

NEXT STEPS

Assurance Fund implementation began with the first group of 11 study water systems in Kenya in October 2023 and is currently ongoing. Assurance Fund implementation will expand to two additional groups (21 additional water systems) over the course of the trial. We are concurrently tracking implementation activities, water system payments, and any unexpected outcomes as part of a process evaluation. Data collection on impact indicators will take place every six months through late 2025.

INTRODUCTION

BACKGROUND

In rural Africa, over two-thirds of the population is estimated to consume contaminated drinking water (UNICEF/WHO, 2022). Monitoring water quality is essential to providing safe water and protecting public health. Yet, many rural water suppliers fail to regularly conduct water quality tests. Since it can be expensive for rural water suppliers to hire and train specialized staff to conduct testing and to purchase testing equipment and supplies, using an existing centralized laboratory for analysis may be a more cost-effective option for expanding testing (Trimmer, 2023). However, existing laboratories may be unwilling to work with rural suppliers due to non-payment risks. The Water Quality Assurance Fund is an innovative program with a financial mechanism developed to address these issues and to support regular water quality monitoring in rural areas of Ghana, Kenya, and other similar settings.

HOW THE ASSURANCE FUND INTERVENTION WORKS

The Water Quality Assurance Fund allows existing professional laboratories to expand regular water quality testing to small rural water suppliers without taking on additional financial risks that would otherwise deter them from working with these systems (Figure 1). A third-party nongovernmental organization (NGO) holds the Assurance Fund to guarantee payment to the laboratory if a rural water system is unable to pay for water testing services on time. The Assurance Fund also provides payment if water is not flowing during a scheduled sampling visit. The Assurance Fund thus "assures" the laboratory that it will not suffer losses due to the non-payments of testing fees. The laboratory thereby gains revenue by opening another market for their services, while the rural water supplier gains a means to verify their drinking water safety with greater certainty and at a lower startup cost than establishing onsite laboratory capacity. Additionally, the Assurance Fund can channel subsidies for water testing when needed (e.g., during COVID-19 revenue shortfalls or periods when laboratory fuel costs are unusually high). The Assurance Fund can provide a cost-effective application of financial resources for water quality testing, because the Fund is only drawn down when water systems miss payments or subsidies are given. The Assurance Fund implementation model includes a replenishment mechanism through water system reimbursements of delinquent fees. Local authorities enforce the water system reimbursements and associated fines (REAL-Water, 2023a; REAL-Water, 2023b).

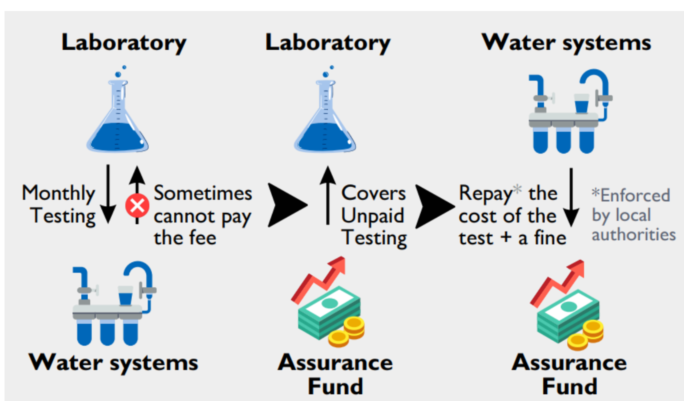

Figure 1. Water Quality Assurance Fund implementation model. The Assurance Fund assures payment to laboratories for water quality testing services provided to rural water systems.

The Assurance Fund implementation program includes capacity-building and engagement components to increase water safety knowledge and to promote responses to the test results:

- Monthly or quarterly meetings with water operators and local government authorities to discuss test results and water treatment;
- Technical assistance to improve water treatment at the request of operators or local government authorities;
- Initial community engagement to inform them about the water quality testing program and to answer their questions; and
- Online dashboards for visualizing water quality test data and payment compliance to foster accountability and competition among participating water systems.

OBJECTIVES

An initial pilot of the Assurance Fund implementation model in Ghana has led to water supplier improvements in testing frequency and water treatment (Press-Williams, 2021). However, this pilot only included water systems within one district in Ghana and was not designed to quantify the effects of the Assurance Fund intervention. The current impact evaluation is designed to measure these effects across diverse settings.

This study has the following overall research objectives:

1. Evaluate the effect of the Water Quality Assurance Fund across diverse contexts in Africa. We hypothesize the intervention will improve water system operator knowledge, chlorination practices, and thereby water quality at the point of collection, as well as improve consumer satisfaction, awareness, and willingness-to-pay for tested and treated water.

2. Explore how efficiently existing professional water quality laboratories can expand their water testing services to rural water supplies.

This report describes the baseline status of community-managed water systems in rural Kenya, prior to their enrollment in the Assurance Fund program. The overall evaluation proceeds through 2025.

METHODS

STUDY DESIGN

We will evaluate the Assurance Fund program in Kenya using a stepped-wedge randomized trial (Hemming, 2015), which will allow us to measure program effects through comparisons between intervention and control groups while rolling out the intervention gradually. The evaluation in Kenya includes 32 water systems randomly assigned to one of three groups successively entering the Assurance Fund program at six-month intervals (Figure 2). Each water system will serve as a control prior to their enrollment in the Assurance Fund program at their specific crossover point. We are also separately evaluating the effects of the Assurance Fund program in Ghana using a similar stepped-wedge randomized trial with 28 water systems (21 randomly assigned and 7 that non-randomly received the intervention at the beginning of the trial).

Assurance Fund program implementation in Kenya began in the first group of water systems in October 2023 and is currently ongoing. We are concurrently tracking implementation activities, water system payments, and any unexpected outcomes as part of a process evaluation. Data collection will take place every six months through late 2025.

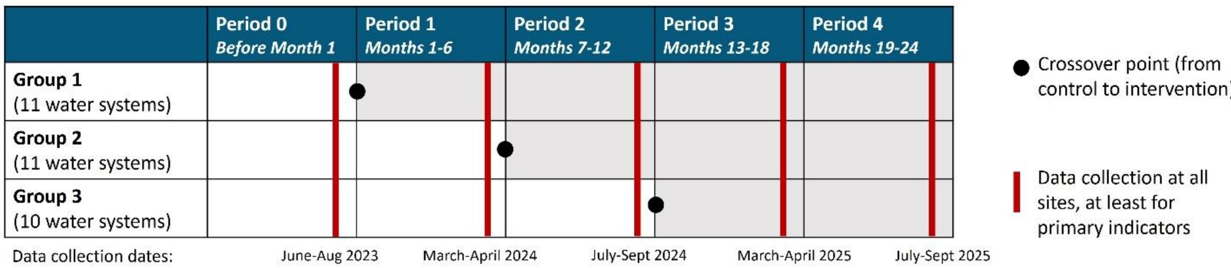

Figure 2. Study design for Assurance Fund evaluation in Kenya with groups of water systems transitioning from control to intervention at different times.

Our primary outcome of interest is chlorine residual in water at the point of collection as a proxy measure for water treatment. Points of collection include public standpipes and private, household-level taps. Other priority outcome indicators include *E. coli* levels at the point of collection; water system operator knowledge related to water quality; and consumer awareness, satisfaction, and stated willingness-to-pay for treated and tested water. We will also collect qualitative data on stakeholders' perspectives regarding water safety and evaluate water quality (chlorine residual and *E. coli*) in household stored water.

This report presents the results of our baseline data collection efforts in Kenya to understand the existing conditions in eligible water systems and communities prior to randomization and enrollment in the Assurance Fund program.

WATER SYSTEM SELECTION

We considered five counties that had an accessible accredited laboratory and where members of the REAL-Water consortium had preexisting relationships with local stakeholders that could facilitate the study. We identified 210 rural piped water systems within these five counties through engagements with county governments, local NGOs, and rural water utilities. In three counties (Trans Nzoia, Uasin Gishu, and Bungoma), the list of piped water systems we established was close to comprehensive because we engaged all relevant stakeholders. In the other two counties (Kericho and Nakuru), we only engaged utilities (but not the county government or local NGOs), therefore we likely did not capture all existing piped water systems.

Out of the 210 piped water systems identified, 154 water systems (73 percent) were ineligible to participate in the Assurance Fund program. Water systems were ineligible because they were non-functional (11 systems), not interested (14 systems), or unable to afford monthly testing services from the selected laboratory (129 systems). In fact, 97 water systems (46 percent) collected no revenue at all from users.

Three counties (Kericho, Nakuru, and Uasin Gishu) contained the remaining 56 eligible water systems. Because budget and logistical constraints limited our trial to approximately 30 water systems, we selected 32 water systems for the trial. These 32 systems represent a range of management arrangements: 25 are managed by a utility, six by the county government, and one by a private institution.

WATER SYSTEM DESCRIPTION

All 32 included water systems[1] were piped schemes, primarily located in rural areas and small towns. Water systems relied on a mix of groundwater and surface water sources, with 50 percent using surface water (41 percent from a river and 9 percent from a spring), 34 percent using groundwater from boreholes, and 16 percent using both a borehole and a surface water source. Most groundwater systems only had one or two functional boreholes. All water systems offered private household connections. Less than half of water systems (47 percent) supplied public standpipes. Most systems charged a tariff for water. At standpipes, the tariff was typically between 2-10 KES per 20 liters (about 0.01-0.06 USD). At private household connections, most water systems applied an increasing block tariff, with the first six cubic meters of water costing between 250-300 KES regardless of actual consumption, and higher usage charged at increasing rates per cubic meter. Some water systems had flat monthly rates, and a few systems offered water from standpipes or household connections for free (although they had charged tariffs in the past and usually explained they were currently providing water for free temporarily due to a management change or reduction in system functionality). Rates for institutional connections were typically higher than rates for household connections. Each water system supplied 4 to 5,814 household connections, with a median of 250 household connections supplied per system. Nakuru county provided production data: water systems produced an average of 588 to 356,000 cubic meters per month, with a median of 3,500 cubic meters.

BASELINE DATA COLLECTION

We collected baseline data from June to August 2023 (dry season). We interviewed operators of all 32 water systems, surveyed 20 residential customers per community, conducted focus group discussions with community members, interviewed community leaders, and interviewed county officials (Table 1).

We measured water quality from up to 5 public standpipes per water system (known locally as water kiosks) and from private taps or storage containers in most households. We collected 31 standpipe, 440 private tap, and 605 stored water samples.[2] We used a Hach DR300 digital colorimeter to measure free and total chlorine, a Hach 2100Q Portable Turbidimeter to measure turbidity, and a digital Pocket Pro+ Multi 2 Tester to measure pH in the field. For *E. coli* analysis, we collected 100 milliliter water samples in sterile Whirl-pak bags containing sodium thiosulfate and processed these samples following procedures in the Multiple Indictor Cluster Survey Manual for Water Quality Testing (MICS, 2017), which includes identifying and counting *E. coli* on CompactDry media plates (manufactured by NISSUI Pharmaceutical Co. Ltd., Japan). We measured customers' stated willingness-to-pay for consistently tested and chlorinated piped water, using the double-bound dichotomous choice method.

We obtained ethical approval of our research protocol from the Amref Ethics and Scientific Review Committee (ESRC) and a research permit from the National Commission for Science, Technology, and

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1 We defined a water system as a facility with a distinct intake source, distribution system, and operator. This was sometimes different than how the operating utility defined a water system.

2 We measured free and total chlorine at 440 private tap and 605 stored water samples, which included all households with water available to sample at the time of the survey. However, we only measured *E. coli* in a subset of these households (up to 10 per water system) for a total of 283 private tap and 325 stored water samples.

Innovation (NACOSTI) in Kenya. We introduced the study and obtained written informed consent from all participants before surveying or interviewing them.

TABLE 1. SUMMARY OF BASELINE DATA COLLECTED

DATA SOURCE	TARGET	DATA COLLECTED
Water systems (N=32)	System operator (N=32) Area manager (N=5)	System characteristics Treatment practices Revenue and financials Water quality knowledge
	5 standpipes or private taps per system[*]	Water quality (chlorine residual, *E. coli*, pH, turbidity)
Households (N=656)	20 households per water system[†]	Consumer awareness and perceptions Chlorine residual and *E. coli* in stored water (subset of households) and from private taps Willingness-to-pay for more consistent water treatment and testing
Focus group discussions with community members (N=42)	1-2 per community (sometimes gender-separated, sometimes combined)	Consumer awareness and perceptions Gendered perspectives
Traditional authority (N=30)	Chief	Awareness and perceptions related to the water system and water quality testing Gendered perspectives
Local government (N=6, capturing all 3 counties)	County water director or technical manager County commissioner	County commitment to water quality Water quality knowledge

[*] If a water system had fewer than five functional standpipes, we sampled all functional standpipes and supplemented with private taps if they were available. No system had more than five functional standpipes per system with water available at the time of sampling.

[†] We systematically selected survey households by dividing the community into up to five zones based on the piped distribution system layout and surveying the same number of households in each zone. We used predetermined distances between households to ensure good spatial coverage of respondents with respect to the piped network. When there were fewer than 20 available households using the target water system (N=5 water systems), we surveyed all available households.

RESULTS

RESPONDENT CHARACTERISTICS

WATER SYSTEM OPERATORS. Almost all interviewed water system operator respondents were male (88 percent). Respondents typically identified as water operators or plumbers, whose duties involved tasks such as general maintenance and operation of the water system, revenue collection, and meter reading. Over half of respondents (59 percent) had worked at the water system for five or more years. Most (68 percent) had also completed some form of tertiary education (e.g., certificate, education at university). Water system management teams were also male dominated, with males accounting for 75 percent of their members overall. Management teams almost always had a member who had completed tertiary education (except for one system where members had only completed primary education). Most water systems (81 percent) paid all their staff, while the remainder had a mix of paid and unpaid staff (such as interns and volunteers). However, at some systems, the paid staff had not received their salaries for months due to payment delays. We also interviewed five area managers who oversaw several water systems in different geographical areas for one of the water utilities.

HOUSEHOLDS. Most household respondents were female (62 percent), with a median age of 40 years. Almost all respondents had completed primary or higher education (91 percent). Their primary occupations were in agriculture (34 percent) or the private sector (21 percent self-employed; 13 percent employed by others). The rest worked for the government or NGOs, sold produce or petty goods, were students, or were not employed outside of the home. Almost all households had a mobile phone (98 percent), most had electricity (85 percent), and over one-third (39 percent) had a motor vehicle (e.g., car, truck, motorbike). Most surveyed households (86 percent) households had a private tap in their house or yard and only 14 percent used a public standpipe.

COMMUNITY LEADERS. We interviewed the chief or assistant chief in 30 communities, capturing all water systems. This includes a few instances where there were multiple communities and chiefs per water system, as well as some large communities with multiple water systems. Chiefs were most commonly interviewed (83 percent). Respondents were also almost always men (90 percent); we only interviewed two female chiefs and one female assistant chief.

LOCAL GOVERNMENT. In all three counties, we interviewed at least one county water director or technical manager for water and sanitation. In one county, we also interviewed the deputy county commissioner. Although all respondents were dedicated to county-level services, some were employed by regional or national government entities. All respondents were male and most (67 percent) had worked in their current positions for two to four years.

KEY FINDING 1: MOST WATER SYSTEMS DID NOT PERFORM ADEQUATE CHLORINATION.

WATER TREATMENT

Most water systems performed water treatment prior to distribution. About one-quarter of systems (28 percent, all relying on river water) used chlorination combined with at least one other type of treatment, such as adding alum as a coagulant with or without flocculation and sedimentation. A few systems also used filtration. Almost half of systems (44 percent) used chlorination as their only method of treatment. The remainder (28 percent) performed no treatment.

CHLORINATION FREQUENCY

Although most water systems (72 percent) performed chlorination, the frequency of chlorination was often inadequate (Table 2). Only one-third of systems (34 percent) chlorinated continuously on a daily basis, and a few chlorinated at least weekly (9 percent). The rest reported chlorinating only once a month (6 percent), every few months (9 percent), or yearly (3 percent). Some water systems only added chlorine after cleaning the storage tank once or twice a year, and were not using chlorine as a regular form of water treatment. When chlorinating, water operators typically added a specific amount of chlorine granules to a storage tank or prepared a liquid chlorine solution for continuous dosing into supplied water.

TABLE 2. WATER SYSTEM CHLORINATION FREQUENCY

FREQUENCY OF CHLORINATION	WATER SYSTEMS, N (%) N=32
Daily	11 (34%)
At least weekly (but less than daily)	3 (9%)
Monthly*	2 (6%)
Every 3-6 months	3 (9%)
Yearly	1 (3%)
Other/Don't know†	3 (9%)
Never	9 (28%)

* Includes one water system that chlorinates every three weeks.
† This category includes one water system respondent that was not asked this question, one respondent that did not know information on frequency of chlorination, and one water system that used to chlorinate every two days but stopped one month ago due to complaints.

CHLORINE RESIDUAL LEVELS

Almost all (90 percent) public standpipes and private household taps had free chlorine residual levels below the WHO recommended level of 0.2 mg/L (Figure 3; WHO, 2022). Almost all (95 percent) were also outside of the Kenya standard limit for potable water of 0.2-0.5 mg/L (WASREB, 2008; KEBS, 2018). Most (83 percent) free chlorine measurements were even below 0.1 mg/L, which is often considered the lower detection limit due to potential interference from manganese or other water constituents. Two-thirds (66 percent) of free chlorine measurements were under the less conservative detection limit of 0.05 mg/L. This level of chlorination would not be sufficient to protect water from contamination during collection, transport, and household storage (WHO, 2022).

Free chlorine residual levels in household stored water were also low, with residuals of at least 0.1 mg/L in only 5 percent of samples. However, in a little over half (54 percent), households had collected water more than 24 hours before sampling, and in about 20 percent of cases, stored water had been mixed with another source of water, such as rainwater.

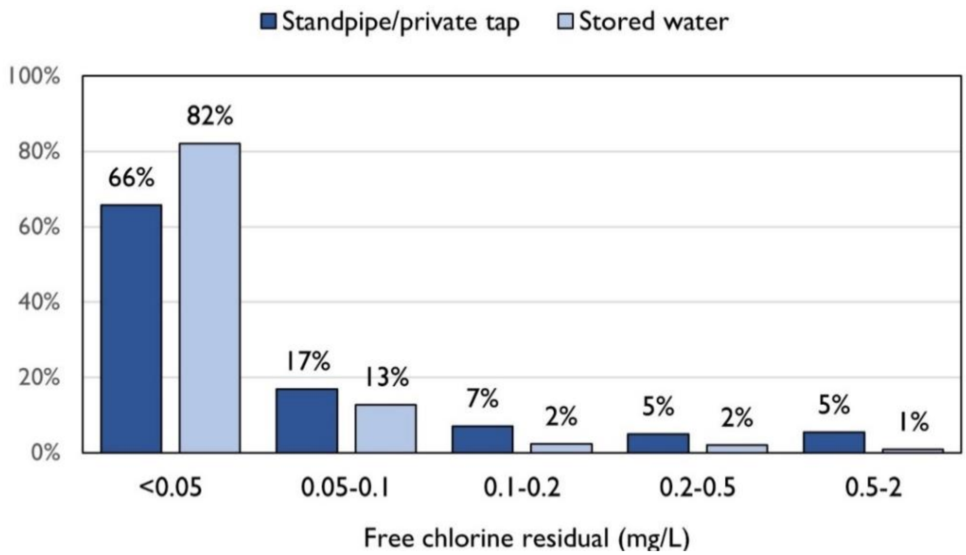

Figure 3. Free chlorine residual in standpipe (N = 27), private tap (N = 440), and household stored (N = 605) water samples. Most samples were below recommended minimum chlorine residual levels of 0.2 mg/L.

KEY FINDING 2: WATER OFTEN HAD MICROBIAL CONTAMINATION AT THE POINT OF COLLECTION AND AT THE POINT OF USE.

Most standpipe and private tap water samples (55 percent) had detectable *E. coli* (Figure 4). The high prevalence of microbial contamination was likely due to inadequate disinfection and is consistent with the poor chlorination practices reported above. Microbial contamination was even higher in household stored water, with several samples having higher *E. coli* levels. Water quality thus deteriorated during water collection and storage, further demonstrating the importance of adequate chlorine residuals to protect against recontamination.

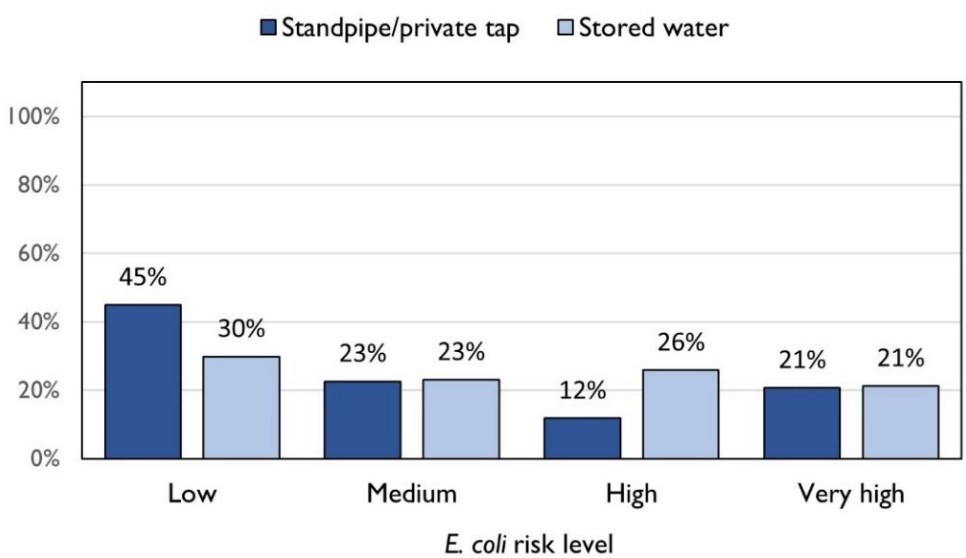

Figure 4. *E. coli* risk level in standpipe (N = 31), private tap (N = 283), and household stored (N = 325) water samples. Low risk corresponds to no colony forming units (CFU) per 100 ml sample, medium risk to 1-10 CFU per 100 ml, high to 10-100 CFU per 100 ml, and very high to >100 CFU per 100 ml. Water was often contaminated, with somewhat higher levels of contamination at point of use compared to the point of collection.

KEY FINDING 3: WATER SYSTEM OPERATORS AND LOCAL GOVERNMENT OFFICIALS GENERALLY HAD LOW WATER QUALITY KNOWLEDGE.

Knowledge on water quality among water system operators, water utility area managers, and county officials was low. We assessed knowledge using 15 standardized interview questions that address these knowledge categories: types of contamination, sources of contamination, chlorination and water safety, and regulations and standards related to water quality. These included open-ended questions and true/false questions where we also assessed the respondent's justification for their selection. Out of 32 possible points, the median score was 11 (range: 4.0 –19.5) among water system operators, 10 (range: 7.0–10.5) among water utility area managers, and 15.5 (range: 15–17.5) among local government officials.

Knowledge levels varied across water quality topics and respondent type (Figure 5). Water system operators and area managers were most knowledgeable about sources of contamination, providing correct answers for a little over half of questions. Specifically, they were most aware of risks related to certain point contamination sources (e.g., latrines, mining activities, excess application of fertilizer or pesticides), answering an average of 75 percent or more of related true/false questions correctly. However, they often could not explain the different potential sources of contamination when we initially asked open-ended questions (less than 25 percent correct). Operators and area managers also had some knowledge of chlorination and what makes water safe as well as water quality regulations and standards (around one-quarter to one-third of correct answers), but little knowledge about types of contaminants or pathogenic microorganisms (17 percent or less correct answers). Better understanding of water quality topics could help improve water treatment, system management, and source protection.

County government officials, who typically had higher levels of education, also had higher levels of knowledge across most water quality topics. In particular, they had much higher knowledge on types of contamination and chlorination. However, some of their knowledge on water quality regulations was low, and none of the county respondents reported knowledge of the national standards for microbial quality, including the required testing frequency.

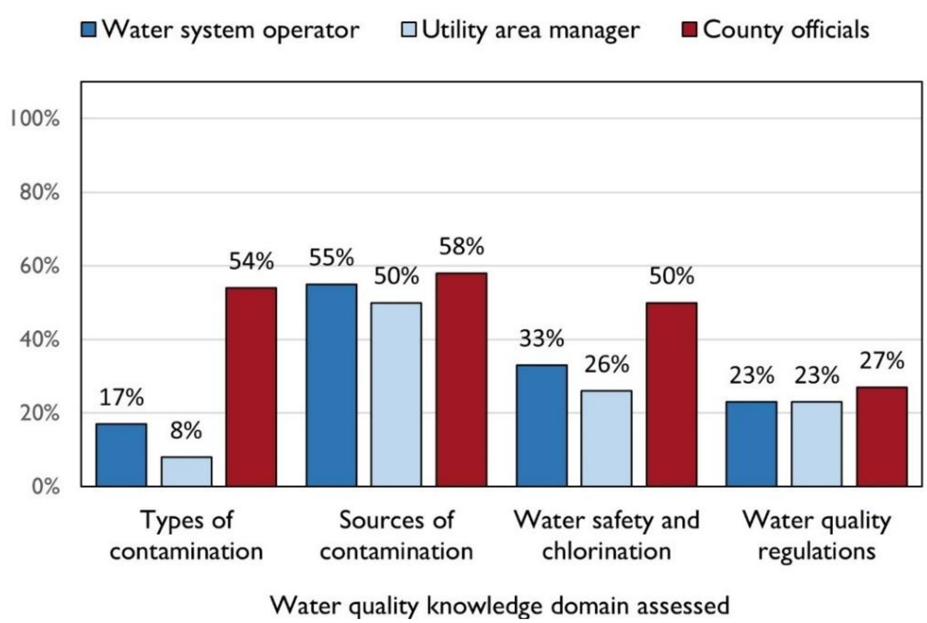

Figure 5. Water quality knowledge among water system operators, water system area managers, and county officials based on 15 interview questions. Water operator knowledge was generally low across subject domains but was the highest for sources of water contamination and lowest for types of water contamination. County officials typically had higher levels of knowledge than water system operators and area managers.

KEY FINDING 4: MOST HOUSEHOLDS WERE SATISFIED WITH WATER SERVICES, BUT MANY WERE WILLING TO PAY MORE FOR WATER THAT IS REGULARLY TREATED AND TESTED.

Almost all household survey respondents reported that the piped water system under investigation was their main source of drinking water (92 percent). The rest reported drinking rainwater (3 percent), bottled water (3 percent), or spring water (1 percent), with a few drinking from a borehole, a dug well, or surface water (<1 percent each). One-quarter of households reported treating their water to make it safer before drinking it in the past week, typically by boiling or filtering it.

Most survey respondents were very satisfied (40 percent) or somewhat satisfied (44 percent) with the local piped water system. Only a few were somewhat dissatisfied (12 percent) or very dissatisfied (4 percent). Common reasons for dissatisfaction included unreliability, water color, and cost. Some respondents (15 percent) also thought the water supplied by their local system was unsafe for health. Many water systems had received complaints from customers within the past month, often related to interruptions in water supply, leakages, or breaks in the systems. Complaints were occasionally related to water quality, such as reports of dirty, turbid, or brown water.

Almost two-thirds of households reported that they were willing to pay higher tariffs if water was regularly treated and tested (61 percent of households with private taps and 64 percent of standpipe users). The median stated increase in willingness-to-pay was a 10 percent addition to current tariffs. This would be 50 KES (about 0.31 USD) more per month for those using private taps and 3 KES (about 0.018 USD) more per 20 liters for standpipe users. Additionally, households who felt the water was unsafe were the most likely to report being willing to pay for tested and treated water.

KEY FINDING 5: WATER SYSTEMS RARELY COMMUNICATED WITH CONSUMERS REGARDING WATER QUALITY.

Most water system operators reported that their communication with customers was primarily related to billing, pipe bursts or leakages, or service interruptions. This type of communication often occurred with phone calls, text messages, or in-person; and customers sometimes initiated the communication. Only a few water system respondents reported communicating with customers about water quality, often through community meetings.

Community leaders and households similarly reported infrequent communication from water systems about the safety of the water. In most communities, chiefs reported that water system staff had not shared any information related to the safety of water from the system. In some communities where information was shared, the community was just told that the piped water was clean or safe to drink. In one community, a chief described how the water system staff had communicated that the supplied water was safe, yet he felt that himself and others within the community had gotten typhoid from drinking the water. Only a few chiefs reported more detailed information sharing from water systems through community meetings (called *Baraza*), sometimes with community leaders disseminating this information.

Most households (84 percent) reported not receiving any information from the water system about water safety. The rest had received information about chlorination or storage tank cleanings. Only a few households reported receiving information about water testing or safe storage practices.

Consumer perceptions reflected the lack of communication regarding water quality. Over two-thirds of surveyed households were unsure if the water was tested (69 percent). Just under half (47 percent) believed that water supplied by their community system was treated, 19 percent believed it was not treated, and 34 percent did not know if it was treated. The treatment practices they were aware of were mostly occasional or ongoing chlorination, with a few mentioning the addition of alum or filtration. Respondents were aware of treatment primarily through changes in the taste or smell of their water, though some had heard about it from the water utility. Over half of the household respondents (56 percent) that believed their community water supplies were treated also thought current chlorination practices were sufficient to ensure that the water was always safe to drink, with 19 percent being unsure, and 25 percent disagreeing.

KEY FINDING 6: SOME BASELINE IMBALANCES EXIST BETWEEN STUDY ARMS THAT WILL BE ACCOUNTED FOR IN FUTURE ANALYSIS.

Due to the small number of water systems randomized for the study, not all important characteristics are balanced across study arms (Table 3). For example, water systems in the first arm had higher chlorine residual levels at standpipes and private taps, and the third arm had fewer water systems chlorinating on a daily basis. We will account for key baseline differences in the final evaluation analysis and will describe analysis methods in a forthcoming pre-analysis plan.

TABLE 3. BASELINE CHARACTERISTICS AMONG STUDY ARMS

CHARACTERISTIC	STUDY ARM		
	GROUP 1	GROUP 2	GROUP 3
Water systems, N	11	11	10
Water systems supplying private taps that were functional at the time of data collection, N (%)	9 (82%)	10 (91%)	10 (100%)
Water systems never chlorinating, N (%)	2 (18%)	2 (18%)	5 (45%)
Water systems chlorinating on a daily basis, N (%)	5 (45%)	5 (45%)	1 (9%)
Water system operator knowledge from assessment, mean score out of 32	10.5	12.1	9.9
Standpipes and private taps sampled, N	159	148	160
Free chlorine residual of at least 0.2 mg/L at standpipes or private taps, N (%)	28 (18%)	6 (4%)	14 (9%)
Households surveyed, N	236	210	210

Households using target water system for drinking, N (%)	221 (94%)	186 (89%)	194 (92%)
Household respondents very satisfied with target water system, N (%)	202 (86%)	171 (81%)	177 (84%)

NEXT STEPS

This evaluation in Kenya, along with a similar evaluation in Ghana, will continue through 2025. Together, these two studies will enable the REAL-Water team to evaluate the effect of this novel financial and capacity-building intervention for water quality monitoring across diverse contexts in Africa. Although baseline results had many similarities across the two countries, there were also some key differences in water system management and local governance, source type, population served, and baseline levels of treatment. Our recent report (REAL-Water, 2024) provides more details from the Ghana baseline results and water system characteristics there.

Similar to Ghana, baseline results in Kenya identified several areas of improvement in water safety management that we will measure as indicators of the Water Quality Assurance Fund program impact evaluation:

- **WATER QUALITY KNOWLEDGE**: Monthly water quality testing and debrief meetings may improve water quality knowledge among water system operators, water utility area managers, and local government officials. We hypothesize that better access to water quality data will lead to better water treatment, system management, and source protection practices.
- **WATER TREATMENT**: Technical guidance on remedial actions may support water operators to improve their water treatment practices and source protection. We hypothesize that better access to information and technical assistance will lead to improvements in chlorine residual levels and reductions in *E. coli* at the point of collection.
- **COMMUNICATION AND CONSUMER PERCEPTIONS**: Encouraging water systems to communicate with their consumers may improve community members' awareness of water quality testing, treatment practices, and actual water safety levels. We hypothesize that with adequate community engagement, water systems may also be able to increase their tariffs to fund improvements in water safety management.

Many piped water systems screened for eligibility were excluded from this study because they were unable to pay for monthly testing services. Subsidies will likely be required to deliver this program at scale.

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