HOW MUCH WILL IT COST TO MONITOR MICROBIAL DRINKING WATER QUALITY IN SUB-SAHARAN AFRICA?

Monitoring for Safe Water (MfSW) is an action research program that promotes drinking water safety through improved monitoring. MfSW was launched with a grant from the Bill & Melinda Gates Foundation to the Aquaya Institute (Aquaya). Partners have included the African Water Association (AfWA), the International Water Association (IWA), and the World Health Organization (WHO).

INTRODUCTION

Measuring drinking water quality is essential for understanding the safety of drinking water supplies and for evaluating efforts to reduce contamination. Nevertheless, regulated monitoring programs in sub-Saharan Africa often struggle to achieve the testing levels specified by national standards. Because the financial requirements for water quality testing are poorly understood in many settings, the extent to which cost is a barrier to monitoring is unclear.

To answer this question, Aquaya researchers and collaborators have recently published a study analyzing how much it would cost to monitor microbial drinking water quality according to the levels specified by the WHO Drinking Water Quality Guidelines:

Delaire, C., Peletz, R., Kumpel, E., Kisiangani, J., Bain, R., & Khush, R. (2017). How Much Will It Cost To Monitor Microbial Drinking Water Quality In Sub-Saharan Africa? *Environmental Science and Technology* 51:5869–5878.

This brief summarizes the results of their analysis.

1 MICROBIAL WATER QUALITY TEST COSTS
21 USD
(Consumables, equipment, labor, and logistics)

ALL PIPED SUPPLIES IN SUB-SAHARAN AFRICA
10.9 million USD per year

ALL IMPROVED POINT SOURCES IN SUB-SAHARAN AFRICA
5.1 million USD per year
(Boreholes, rainwater, protected springs/dug wells)

Key Findings

1. In sub-Saharan Africa, conducting a microbial water quality tests costs 21 USD on average, including equipment, consumables, labor, and logistics (transport and communication).
2. The operating expenses for monitoring all improved water sources in sub-Saharan Africa at the frequency recommended by the WHO Guidelines are approximately 16.0 million USD per year.
3. For many countries, the operating expenses for monitoring all improved water sources are less than 2% of current government budgets for water and sanitation infrastructure and services.
4. Although water quality monitoring appears affordable at national levels, the operating expenses are often prohibitively expensive for smaller water suppliers and surveillance agencies.

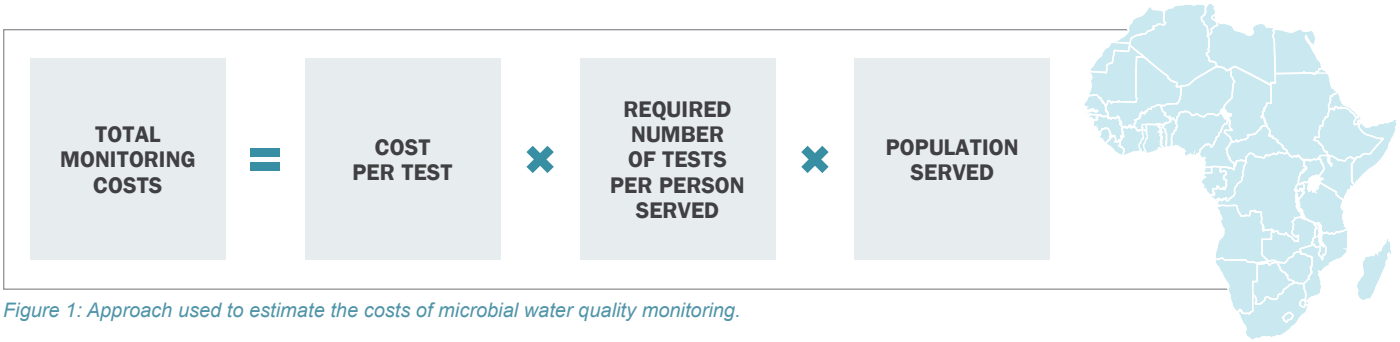

Figure 1: Approach used to estimate the costs of microbial water quality monitoring.

A. COST PER TEST

The cost of a microbial water quality test was broken down into four categories: equipment (reusable laboratory items), consumables (reagents and supplies), labor (for sample collection and analysis), and logistics (transport and communication). Eighteen MfSW partners (eight water suppliers and 10 surveillance agencies) in Kenya, Uganda, Zambia, Ethiopia, Guinea, and Senegal provided information on their expenses in the four categories.

The researchers found that on average, a microbial water quality test costs 21 USD, though costs varied substantially across institutions (Figure 2). This amount was higher than previously reported estimates, because it includes 1) the costs of importing and delivering equipment in country and 2) the labor and logistical costs of reaching all sampling locations.

The researchers found no systematic cost difference between the common quantitative testing methods: membrane filtration, most probable number estimates, and the Petrifilm-Colilert combination assay.

B. MONITORING PIPED SUPPLIES AND IMPROVED POINT SOURCES

According to the WHO Guidelines for Drinking Water Quality, the annual number of microbial tests required for a piped system depends on the population served, while all point water sources should be tested every 3-5 years (or every 4 years for simplicity, Table 1). To calculate the total costs of microbial water quality monitoring in sub-Saharan Africa, the researchers estimated the required number of tests per person served for each country, then multiplied it by the total population served (JMP data) and by the unit cost per test (Part A) (Figure 1).

Using publicly available data from national suppliers, regulators, and ministries from eight countries (Guinea, Kenya, Mauritius, Mozambique, South Africa, Tanzania, Uganda, and Zambia), the researchers estimated the number and size of piped water

TYPE OF WATER SUPPLY AND POPULATIONS	TOTAL NUMBER OF SAMPLES PER YEAR
POINT SOURCES	Progressive sampling of all sources over 3- to 5-year cycles
PIPED SUPPLIES	
< 5,000	12
5,000–100,000	12 per 5,000 population
> 100,000–500,000	12 per 10,000 population plus an additional 120 samples
> 500,000	12 per 10,000 population plus an additional 600 samples

Table 1: WHO Drinking Water Guidelines 4th Edition

systems and then calculated the corresponding number of tests per capita required annually, which ranged between 12 tests per 10,000 people (Zambia) and 29 tests per 10,000 people (Uganda). They also used water point inventories from 10 countries (Benin, Ghana, Guinea Bissau, Kenya, Liberia, Malawi, Senegal, Sierra Leone, Tanzania, and Uganda) to estimate that each point source in Africa serves an average of 330 people, which translates into an annual required number of 8 tests per 10,000 people.

Extrapolating these findings to the rest of sub-Saharan Africa, the researchers estimated that monitoring all piped supplies in the subcontinent would require 521,000 microbial tests per year, costing an annual 10.9 million USD, and that all improved point water sources would require 243,000 microbial tests per year, costing an annual 5.1 million USD.

C. MONITORING ALL IMPROVED WATER SOURCES

In total, the operating expenses for monitoring the microbial quality of all improved water sources in sub-Saharan Africa are approximately 16.0 million USD per year. Figure 3 provides the operating expense breakdown by country. The six most populated countries – Nigeria, Ethiopia, DRC, South Africa, Tanzania, and Kenya- account for 50% of the total financial requirements.

The researchers compared the operating expense estimates with current national water and sanitation budgets for 16 countries. They found that the costs of monitoring microbial water quality would correspond to less than 2% of what is already being spent in the sector.

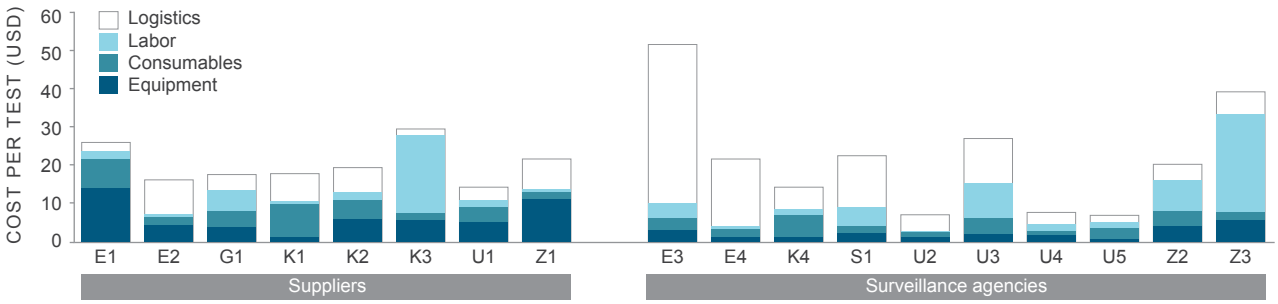

Figure 2: Cost of one microbial water quality test in sub-Saharan Africa. (Institutions are labeled by the first letter of their country.)

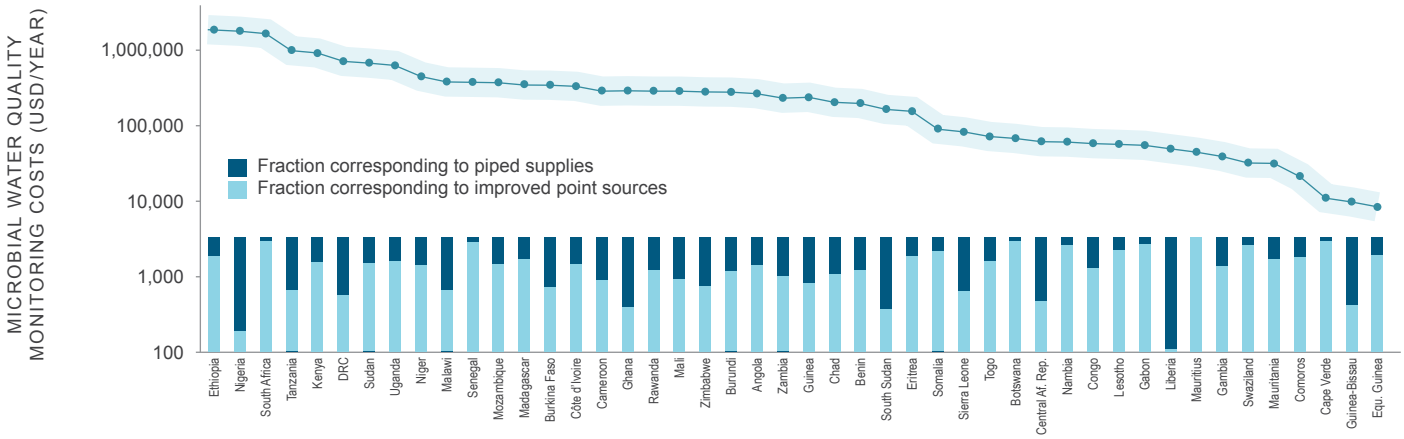

Figure 3: Annual costs of microbial water quality monitoring in sub-Saharan Africa.

D. BARRIERS TO WATER QUALITY MONITORING

Overall, this analysis shows that the financial requirements for microbial water quality testing in sub-Saharan Africa are modest, suggesting that other constraints to testing exist. Insufficient capacity, weak regulations, and other institutional barriers may be as critical as cost to explain the lack of testing.

Affordability of water quality monitoring

Although the operating expenses for microbial water quality monitoring appear affordable at national levels, testing costs may be prohibitive for individual institutions with limited resources.

- Small piped systems and surveillance agencies have limited revenue per capita
- Small piped systems have to conduct more tests per capita (Table 1)
- Logistics (transportation) costs of covering vast rural areas (for surveillance agencies) can be very high
- Capital expenditures (for physical infrastructure, laboratory equipment, and staff training) are likely to be a more substantial barrier to testing than ongoing costs

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The full text can be found at: http://pubs.acs.org/doi/abs/10.1021/acs.est.6b06442

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