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ASSESSING THE EFFECTS OF COVID-19 ON ACCESS TO WATER, SANITATION, AND HYGIENE IN USAID HIGH PRIORITY AND STRATEGY-ALIGNED COUNTRIES

Synthesis Report

Photo credit: Bashiru Yachori, 2020.

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ACRONYMS AND ABBREVIATIONS

AFD	*Agence Française de Développement* (French Development Agency)
COVID-19	Coronavirus Disease 2019
CRS	Catholic Relief Services
DHS	Demographic and Health Survey
DRC	Democratic Republic of the Congo
FEPEAR	*Forum des Exploitants Privés des Systemes d'Eau er Assainissement* (Association of Private Water and Sanitation System Operators [Rwanda])
FIPAG	*Fundo de Investimento e Património do Abastecimento de Água* (Water Supply Assets and Investment Fund [Mozambique])
FPA	*Fornecedor Privado da Água* (Private Water Provider [Mozambique])
GDP	Gross Domestic Product
GWC	Global WASH Cluster
HDPE	High Density Polyethylene
HH	Household
ICRC	International Committee of the Red Cross
IMF	International Monetary Fund
JICA	Japan International Cooperation Agency
JMP	Joint Monitoring Programme of WHO and UNICEF
KfW	*Kreditanstalt für Wiederaufbau* (German state-owned development bank)
LIA	Low-Income Area
MAWASCO	Mathira Water and Sanitation Company (Kenya)
MICS	Multiple Indicator Cluster Survey
MIS	Malaria Indicator Survey
NGO	Nongovernmental Organization
NYEWASO	Nyeri Water Services Company (Kenya)
OD	Open Defecation
REGIDESO	*Régie de distribution d'eau* (Water Distribution Board [DRC])
SINAS	Sistema de Informação Nacional de Água e Saneamento (Mozambique)
SME	Small-to-Medium-Sized Enterprise
SMS	Short Message Service (Text Message)

SWA	Sanitation and Water for All
THIWASCO	Thika Water and Sewerage Company (Kenya)
USAID	United States Agency for International Development
WASAC	Water and Sanitation Corporation (Rwanda)
WASH	Water, Sanitation, and Hygiene
WASH-FIN	Water, Sanitation, and Hygiene Finance program of USAID
WASHPaLS	Water, Sanitation, and Hygiene Partnerships and Learning for Sustainability Project
WASREB	Water Services Regulatory Board (Kenya)
WHO	World Health Organization
WSP	Water Service Provider
WSPA	Water Service Provider Association (Kenya)
WSTF	Water Sector Trust Fund
WSUP	Water and Sanitation for the Urban Poor

EXECUTIVE SUMMARY

In May 2020, the United States Agency for International Development (USAID) tasked the Water, Sanitation, and Hygiene Partnerships and Learning for Sustainability (WASHPaLS) project with assessing the effects of the novel Coronavirus Disease 2019 (COVID-19) on access to water, sanitation, and hygiene (WASH) services and products in USAID high-priority and strategy-aligned countries.[1] The assignment sought to characterize the current state of affairs and to forecast near-term (6–18 month) trends that could assist governments, donors, and implementers prepare an informed response to the WASH-related impacts of the pandemic.

The assessment team pursued two lines of inquiry. The first is a set of "deep dives" in seven countries (the Democratic Republic of the Congo [DRC], Ghana, Kenya, Mozambique, Nepal, Rwanda, and Senegal) selected to reflect a spectrum of geographic, cultural, and vulnerability characteristics. These deep dives consisted of interviews with key informants (WASH product and service providers, government officials, donors, and WASH program implementers) as well as SMS-based surveys of over 3,000 randomly selected individuals in all countries save Nepal. The second line of inquiry is development of an econometric model linking income changes to WASH outcomes, relying on Demographic and Health Survey (DHS) and Multiple Indicator Cluster Survey (MICS) information, constructed using data from the 28 USAID high-priority and strategy-aligned countries, to generate WASH outcome forecasts for those same countries.

This document represents the synthesis of that work, carried out by the WASHPaLS team between June and October 2020. Detailed findings for each of the seven deep-dive countries are presented in separate reports. The team's topline findings, by subsector, are as follows:

WATER SUPPLY – CURRENT STATUS

1) COVID-19 has made water access more difficult for consumers—significantly more difficult than would be expected based only on cross-sectional correlations between income and water service level. Declines in water access are linked not only to economic shocks borne by consumers but also to financial pressures endured by water service providers (WSPs) as they suffer revenue shortfalls, which are a function of both government directives for free water provision and tariff collection difficulties. These consumer reports of pandemic-related water access difficulties exceed what is predicted based on the statistical relationship the assessment team measured between income and water supply outcomes using DHS and MICS data.

2) COVID-19-driven water access difficulties are reported across the urban-to-rural spectrum. Cumulatively across six countries in which the team conducted SMS surveys, roughly one-third of both urban and rural respondents reported that the pandemic had made accessing drinking water more difficult. There was no consistency across countries as to whether urban or rural dwellers were impacted more. For example, in DRC, Ghana, Mozambique, and Senegal, the proportion of urban respondents reporting difficulties was 7 percentage points lower than that for rural respondents (36 percent vs. 29 percent). In Kenya and Rwanda, the proportions of urban respondents reporting COVID-linked water access difficulties were 5 and 15 percentage points *higher* than that of rural respondents, respectively.

3) Water suppliers face major financial challenges, and (to a lesser extent) operational obstacles related to supply chain disruptions and price increases for chemicals and

[1] The team's analysis proceeded on the hypothesis that COVID-19's direct health consequences in terms of morbidity and mortality would ultimately be far outweighed by the pandemic's economic shock, based in part on predictions of an epidemiological model for the World Health Organization's African region published in May (Cabore et al., 2020).

hardware. International donor and lender assistance has been necessary to bridge service providers through to a period of economic recovery; in some countries, that assistance has been significant and sufficient for the immediate term. The situation for smaller providers is likely much more dire. In selected countries, the team learned of service disruptions already having begun as smaller operators had exhausted cash reserves and were unable to cover electricity costs to operate pumps.

SANITATION – CURRENT STATUS

4) Consumer-reported pandemic-driven declines in sanitation access—latrine components and installation services as well as desludging services—are, so far, much less pronounced than those for water supply, and more in line with the sanitation services' direct connection to income. Very few SMS survey respondents reported changes in sanitation service modality. This is understandable, given that sanitation is not sensitive to sudden operational disruptions as can happen with water supply systems (with the exception of piped sewer service, whose profile matches that of piped water supply, but which is enjoyed by an exceedingly small fraction of the populations under study). The consumer-reported changes in sanitation service modality are comparable to what the statistical relationship between income and sanitation outcomes would predict.

5) Providers of sanitation services are suffering because of declines in demand. The fecal sludge management sector is particularly at risk, although a number of key informants also reported some recovery as movement restrictions had been lifted and economic activity returned in different countries. In particular, fecal sludge treatment plant operators face a steep path to recovery, given their dependency on government and donor funding to close financial gaps.

6) Supply chain problems are making sanitation product and service provision less profitable. The team's interviews indicated significant margin contraction among both suppliers of onsite containment inputs and fecal sludge value chain actors resulting from increasing costs of hardware and chemicals.

HANDWASHING – CURRENT STATUS

7) Consistent with a number of studies, self-reported handwashing behavior is very high during the pandemic period, with self-reports reinforced by consultations with value chain actors who confirm that sales of soap have risen dramatically since the onset of the pandemic.

8) The team found no evidence of persistent or widespread shortages of soap and noted multiple examples of both soap prices and availability remaining constant. At the same time, the *affordability* of soap does appear to have declined, insofar as the ratio of spending power to prices dropped as household income losses have mounted. Two of the six deep-dive countries in which the team conducted SMS surveys, Kenya and Rwanda, had much higher fractions of respondents reporting soap access becoming relatively more difficult post-COVID-19 (35 percentage points higher in Kenya and 33 percentage points in Rwanda). This is in contrast to the other four countries where soap access was reported to become either relatively easier (Ghana and Senegal) or remaining constant (DRC and Mozambique). The team suspects that these difference are likely linked to the relatively higher income shocks that Kenyans and Rwandans reported, as the evidence the team found of soap price trends indicated no increase.

9) Manufacturers and distributors of hygiene products report margin losses despite increased demand. These losses are driven by: 1) a shift in preference away from luxury brands toward lower margin economy brands, 2) increases in raw material costs, and 3) the inability to raise prices because of increased competition and a recognition of the weakened purchasing power of consumers.

NEAR-TERM FUTURE TRENDS

10) The assessment team anticipates that the largest WSPs will mostly avoid major disruptions in the next 6–12 months as their financial positions are secured with assistance from the development banks and bilateral and multilateral aid institutions. In a number of the investigated countries, major aid packages have been finalized and appear sufficient to bridge the utilities through periods of acute difficulty, especially as revenue collections have resumed following limited tariff suspensions.

11) Smaller piped water supply systems are susceptible to system disruptions, particularly in contexts where they have had to suspend tariff collection for extended periods in response to government policy/mandates. Without external assistance, smaller providers will feel pressure to re-initiate billing of economically burdened customers. Even in the absence of full suspension of services, such measures of supplier performance as frequency of running water and duration of down times are likely to suffer from operator inability to cover electricity maintenance costs.

13) In the rural context, deferred maintenance on handpumps from economic burdens may cause system failures over the next 6–18 months if recovery from COVID restrictions lag. That said, the assessment team does not expect disruptions as immediate or severe as those anticipated for schemes relying on electricity or diesel for production and conveyance. The down time of deep lift handpumps may well increase if the declining revenues limit the resources available to operators for regular maintenance. It is worth noting that even in pre-pandemic circumstances, handpumps recover only on the order of 10 percent of the operating costs (McNicholl et al., 2019).

13) The team expects demand for sanitation products and services to track economic conditions. Unlike water supply, for which extended financial difficulties can result in both sudden and extended performance declines by providers, consumer demand for sanitation commodities, installation services, and tank and pit desludging should recover if and when economic activity rebounds (as the assessment team did not uncover evidence of enterprises shutting down completely). If the economic recovery is more prolonged and there are delays in consumer ability to service, replace, and/or repair their latrines, reversion to open defecation is possible. The assessment team does not envision this as a widespread problem.

14) The team is cautiously optimistic that the pandemic may have brought about a social norms shift with respect to handwashing, and foresees few immediate crises with respect to hygiene product supplies and general availability. Although value chain actors did report margin contractions, none interviewed reported even considering withdrawing from the market.

1.0 INTRODUCTION

Between June and October 2020, the United States Agency for International Development (USAID) Water, Sanitation, and Hygiene Partnerships and Learning for Sustainability (WASHPaLS) project conducted a rapid assessment and forecasting analysis of the effects of the novel Coronavirus Disease 2019 (COVID-19) pandemic on access to WASH services and products in USAID high priority and strategy-aligned countries. The central question the team sought to answer was:

> ***How and for whom will the COVID-19 pandemic (and resulting economic crisis) affect access to water supply services, sanitation services and products, and hygiene products across the WASH high priority and aligned countries, and how will these access effects vary by subsector, geography, and provider type?***

The assessment team proceeded on the assumption that direct health effects of the pandemic in USAID high-priority and strategy-aligned countries would be exceeded by the economic shock of measures taken to contain the pandemic (restrictions of movement, closures of business, disruptions of supply chains, and so forth).[2]

On 4 May 2020, the Global WASH Cluster (GWC) and Sanitation and Water for All (SWA) released an advocacy document entitled "Mitigating the Socio-Economic Impacts [of COVID-19] on the Water, Sanitation, and Hygiene (WASH) Sector," which predicted the following:

- Decline in access to and increase in prices for WASH commodities and services due to rupture in global supply chains caused by restrictions or no movements of goods and essential consumables (e.g. fuel, chemicals), affecting continuity of services. …
- Decline in the financial viability of WASH services due to loss of revenue and subsidies, and income loss by households, limiting ability to pay for WASH commodities and services.
- Decline in national government's ability to deliver WASH services, affecting social cohesion, leading to tension and instability.
- Diversion and deprioritization of domestic funding away from the WASH sector, due to inability to pay for or suspension of loans.
- Shift in donor funding from the existing commitments and priorities…resulting in a significant reduction in the overall funding of [the WASH sector]." (GWC et al., 2020, p.3).

The assessment was intended to provide both a snapshot of current WASH access conditions and forecasting of near-term trends, but the team also found it useful to investigate the degree to which the GWC/SWA predictions play out in practice. The predictions also served to help the team formulate a set of hypotheses prior to commencing activities (Table 1).

[2] COVID-19 is likely to cause the first increase in global poverty in two decades, pushing some 100 million people into poverty and 50 million into extreme poverty in 2020, with an estimated 23 million going into extreme poverty in sub-Saharan Africa (Mahler et al., 2020). As described herein, the economic shocks of COVID-19 were experienced immediately and profoundly by high-priority and strategy-aligned countries, and persist even as some of these countries inch back toward pre-pandemic conditions of economic activity.

Table 1. Pre-Specified Hypotheses

Water Supply	Sanitation	Hygiene
Service provider revenues will decline because of 1) government policies regarding tariff collection, 2) consumer interpretation of those policies, and 3) reduced ability-to-pay by consumers.	Fragile sanitation value chains (with respect to both excreta containment and management) in urban and peri-urban areas will be most highly impacted. There will be increased stress on working capital and cash flows, profitability, and investment capacity.	Wholesale costs of soap will rise, a function of the reduced buying power of local currency as well as disrupted supply chains.
Supply chains for key commodities will be disrupted.	Consumer spending could shift away from sanitation leading to: 1) slower rate of improved toilet adoption and 2) reversion to OD in case of unaffordability of pit emptying services.	Consumer spending on these products may decline as assets are diminished, with priority spending directed at food and other immediate family needs, but that these spending declines may be partially offset by widespread campaigns to wash hands to prevent COVID infection.
The degree of operational and financial challenges faced by water service providers will vary considerably by modality and target population. The "in-betweeners" will be the most heavily affected; larger utilities will gain donor attention, and rural self-supply will be largely unaffected. Smaller providers, informal sector actors, and centralized community systems will have less "safety net."		There have been supply chain disruptions in most countries, particularly those which are net importers of hygiene products or product components. Compounded by limited mobility due to lockdowns or curfews and panic buying from wealthy consumers, supply chain disruptions could lead to product shortages.
Rural populations who rely on self-supply will see far less dramatic access effects. Supply chains for pump parts and maintenance will be affected, but given the already high failure rates of rural water infrastructure, rural populations generally rely on multiple water sources.		

2.0 METHODS

The assessment team sought to test the hypotheses and predictions noted above through an assessment of COVID-19-linked WASH access effects consisting of two elements:

1. **A "deep dive" into seven countries, consisting of interviews with hundreds of key informants and SMS-based consumer surveys of 500–750 respondents per country (with the exception of Nepal); and**
2. **Construction of an econometric model to forecast changes in access to water and sanitation access from losses in income, using Demographic and Health Survey (DHS) and Multiple Indicator Cluster Survey (MICS) data.**

2.1 DEEP DIVES

Given the time frame for this analysis, the assessment team elected to conduct a detailed investigation into a subset of the high-priority and strategy-aligned countries. The team selected seven countries for deep-dive analysis based on their representation of a spectrum of geographic, cultural, and vulnerability characteristics, as well as the confidence in the team's ability to secure interviews with key informants identified via snowball sampling. The seven countries are the Democratic Republic of the Congo (DRC), Ghana, Kenya, Mozambique, Nepal, Rwanda, and Senegal (Figure 1).

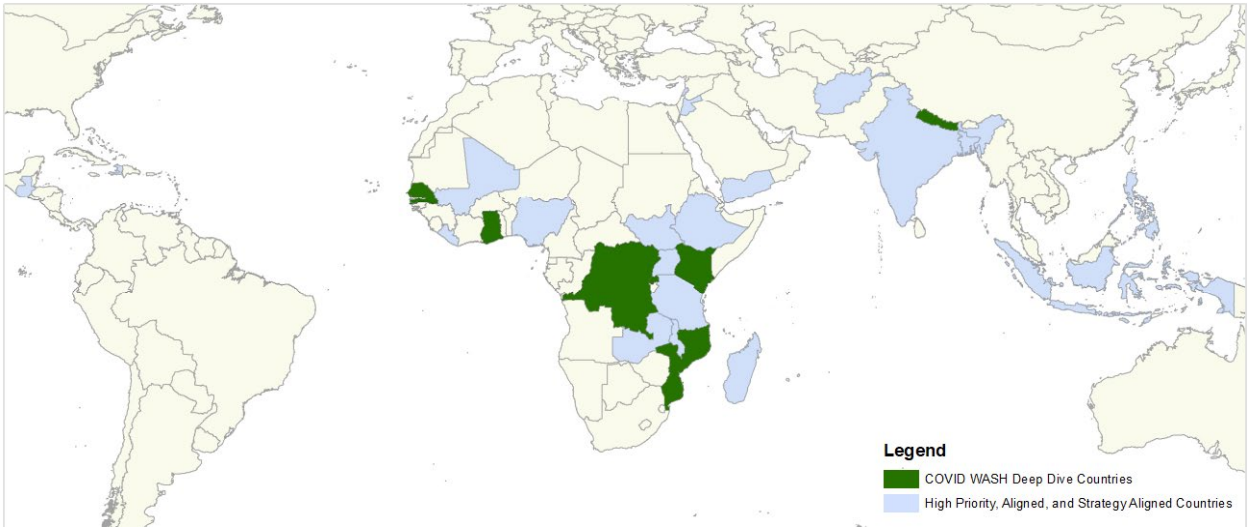

Figure 1. Highlighted countries are USAID high priority and strategy-aligned countries, with the deep-dive countries in green.

Key Informant Interviews. The team conducted semi-structured interviews for 277 key informants via phone or videoconference across the seven countries, ranging from 15 in Rwanda to 73 in Ghana, following pre-set interview guides for service providers, government regulatory and oversight officials, private sector actors, and program implementers. The purpose of these interviews was twofold: first, to secure macro-level insights from well-positioned observers (essential during a period in which in-country visits were rendered impossible) and second, to hear directly from suppliers of WASH products and services of their present and anticipated financial and operational challenges. Ultimately, the interviews served to complement the consumer surveys, providing a depth of observation that is not possible to gain from a short SMS questionnaire. The assessment team also hoped that the interviews

would contribute to predictions of future trends and aid in clarifying differences observed among countries. Key informant interviewees included (see Appendix 1):

- National and local government officials, both policymakers and regulators;
- Operators of water supply systems;
- Providers of sanitation products (latrine inputs) and services (pit/tank emptying, fecal sludge transport, and waste management);
- Producers and distributors of hygiene products (mainly soap);
- Implementers of donor-funded WASH programs; and
- Multilateral and bilateral donors and implementers (including the World Bank, UNICEF, United Kingdom Department for International Development [now the Foreign, Commonwealth & Development Office], Japan International Cooperation Agency [JICA], and others).

SMS Consumer Surveys. The assessment team complemented the investigation of supplier perspectives on the WASH access effects from COVID-19 with those of consumers by way of cross-sectional SMS surveys of at least 500 respondents per deep-dive country (with the exception of Nepal, where SMS surveying is not yet routinely executed). The team contracted the mobile-based research firm GeoPoll to conduct the survey using an instrument of the team's design (see Appendix 2).

SMS surveying is an extraordinarily efficient means of collecting consumer information. With formal access to mobile subscriber databases consisting of millions of people in each of the African deep-dive countries analyzed, GeoPoll was able to secure SMS survey responses from a sample with geographic and age distributions representative of the broader population of each country. This survey could be easily read and filled out with a basic feature phone (non-smartphone), and was offered to potential respondents incentivized by a modest offer of top-up credit. The instrument consisted of 33 questions, with skip patterns that meant that a respondent typically saw on the order 20–25 questions. The team offered the surveys in the following languages for each country:

- DRC: French and Swahili;
- Ghana: English;
- Kenya: English and Swahili;
- Mozambique: Portuguese;
- Rwanda: English and Kinyarwanda; and
- Senegal: French and Wolof.

The survey contained modules on employment and migration, water supply, sanitation, and handwashing. Completion rates of the survey ranged from 19 percent in Rwanda to 55 percent in Senegal (meaning, for example, that roughly 2,800 opt-ins were required to achieve 500 completed surveys in Rwanda, but only 860 opt-ins were required to achieve 500 completed surveys in Senegal). The surveys for DRC, Ghana, Kenya, Mozambique, and Senegal were completed during the latter half of August 2020. The survey for Rwanda was executed during the first two weeks of October 2020.

The team notes that SMS survey respondents, by virtue of their possession of a charged cell phone and the technical ability to fill out a survey, are likely a biased sample of the broader populations of the deep-dive countries. Cell phone ownership is estimated to be 10 percent lower among women than among men in low-to-middle-income countries (GSMA Connected Women, 2019). The team attempted to address this by setting a 50-50 gender split quota for survey results. The team considers it likely for respondents to have an elevated wealth and educational status than those who do not own a functional phone. Nonetheless, the team considers these biases to be small enough to make using the SMS surveys extremely useful, given the relative ease of deploying them.

2.2 ECONOMETRIC MODEL FOR FORECASTING CHANGES IN ACCESS TO WASH SERVICES

A central objective of this assignment was to forecast future trends in access to WASH services and products. Consumer surveys were expected to reflect current WASH access conditions, while the key informant interviews would provide essential insights on the intensity and possible duration of service disruptions and performance challenges.

In the interest of offering quantitative estimates of future access trends to the degree possible, the assessment team considered how economic indicators relate to WASH outcomes and then to explore numerical forecasts of WASH access changes resulting from an economic shock. There is some published literature to support this endeavor: Jeuland et al. (2013) developed long range (1975–2050) projections for Joint Monitoring Programme of the World Health Organization (WHO) and UNICEF (JMP) -defined improved water and improved sanitation and piped water and sewer coverage, based on cross-country associations between income and water/sanitation access, and urbanization. Their analysis employs projections of urbanization, population growth, and economic growth to simulate trends in water and sanitation coverage levels. Building on this analysis, Fuente et al. (2020) focused on sub-Saharan Africa to estimate WASH-related mortality and economic losses associated with poor access to water and sanitation infrastructure. The assessment team extended this approach by focusing exclusively on the income effect, dividing it into two sub-questions:

1. How responsive is WASH to falling income; and
2. How much has the COVID-19 crisis affected incomes?

Summary of the approach. The team first estimated how wealth predicts WASH access by running cross-sectional models in each high-priority and strategy-aligned country. Then, in a univariate model, the team regressed water or sanitation access level on an index measure of wealth. Subsequently, to control for rural vs. urban effects, education, and neighborhood/village effects, the team ran three additional multivariate models. The team then multiplied the estimate of the responsiveness of WASH access to wealth, education, and neighborhood/village effects by forecasts of the size of Gross Domestic Product (GDP) shock (from World Bank estimates). This allowed the team to estimate the water and sanitation effects from the pandemic's economic shock scaled by an economic decline of a user's choice. This was done for all high-priority and strategy-aligned countries. For a detailed description of the model approach and results, see Appendix 3.

Datasets. The team used the most recent, pre-pandemic DHS (including the Malaria Indicator Surveys, or MIS) or MICS in each high-priority or strategy-aligned country (see Appendix 3), analyzing water supply effects in 27 countries and sanitation in 28 countries.

Dependent variable. The response variable in the model is WASH access. DHS and MICS record the means by which respondents report accessing drinking water ("piped into dwelling," "piped into yard/plot," "public tap/standpipe", etc.), as well as sanitation service level ("piped sewer system," "septic tank," "pit latrine," etc.). The team's model focuses on changes in rungs of the JMP service ladder, with the objective of estimating the percentage of the population falling below the "Basic" level of water or sanitation service (see Appendix 3).

Explanatory variables. The team sought to explain changes in WASH access as a function of changes in wealth. The wealth measure is based on asset ownership, housing quality, land and home ownership, and livestock ownership, following the DHS procedure for creating a wealth index and examining quintiles,[3] but diverging by removing the water and sanitation access measures from the list of assets.

[3] "Steps to constructing the new DHS Wealth Index." Shea O. Rutstein, DHS Program, no date. https://dhsprogram.com/programming/wealth%20index/Steps_to_constructing_the_new_DHS_Wealth_Index.pdf

3.0 GOVERNMENT RESPONSE IN DEEP-DIVE COUNTRIES AND REPORTED ECONOMIC DISTRESS

In addition to differing pre-existing and contextual vulnerabilities to the pandemic, deep-dive countries saw differing degrees and durations of government response, enforcement, and population adherence to restrictions, which in turn drove impacts on economic activity. One way to visualize these differences is to consider the trends in restricted movement indicated by cellular phone mobility, with the caveat that mobile phone penetration varies from country to country and is complex to estimate with precision.[4] Figure 2 displays the trend in percentage departure from baseline levels of time spent in residential settings (as distinct from commercial/industrial settings or other location categories). The higher the value, the more time the cell phone user spends at home, and less time at commercial, industrial, or other non-residential locations, relative to baseline.

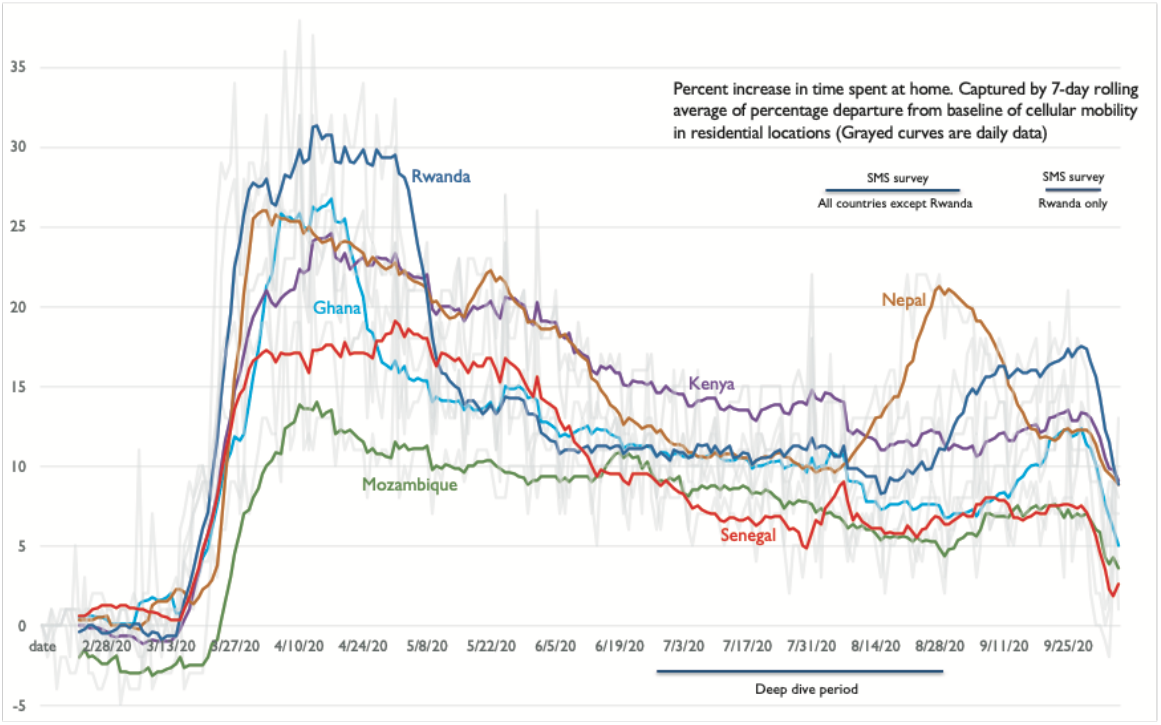

Figure 2. Percent departure from baseline mobile phone mobility, residential category, February to early October 2020. Periods of the SMS surveys and deep-dive interviews are noted. There are no mobility data available for DRC. Source:* Google COVID-19 Community Mobility Reports *(Google, 2020).

For the deep-dive countries in the analysis, there is a notable range in both the intensity and duration of effects on movement. Rwanda's lockdown resulted in the most extreme movement restrictions. The

[4] According to a 2017 survey by the Pew Research Center, reported ownership of mobile phones by adults was roughly 80% in Ghana, Kenya, and Senegal (Pew Research Center, 2018). Meanwhile, the 43 million mobile connections in Nepal correspond to 148% of its population, and the 9.4 million mobile connections in Rwanda in January 2020 correspond to 73% of its total population (Kemp, 2020). Because multiple SIM card use per person is common in the Global South, it can be difficult to estimate mobile phone penetration using accounts alone; a survey by Research ICT Africa estimates the 2017 penetration in Rwanda at 50% and Mozambique at 40% (Research ICT Africa, 2019). With these cautions in mind, cellular mobility data still provide the best possible proxy for movement effects resulting from COVID-19 restrictions.

easing of those restrictions in May brought the country in line with those in place for Ghana and Nepal; for about four weeks, the country witnessed even less disruption than in Senegal. Ghana's lockdown was intense but very short, while the effects of Mozambique's movement restrictions were consistently the least extreme of the deep-dive countries. Kenya's restrictions were sustained for a longer period than other countries; from mid-June until the first week of August, its restrictions resulted in the greatest limits on movement. Some countries re-introduced restrictions at different times: the government of Nepal issued a strict nationwide lockdown from 24 March to 21 July 2020, prohibiting domestic and international travel, instituting border closures, and suspending non-essential services, but then re-imposed restrictions in Kathmandu Valley on 19 August following an increase in local transmission attributed in part to large-scale entry of travelers from India when the border re-opened. These measures are reflected in Nepal's second peak in residential mobility in early August corresponding to the re-imposition of lockdown measures through the end of the month.

While there are other important drivers of COVID-19 economic burden (particularly the loss of the tourism revenue and remittances), these movement indicators are a useful indicator of the magnitude of pressure endured by different countries.

Additionally, the team's SMS surveys asked respondents how their employment had changed due to the pandemic (Figure 3). In addition to how widespread the pandemic's economic pain is being felt, with greater than half the respondents reporting job or income loss stemming from COVID-19, the numbers for Kenya and Rwanda show pronounced effects to consider in the analysis of WASH access effects.

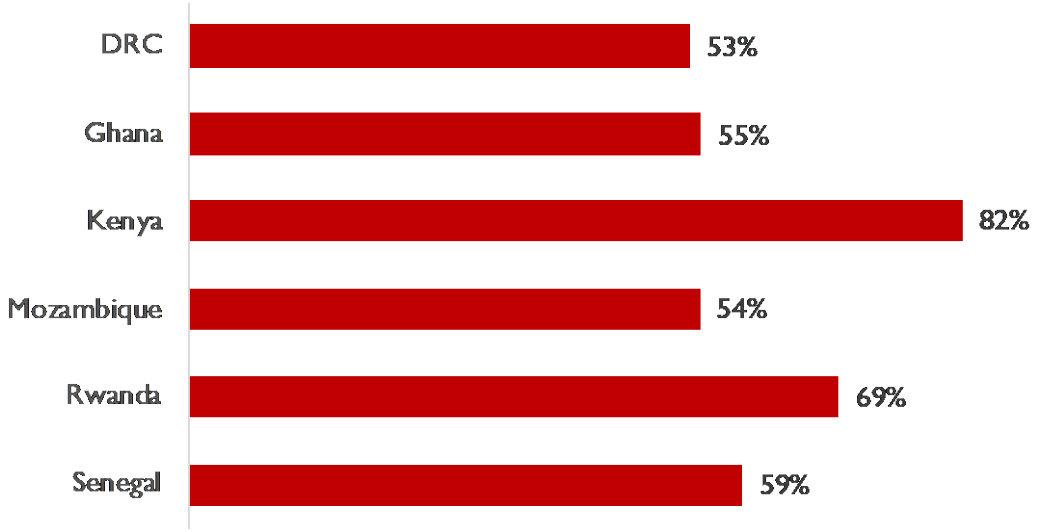

Figure 3. Percentage of respondents answering, "I lost my job" or "I earn less money" to the question, "How has COVID-19 changed your employment?"

Source: The team's SMS surveys, conducted in August 2020 (except for Rwanda, which was conducted in October 2020).

In most of the deep-dive countries, radical emergency travel restrictions were put in place from late March through June or July, although the duration of (and continued adherence to) these measures varied. The Government of Nepal issued a strict nationwide lockdown from 24 March to 21 July 2020, prohibiting domestic and international travel, instituting border closures, and suspending non-essential services. Following a relaxation of restrictions, it reimposed measures in Kathmandu Valley on 19 August following an increase in local transmission attributed in part to large-scale entry of travelers from India when the border re-opened (*Nepali Times,* 18 August 2020). In Ghana, following initial border closings; travel restrictions; partial lockdowns in the major hubs of Greater Accra and Kumasi metropolitan regions; closings of bars, restaurants, schools, and universities; and restrictions on the sizes

of public gatherings (conferences, workshops, funerals, festivals, political rallies, church activities and other related events), relaxation began in late April. This restriction relaxation is reflected in a rapid return toward baseline levels of mobility (Figure 2), and then a further steady decline in time spent in residential settings from May through September. Taken together, this suggests a shorter period of economic shock in Ghana than other countries analyzed.

Rwanda implemented the most comprehensive nationwide lockdown, from late March to early May, resulting in the highest movement disruption of any of the deep-dive countries, with renewed restrictions in September (Figure 2). Rwanda has resumed most business operations as of November 2020, including restaurants, hotels, shops, and tourism operations, although bars remain closed. Schools are in the process of a phased reopening.

In Kenya, by contrast, curfews from 19h00 to 05h00 were instituted from 27 March to 7 July, adjusted to 21h00 to 04h00 through September. Schools were closed 15 March and remain so, but are due to reopen in January 2021. These restrictions correspond to restrictions on mobility (and consequent increases time spent at home) that were sustained for longer periods than other deep-dive country.

In terms of WASH sector support, most governments instituted free water directives, although these varied in scope and duration. The Ghanaian government initially allocated US$205 million to pay water bills for all customers for three months (April to June) and to provide water tanker services to vulnerable communities, as well as investing in hand-washing facilities in public places. The directive was subsequently extended through August, and then again through December 2020. In Kenya and Mozambique, free water initiatives explicitly prohibited disconnection of customers with outstanding water and sewer bills and required the reconnection of previously disconnected customers. Tariff suspensions in these countries were targeted to Low Income Areas (LIAs, defined specifically as informal settlements) in Kenya, and to customers using less than 5m^3/month and those relying on water from public and private standpipes in Mozambique.

In DRC and Senegal, the free water mandate covered the entire country, but was limited to two months. In DRC, however, the tariff holiday was followed by a rate increase of 13–15 percent, depending upon the monthly consumption volume.

Neither the Nepalese nor Rwandan governments issued formal water tariff relaxation policies. Rwanda launched a fund to support affected businesses through subsidized loans from commercial banks and microfinance institutions and credit guarantees, targeting small-to-medium-sized enterprises (SMEs) and hard-hit sectors such as the hospitality industry (International Monetary Fund [IMF], 2020). The Government of Rwanda also extensively promoted handwashing, including making handwashing stations and sanitizers compulsory in all public places, such as churches, bus stations, and market places, and issuing decrees to keep the consumer cost of hand hygiene products reasonable.

4.0 DEEP DIVE RESULTS: DRINKING WATER

This section summarizes the results of the team's analysis of COVID-related drinking water access changes in the seven deep-dive countries, based on key informant interviews and the SMS consumer surveys conducted in the six African countries.

4.1 THE CONSUMER SIDE

Consumers widely report that COVID-19 has made getting drinking water more difficult, with those difficulties reflected in how respondents to the SMS surveys reported changes in how they access drinking water before and after the onset of the pandemic. The most notable reported challenges were shifts away from piped water among both urban and rural respondents in Kenya (and toward surface water among rural respondents) as well as declines in bottled/sachet water and cart vendor use in several countries.

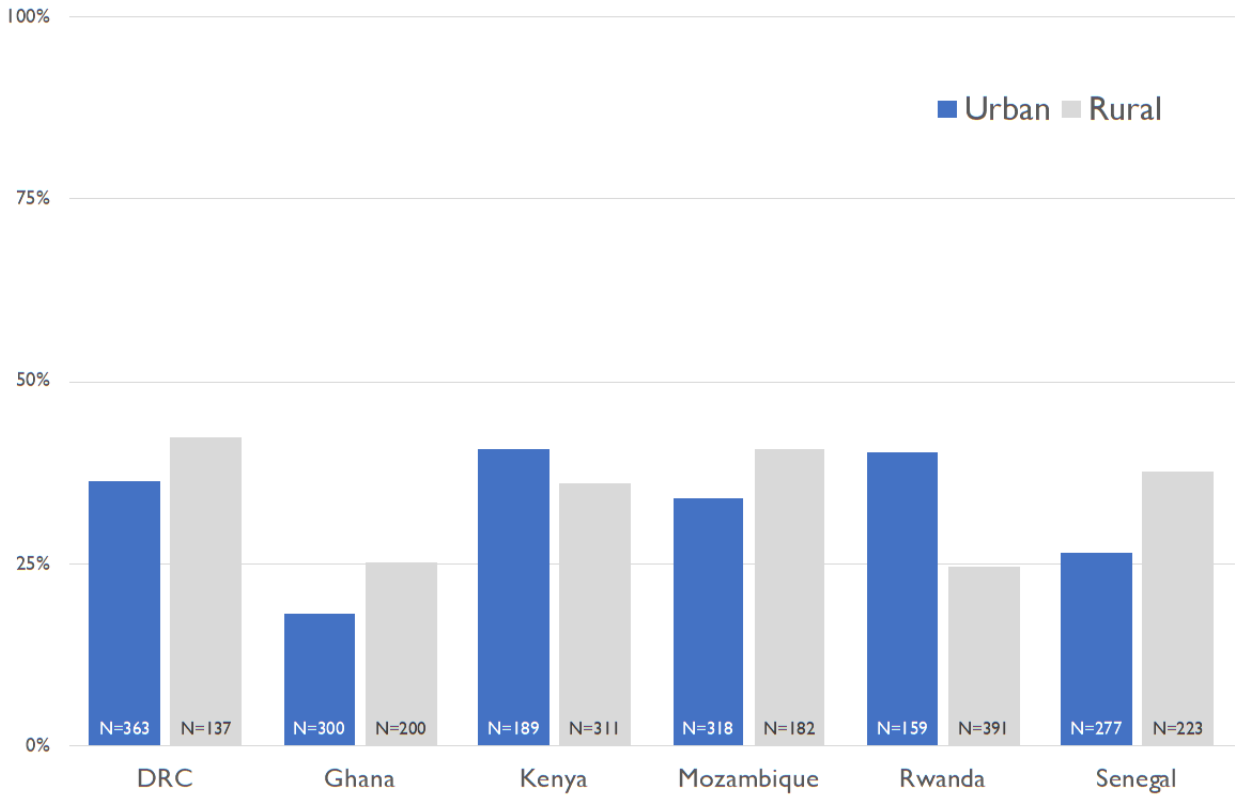

Figure 4. Percentage of respondents answering "Yes" to the question, "Has COVID-19 made it more difficult to get your drinking water?"

Source: SMS surveys conducted in August 2020 (except for Rwanda, which was conducted in October 2020). Sample sizes for each country segment shown at the base of the columns.

Figure 4 offers the results of the SMS survey question on pandemic-related drinking water difficulties. Although there is some important variation among countries, of those surveyed a significant number reported that COVID-19 has made accessing drinking water more difficult. In all but Kenya and Rwanda, more self-identified rural respondents reported pandemic-linked water access problems than urban

respondents. The slightly higher urban numbers in Kenya co-occur with its urban respondents reporting considerably more economic hardship than the other countries' urban respondents (with 75 percent of urban Kenyans reporting either losing jobs or suffering income losses, vs. a mean of 52 percent of urban respondents in the other countries). For Rwanda, where the urban vs. rural divide on WASH difficulties is by far the most pronounced (with a difference of 15 percentage points), the team observed no comparable income link; the 57 percent of urban Rwandans who report losing jobs or suffering an income loss is almost exactly the mean value (and near the median value) of the deep-dive countries.

Through the SMS surveys, the team also sought to learn how those reporting water access problems were experiencing them. Those who responded in the affirmative to the question, *"Has COVID-19 made it more difficult to get your drinking water?"* were then asked a series of questions of how they accessed drinking water before and after the onset of the pandemic. The results of those questions appear in Figure 5.

Figure 5. Heat map depicting percentage point changes in reported water service modality, pre-COVID-19 vs. at present, among those responding "Yes" to the question, "Has COVID-19 made it more difficult to get your drinking water?"

Those survey respondents reporting difficulties with drinking water access frequently reported changes in the means by which they acquired drinking water. The largest percentage point changes are apparent in Kenya and Rwanda. Rural Ghanaians reported major drops in bottled water/sachet usage, possibly related to Ghana's ambitious free water directive, which required water service providers (WSPs) to provide water to all domestic customers at no charge.

Across all the deep-dive countries, an average of 3.7 percent of SMS survey respondents reported falling below the "Basic" water service level defined by the JMP.[5] (This even as others moved up the ladder, including a progression from either surface water or unimproved services to Basic, where they may have been served by emergency distribution locations. What will happen when emergency distribution of drinking water stops is not clear.) If the country-level numbers are assumed to be representative of the broader population of each of these countries, the totals are reflected in Figure 6 (1.25 million in Mozambique, 2.1 million in DRC, and nearly 3.2 million in Kenya). Appendix 4 presents, by country, the pathways for water supply modality changes among the combined rural and urban sets of respondents who report pandemic-driven water access difficulties.

	% that fell below JMP "Basic"
DRC	2.6%
Ghana	2.2%
Kenya	6.4%
Mozambique	4.2%
Rwanda	5.1%
Senegal	1.4%

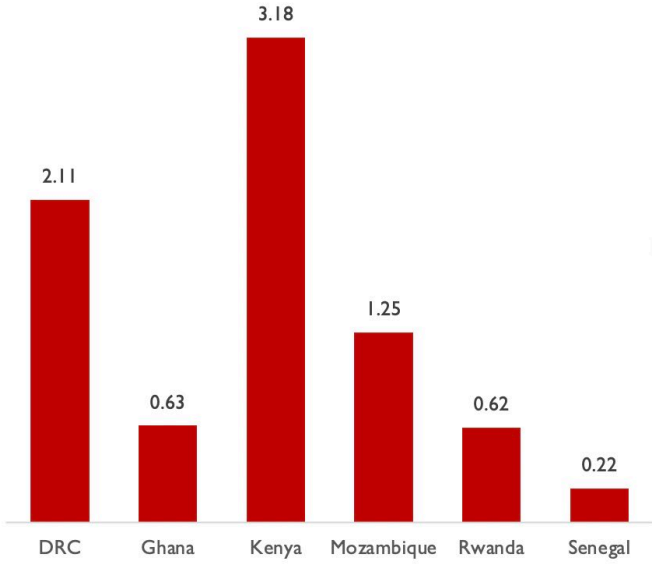

Figure 6. At left, percentages of respondents (N=500+ respondents); at right, estimated populations in millions of each country falling below Basic service levels on the JMP Water Ladder.

4.2 THE SUPPLIER SIDE – CURRENT STATUS

Interviews with regulators and operators of water supply systems in all of the deep-dive countries confirmed expectations of ***significant declines in revenue resulting from both financial distress of customers (leading to non-payment) and tariff holidays issued by governments*** (as discussed in Section 3 above). The following sections present the impacts on large and small WSPs.

[5] The highest JMP drinking water ladder level is "Safely Managed" (from an improved water source on premises, available when needed and free from fecal and priority chemical contamination), followed by "Basic" (an improved source, provided collection time is not more than 30 minutes for a round trip including queuing). Levels below "Basic" are: "Limited" (from an improved source for which collection time exceeds 30 minutes for a round trip including queuing), "Unimproved" (from an unprotected dug well or an unprotected spring), and "Surface Water" (drinking water sourced directly from a river, dam, lake, pond, stream, canal, or irrigation canal).

4.2.1 LARGE PROVIDERS

Revenue losses have already been documented among larger water utilities in USAID high-priority and strategy-aligned countries. The USAID-supported Water, Sanitation, and Hygiene Finance (WASH-FIN) project has been conducting financial stress tests of utilities in a number of countries employing a tool developed by the World Bank, some of which are now complete and have been publicly released. In Kenya, WASH-FIN conducted the stress test in June 2020 on three WSPs: Nyeri Water Services Company (NYEWASCO), Mathira Water and Sanitation Company (MAWASCO), and Thika Water and Sewerage Company (THIWASCO) (USAID, 2020). WASH-FIN forecast that MAWASCO and THIWASCO alone could require US$1.5 million to sustain operations through October in the absence of taking mitigating actions (maximizing revenue collections, extreme internal cash preservation, asset liquidation, debt restructuring, long-standing debt collection, and delaying electricity bill payments).

WASH-FIN's survey of utilities in Senegal found that 8 of 13 respondents reported 50 percent reductions in revenue compared to comparable periods in 2019, and 10 expected annual reductions of between 10 percent and 50 percent.

In an interview the assessment team conducted with the Water and Sanitation Corporation (WASAC), Rwanda's national urban asset owner and operator, WASAC reported considerable losses (even as it did not execute an official tariff holiday), with consumers reeling from income losses due to the country's strict lockdown order, although collections are climbing again with relaxation of movement restrictions. The team also heard reports of major revenue declines experienced by Mozambique's para-statal owner of urban water supply assets, *Fundo de Investimento e Património do Abastecimento de Água* (FIPAG).

DRC's national utility, *Régie de Distribution d'Eau* (REGIDESO), reported to the assessment team a loss of nearly US$15 million during the two months of that country's free water directive—a particularly difficult stretch for a supplier that already had been suffering financially for years prior to COVID-19.

4.2.2 SMALL PROVIDERS

Smaller WSPs are significantly more vulnerable to revenue losses than larger ones, given their often-precarious financial picture even outside of periods of economic turmoil[6] of the magnitude inflicted by COVID-19. Key informant interviews across multiple countries indicated that these ***smaller operators, particularly smaller piped providers, are now under acute financial pressure.***

In Nepal, WASH-FIN's rapid assessment of small-to-mid-sized utilities (up to 30,000 customers) indicated widespread losses as of July, with 4 of 10 reporting no revenues whatsoever since the onset of the pandemic, and another five reporting declines of 25–50 percent.

In Mozambique, the assessment team conducted phone interviews with 30 randomly selected small private water system operators (*Fornecedores Privados da Água*, or FPAs), drawn from a public dataset of 1,876 WSPs. Of these 30, 25 reported revenue declines linked to the pandemic, even as none interviewed were complying with the national free water directive (although 8 of the 30 had decreased their prices, and 10 of 30 reported selling more water than prior to the pandemic). However, none reported an imminent shutdown of operations, which would be consistent with the pattern observed in Figure 5 (where reported piped connections actually increased).

The situation the team observed in Mozambique stands in stark contrast to reports regarding small-town and rural piped system providers in Ghana, where multiple operators reported dire financial

[6] A 2019 assessment of data supplied from five high-performing service providers across Burkina Faso, the Central African Republic, Kenya, and Uganda found that among 800 piped schemes, the median annual operational working ratio was about 70% (McNicholl et al., 2019). Even well-run small systems have difficulty covering their operating costs.

conditions from having supplied water at no cost for seven months at volumes higher than before the pandemic, with reimbursements publicly committed by the government not keeping pace with the losses (with reimbursements averaging just over 7 percent of the amount for which providers applied, based on the team's interviews). Approximately 2.3 million Ghanaians rely on water from small town and small community piped systems and are vulnerable to widespread disruptions in service that will occur rapidly if operational costs cannot be met by providers. While not as dramatic (and functioning outside of an extended water tariff holiday as in Ghana), Rwanda's rural water system operators' association (*Forum des Exploitants Privés des Systemes d'Eau er Assainissement* [FEPEAR]) also reported major losses from its members and stated difficulties collecting revenues.

Rural handpumps are an important means of water service delivery; but as very few are monitored regularly, assessing their current status was difficult. The SMS surveys did not reveal any reported shifts away from "wells" (although the team did not distinguish between tube wells with deep lift pumps and shallow wells). The interviews with implementers of rural water supply programs did not point to widespread performance issues; indeed, in Ghana and Senegal, key informants indicated not only that production was steady, but that water payments were continuing despite economic hardship.

The best objective performance information the assessment team located came from the nongovernmental organization (NGO) charity: water from Ethiopia (outside of the deep-dive sample), where a sample of 142 of its network of remote sensors indicated a 25 percent decrease in handpump production, when comparing April 2019 and April 2020. The assessment team cannot conclude whether this decline was attributed to performance issues. Given how little time had passed between the imposition of movement restrictions and the collection of these data, the assessment team hypothesizes that the decline was likely due to reluctance of populations to congregate, out of fear of contracting COVID-19. ***More broadly, the assessment team found no evidence of widespread rural handpump performance issues to date, but cautions that it may be a lagging indicator in response to economic hardship***: deferred maintenance from significantly reduced operating reserves will likely require more time to manifest themselves. The next three to six months will clarify the picture. Despite the team's (anecdotal) interview findings, a delayed onset of pump maintenance challenges would not be unexpected.

Another water supply modality that appears to have been strongly affected is worth mentioning. First, the SMS survey in Kenya reveals a dramatic shift away from cart vendors of water in jerrycans (known locally as *Mkokoteni*). Although the assessment team did not have occasion to interview *Mkokoteni* directly, these survey responses suggest that the vendors have seen their business decline significantly. Second, key informant interviews indicate that "jar" water suppliers of 20-liter plastic jugs of treated water in Kathmandu, Nepal, where they are a central source of drinking water, appear to be heavily impacted, with 50 percent declines in sales resulting from major out-migration from the capital at the onset of the pandemic.

4.2.3 SUPPLY CHAIN ISSUES

Although interviews did not yield widespread evidence of supply chain issues affecting water suppliers, the team learned of some specific cases in which it had been a problem. In July, the Kenyan Water Services Provider Association (WSPA) cited chemical shortages in chlorine pellets as well as flocculants (specifically polyacrylamides). In DRC, REGIDESO reported diminishing stocks of chlorine for which it maintained only a two-month reserve, a shortage which the World Bank and later *Kreditanstalt für Wiederaufbau* (KfW, the German state-owned development bank) stepped in to rectify with financial assistance.

Hardware supply chain issues were reported in Nepal and Rwanda. The advocacy group of private Rwanda providers (FEPEAR) reported delays in procurement of hardware coming from Dubai and

China, and multiple key informants in Nepal reported that both maintenance and system expansion of rural systems had been hampered by plastic (high-density polyethylene [HDPE]) pipe procurement difficulties as well as disruptions of cement production.

Only 4 of 30 private operators in Mozambique mentioned supply chain issues as operational challenges. If mobility restrictions remain in place in neighboring South Africa, Mozambique's main source of chlorine and imported hardware, shortages could become a factor.

4.2.4 DONOR RESPONSE

The assessment team initially hypothesized that while large utilities would experience large declines in revenue during the pandemic and its aftermath, they would also be able to garner attention of bilateral and multilateral donors to keep them afloat. In a blog post on 30 July entitled "Non-payment is COVID's biggest threat to water," Christopher Gasson (the publisher of Global Water Intelligence), wrote:

> *My feeling is that Africa's big city utilities will probably get bailed out. Their size makes them difficult to ignore. Small island utilities will take a battering, but they are usually close enough to government to get by. The biggest problem is therefore likely to be small systems serving low-income communities. Typically these utilities are a long way away from politics and money. The smart ones will look for ways of clubbing together to make themselves matter. There may never be a cure for the rest* (Gasson, 2020).

Indeed, via interviews with donors as well as with recipient institutions, the assessment team documented donor rescue packages of varying magnitudes, some quite significant, aimed principally at large urban utilities:

- **DRC:** The IMF approved US$30 million to REGIDESO under its COVID-19 Rapid Credit Facility. KfW committed on the order US$4.2 million to cover the cost of water treatment chemicals for the entire country.
- **Ghana:** The World Bank is reportedly adding US$25 million to its US$125 investment to expand water services in Greater Accra.
- **Kenya:** The World Bank will support the water sector via US$75 million to be spent over six months, US$60 million of which are grants and the remaining US$15 million in performance-based loans, administered by Water Services Regulatory Board (WASREB) and the Water Services Trust Fund (WSTF). JICA contributed over US$400,000 in chlorine and coagulant to cover three months of need for nine WSPs (Embu, Meru, Mavoko, Kilifi Mariakani, Nakuru, Ruiru Juja, Eldoret, Nyahururu, and Kisumu).
- **Mozambique:** US$5 million remaining from the World Bank's Water Services and Institutional Support program's typhoon response was redeployed to support FIPAG, along with another US$5.4 million from the World Bank's general budget support, to cover FIPAG's supply of free water at urban standpipes (up to the first 5m^3).
- **Senegal:** The World Bank's US$100 million aid package to Senegal is divided equally between grants and credit, of which water/sanitation services are a part. Concurrently, the *Agence Française de Développement* (AFD) committed US$23.6 million to help cover the country's free water directive for April and May.

Large urban utilities in Nepal and Rwanda do not appear to have received major bilateral or multilateral budget support during the crisis. In Nepal, World Bank focus is on rural development, and its COVID-19 support has been directed through the Rural Water Supply and Sanitation Fund Development Board. In Rwanda, no World Bank urban infrastructure support has been directed to WASAC; only social protection funds have served that purpose in the form of US$10–12 million in payment of public works employee salaries while they were sequestered at home during the lockdown (although this includes

more than WASAC staff). JICA's support of WASAC has been in the form of flocculant/coagulant purchases as well as procurement of 10m^3 storage tanks for emergency distribution points and contracting of privately operated tanker trucks.

5.0 DEEP DIVE RESULTS: SANITATION

This section summarizes results of the team's analysis of COVID-related sanitation access changes in the seven deep-dive countries based on key informant interviews and SMS consumer surveys conducted in the six African countries.

5.1 THE CONSUMER SIDE

In comparison to their responses with respect to water supply, participants in the SMS surveys reported modest pandemic-related difficulties around sanitation (both onsite containment and desludging). Overall, between 8 and 19 percent of respondents reported trouble buying, installing or upgrading latrines, and between 6 and 11 percent reported difficulties with desludging (see Figure 7).

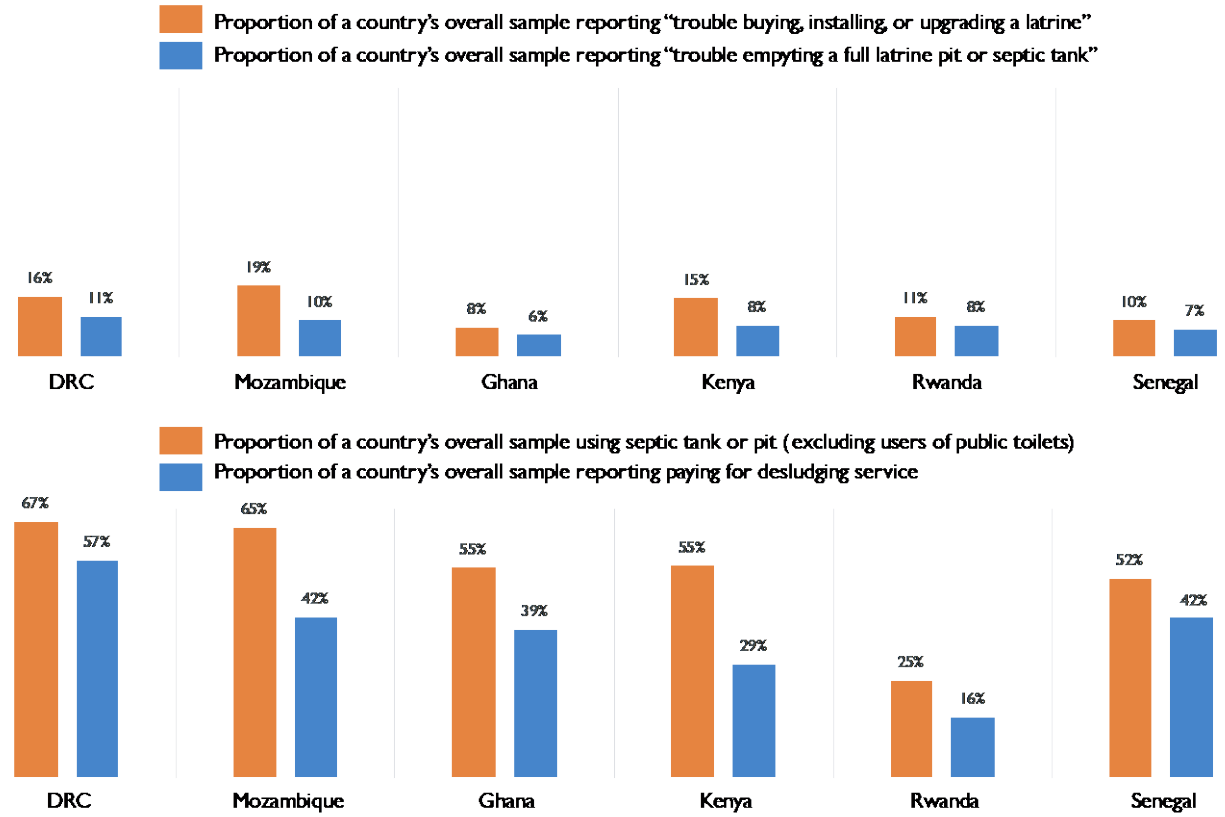

Figure 7. Indicators of sanitation service difficulties reported by respondents to the team's SMS surveys. N = 500+ participants per country.

Among those reporting difficulty with purchase, installation, or upgrades of latrines, "I cannot afford it" was the leading reason given in five of the six countries surveyed (ranging from 54 percent of respondents in Rwanda to 87 percent in Mozambique). In DRC, the leading explanation of difficulty offered by respondents was "I cannot find anyone who was selling what I need," (53 percent of respondents), compared to 33 percent who cited affordability.

The surveys also do not indicate major changes in sanitation service level resulting from COVID-19 (see Figure 8). This is to be expected, given that declines in sanitation service would occur more gradually than those for water supply, which can cease when, for example, a provider cannot afford to operate a pump. Drops in the sanitation service ladder can occur, for example, as a result of migration from a

home with piped sewer to one with onsite containment, inability to repair a latrine following failure, inability to access a desludging service, or due to a shift in preference due to perceived risk (e.g. urban Rwandans moving from public facilities to sharing with a neighbor).

DRC

	Rural N=201	Urban N=493
A private one at home	5	0
One I share	-3	0
A public community toilet	1	0
None	-3	-1

Ghana

	Rural N=253	Urban N=356
A private one at home	1	1
One I share	-1	-1
A public community toilet	1	1
None	-1	0

Kenya

	Rural N=283	Urban N=465
A private one at home	1	-1
One I share	-2	-1
A public community toilet	2	2
None	-1	0

Mozambique

	Rural N=211	Urban N=375
A private one at home	2	4
One I share	-2	-3
A public community toilet	0	1
None	0	-2

Rwanda

	Rural N=391	Urban N=159
A private one at home	-4	-3
One I share	4	7
A public community toilet	0	-5
None	0	1

Senegal

	Rural N=225	Urban N=282
A private one at home	4	6
One I share	-3	-3
A public community toilet	0	-1
None	0	-2

Figure 8. Heat map depicting percentage point changes in reported sanitation level, pre-COVID-19 vs. at present. Magnitude of change is captured both by the color and the number in a particular cell. For example, the proportion of urban Rwandan respondents to who reported reliance on a public community toilet dropped by 5 percentage points, and those reporting reliance on a shared household toilet increased by 7 percentage points.

5.2 THE SUPPLIER SIDE – CURRENT STATUS

Though consumers do not report significant sanitation service changes in our SMS surveys, our key informant interviews across the deep-dive countries do indicate financial pressure on both players in the fecal sludge value chain and providers of onsite containment inputs. In addition, ***supply chain challenges appear to be bearing on sanitation product and service provision more acutely than they have for water service provision.***

5.2.1 FECAL SLUDGE MANAGEMENT

Although expected to increase again in parallel with economic recovery from the COVID-19 economic shock, ***deep declines in demand for pit and septic tank-emptying services were reported in several of the deep-dive countries (Ghana, Kenya, and Nepal)***, reflecting the drop in income across all customer segments, including households and corporate clients and commercial/industrial institutions (with the significant exception of public toilets as reported by pit emptying businesses in Ghana). ***In some instances, the assessment team learned of shifts away from mechanized desludging to manual emptying***, in a sign of consumers searching for lower-cost means for maintaining their pits and septic tanks.

Vacuum truck operators in western Kenya reported a veritable collapse of demand initially, with sales dropping sevenfold, even as movement restrictions meant that household tanks and pits filled more quickly than usual. Reported declines in household demand for desludging there ranged from 30–100 percent (partially offset by increases in desludging demand at public toilets). More modest reductions in pit emptying businesses were reported in Kathmandu, but still exceeded 50 percent declines from pre-COVID-19 levels due to both household income losses and out-migration from the city during the lockdown period.

While the effect of the economic shock on suppliers of emptying and transport services was a consistent finding of the team's interviews, the assessment team also documented multiple instances in which decreased household incomes did not significantly impact demand for desludging services, resulting instead in a shift in emptying service preferences. In Tatale District Assembly (Northern Ghana), where manual emptying is readily available, the team learned of significant decreases in demand for mechanized emptying services in parallel with increases in demand for manual emptying as households opt for a lower-cost consumption basket (with manual emptying fees only on the order of 20 percent of the price of mechanized emptying).

Key informant interviews in DRC and Senegal, two countries with desludging sectors at very different levels of maturity, indicated few significant pandemic effects. The sector in DRC is extremely small and limited to Kinshasa, and the team learned of no significant changes in demand. In Senegal, where fecal sludge management is much more developed, no major changes in demand for pit emptying were reported by Delvic, a major private sector provider of onsite sanitation services in Dakar, Thies, and Diourbel. Delvic did not observe any decrease in revenues at its sludge treatment plant, which is indicative of unchanged household demand.

Delvic did, however, report that supply chains for spare parts and chemicals such as alum, imported from South Africa, were disrupted from border closures; having to pay a premium for supplies purchased in local markets did drive down profit margins. This was emblematic of ***broader reports of desludging margins under pressure, with increasing operational costs (largely fuel, repairs, and maintenance)***. Similarly, in Ghana, the lockdown in primary centers of Accra and Kumasi restricted transport of supplies across the country, resulting in increased transaction costs. All pit emptying businesses interviewed in Ghana noted the disruption in key supply chains (e.g., spare parts, tires) and the negative impact on their businesses. The lifting of the Ghanaian pandemic lockdown has eased the sourcing of spare parts; but prices remain elevated. Interviewees noted that even with the recent border opening, in the medium term, they do not expect a decrease in the price of inputs.

5.2.2 HOUSEHOLD SANITATION

Households appear to be have de-prioritized spending on sanitation facilities, particularly during the initial, more stringent phases of pandemic response, although there are encouraging signs of recovery in selected settings.

In Nepal, rural sanitation entrepreneurs, particularly cement ring manufacturers and latrine component suppliers, have been finding it difficult to remain viable and continue operations since the onset of the pandemic, due to a lack of availability of inputs, restrictions on construction, and scarce demand. Several key informants suggested that due to reduced incomes, Nepali households would likely install lower-cost, lower-quality toilets (e.g., unlined pits) when their current facilities fill up.

All the organizations interviewed in Senegal reported declines in latrine sales, more than 60 percent reductions in the northern regions and 30–40 percent in the south (although with recovery in the southern regions in June and July). In Kenya, Sanergy reported a complete cessation of latrine installation

activities from mid-March to June, compared to a monthly average of 100 toilets delivered prior to the pandemic, and have since recovered to about 50 percent of pre-pandemic levels.

In Ghana, urban sanitation enterprises affiliated with Water and Sanitation for the Urban Poor (WSUP) that averaged 10 sales per month (unsubsidized) pre-lockdown had not received orders for any new toilets in the months since the national lockdown was lifted in April 2020.

By contrast, suppliers in DRC have largely maintained revenue levels and steady cash-flows, as the demand for toilet construction materials has remained relatively unchanged, even with price increases. This trend has played out in the provinces of Kinshasa, Katanga, and Nord-Kivu, and runs counter to the hypothesis that the decline in household income levels would further deprioritize the purchase of new toilet facilities. Suppliers, however, note that it might be too early to confirm these demand levels, which might be short-lived, as they had only been back in business for a couple of weeks at the time of the interviews. Suppliers worried that economic burdens would persist, precluding investments in household sanitation.

Independent of affordability, interviewees in DRC also suggested that COVID-19 is less likely to have a negative impact on rural household construction of new latrines than in urban areas. Improved toilets are relatively more affordable in the countryside, where they are built using local materials and communities contribute to the costs of latrines. Mercy Corps reported an increase in household toilet construction and handwashing facilities, although the team cautions that that this may not be representative across all Congolese regions.

The relatively encouraging findings from DRC are echoed by reports from rural Ghana, where the USAID-funded WASH for Health program reported that sales did not decline at all, with a weekly average of 150–200. The harvest season (July–August), when households typically finance large purchases, is a plausible explanation for the sustained sales. In Rwanda, the USAID-funded Isuku Iwacu program (a focus of which has been establishment of district-level sanitation centers that act as market facilitators) reported that "sanitation product demand did not significantly decline during the lockdown period." At the same time, though, USAID's companion sanitation program, Gikuriru (which employs the Community Health Club model to promote latrine adoption, cessation of open defecation, and other hygienic behaviors), reported a shift in emphasis toward local soap manufacture.

As with fecal sludge management, supply chain disruptions were widely reported in the context of the market for onsite containment products and services. In Nepal, supply of most inputs (e.g., cement, HDPE pipes) ceased completely during the lockdown period. Most NGO implementers have had to delay the timelines for their ongoing projects (e.g., toilet upgrade program or community toilet construction) by 6–9 months. In Ghana, the lockdown in primary centers of Accra and Kumasi had restricted transport of supplies across the country, but existing inventories with wholesalers and retailers were adequate to meet demand, which had been reduced due to a slowdown in construction activity. Ghanaian building materials retailers have cut back on inventory levels, however, given the slowdown in sales.

In DRC, NGOs and sanitation commodity suppliers confirm that the pandemic has significantly affected supply chains. For cities like Bukavu that heavily depend on imports from Rwanda, border closures have restricted movement of all goods with the exception of food products. Lockdown measures in high COVID-19 transmission areas (largely urban and semi-urban zones) also created challenges with internal movement of goods. KfW reported difficulties in sourcing building materials for toilet construction in Kikwit (Kwilu province) and Mbuji-Mayi (Kasaï province).

Finally, working capital is in a critical state as trade credit has dried up for all but large businesses and transactions have shifted strictly to cash-and-carry. In Ghana, building material retailers and sanitation enterprises interviewed reported suspension of credit period or line from their suppliers, and they, in

turn, have stopped giving credit to customers. Nationally, 76 percent of manufacturing businesses and 83 percent of wholesale and retail businesses reported cash flow problems. Micro, small, and medium enterprises businesses are disproportionately affected with more than 70 percent citing cash flow issues compared with 47 percent of large enterprises (Ghana Statistical Service, 2020).

6.0 DEEP DIVE RESULTS: HANDWASHING

This section summarizes results of the analysis of COVID-related hygiene product access changes in the seven deep-dive countries based on key informant interviews as well as SMS consumer surveys conducted in the six African countries.

6.1 THE CONSUMER SIDE

The assessment team found reported handwashing to be extremely high in the aftermath of the onset of the pandemic. Among over 3,000 respondents to the SMS surveys, 84 percent reported that handwashing with soap by neighbors and friends had increased due to the pandemic, with country-level numbers ranging from 79 percent in Ghana to 88 percent in Mozambique (Figure 9). The urban vs. rural split for both of these numbers is minimal, though rural respondents did report slightly lower increases in behavior change and slightly higher levels of soap access difficulty.

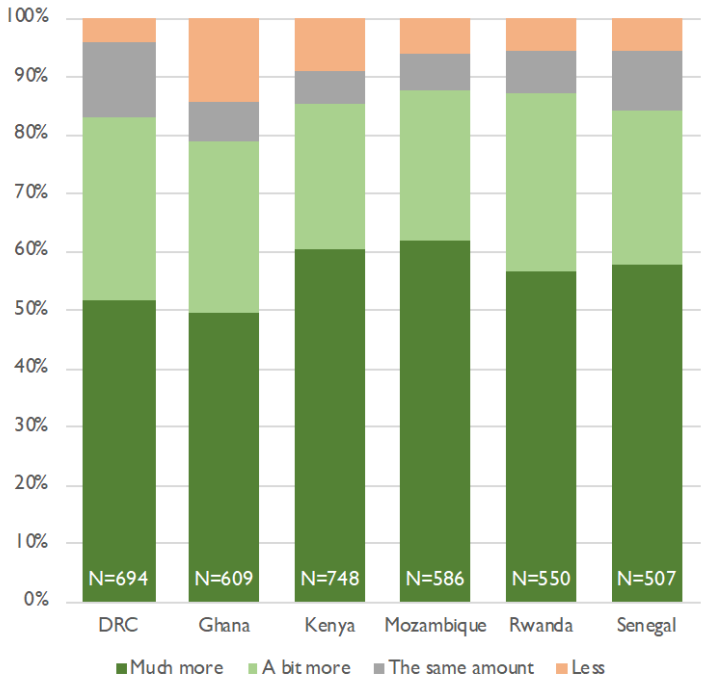

Figure 9. SMS survey response to the question, "Do you notice your neighbors and friends washing their hands with soap more often than before COVID-19?"

The team's findings are consistent with those reported elsewhere. A WaterAid assessment in Nepal (where we were unable to conduct an SMS survey) included phone surveys of 380 households across the country conducted in July. Of those interviewed, 97 percent reported changing their handwashing behavior post-COVID commencement (MITRA Samaj, 2020). That assessment also found consensus among interviewed key informants that the change in behavior was real, and not strictly courtesy bias.

In a recent survey conducted among over 4,800 Rwandans in June 2020, 87 percent reported washing their hands more often (Finmark Trust, 2020). Key informants attributed this positive shift in behavior to the government's extensive promotion of handwashing in the fight against COVID-19 and its decision to make handwashing stations and sanitizers compulsory in all public places, such as churches, bus stations, and market places.

Dramatic changes in behavior in response to crises can be transitory; increased handwashing in the time of COVID-19 may not be sustained. Indeed, there is suggestive evidence that initial increases in self-reported handwashing may be declining.

In collaboration with Facebook, Johns Hopkins University, and the World Health Organization, the MIT Initiative on the Digital Economy has been executing an online survey of 24,000 individuals across 20 countries repeated bi-monthly since July 2020. Responses from selected countries are presented in Figure 10. Over the course of about 10 weeks, there appear to be modest declines in reported handwashing as a COVID-19 preventative measure, with a 3.9 percentage point drop across the 11 countries represented in Figure 10, from 85.3 percent to 81.4 percent. The overall numbers for

handwashing for this online sample remain extremely high (and consistent with this assessment team's SMS surveys). The declining numbers suggest that some meaningful fraction of the survey participants are responding truthfully (with courtesy bias also minimized by virtue of the survey being anonymous).

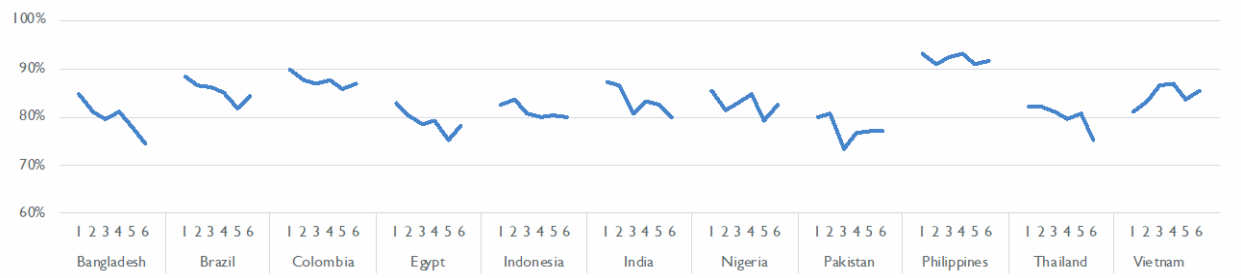

Figure** 10. **Percentage of the respondents listing "washing hands" in response to the question, "What measures have you taken to prevent infection from COVID-19 in the past week?" in the [MIT COVID-19 Beliefs, Behaviors & Norms Survey](). X-axis labels correspond to two-week long survey waves for 11 countries. Source: MIT Initiative on the Digital Economy and Facebook, 2020.

6.2 THE SUPPLIER SIDE – CURRENT STATUS

In both Ghana and Kenya, soap manufacturers and distributors interviewed report increases in demand of up to triple the pre-COVID levels. Higher sales were also reported by producers in Mozambique, Nepal, and Rwanda. These increases in sales are not exclusively linked to increased consumer demand; governments and donors have also purchased both soap and sanitizer in bulk to enable changes in handwashing behavior. Still, increased sales overall is notable, given the backdrop of major reductions in consumer spending power because of income losses. Multiple market players expressed optimism that the positive shift will continue over the longer term, driven by both retail and institutional channels.

Manufacturers and distributors did report reductions in their profit margins from supply chain issues as well as changes in consumer brand preference. Although the assessment team's interviews yielded no reports of widespread or extended shortages of handwashing products (and none were revealed by responses to the SMS consumer survey), the team learned of country-specific supply chain issues, both with respect to imports of soap and its raw materials as well as local transport disruptions from movement restrictions (particularly in Nepal and Rwanda). The assessment team received reports of price increases in raw materials (e.g., tallow, palm oil, stearin, and caustic soda) as high as 30–40 percent, but these were widely alleged to have been absorbed by manufacturers rather than passed on to consumers (either due to competition or out of recognition of reduced consumer purchasing power).

In Mozambique and Nepal, manufacturers and distributors noted that the increases in soap sales have been accompanied by shifts in preference away from premium brands to lower-priced or more hygiene-oriented brands, further squeezing margins, in some markets as high as 35 percent as compared to comparable periods in 2019.

COVID-driven behavior change represents an opportunity for new entrants into local soap markets. Interviews in Ghana revealed that the increase in demand for soap has attracted many new market entrants, primarily SMEs who are convinced that the newly adopted handwashing behaviors will be sustained over time, creating a viable longer-term business opportunity. In Rwanda, two USAID-supported programs have intensified activities centered around fostering local commercial soap production.

6.3 VARIATIONS IN REPORTED ACCESS AND PRICE TRENDS

Although they report more handwashing due to the pandemic, significant fractions of consumers surveyed via SMS also report that access to hygiene products has gotten more difficult because of reduced affordability, despite the fact that significant and widespread consumer price increases have not materialized. That said, the assessment team saw variation across deep-dive countries. Overall, 36 percent of surveyed respondents reported that soap access had gotten more difficult as a result of COVID-19, ranging from 16 percent of respondents in Senegal to 58 percent in Rwanda (Figure 11). Those reporting access difficulties said they were due to price increases as opposed to lack of availability in local markets. Conversely, 28 percent of respondents (on average) reported easier access, ranging from 15 percent in Kenya to 39 percent in Ghana, attributed to either lower prices or free distribution. Across the deep-dive countries, 37 percent of respondents reported no change in soap access due to COVID-19.

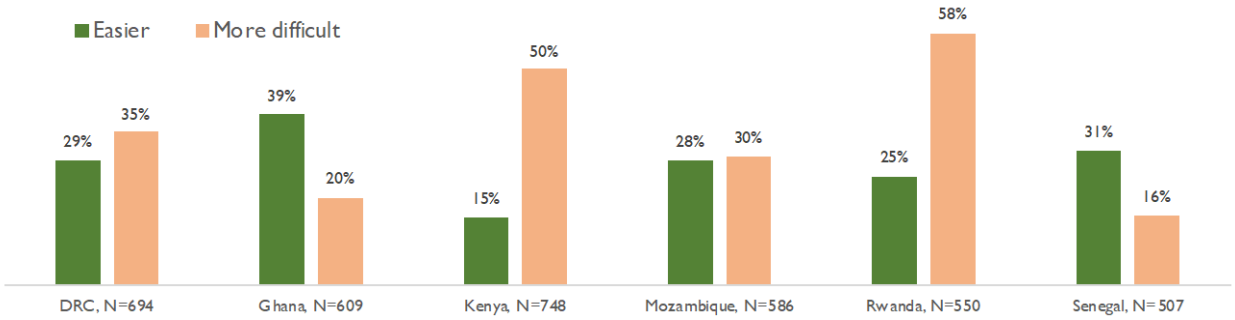

Figure 11. SMS survey response to the question, "Since COVID arrived, has it become easier or more difficult for your family to obtain any kind of soap to wash hands?"

Fractions reporting "no change" are not displayed, but in each case equal the remainder to reach 100 percent.

Among the surveyed countries, there appears to be three distinct groups: first, those for which reported soap access improvements outpace reported difficulties by 2:1 (Ghana and Senegal); second, those for which access difficulties are far more widely reported than improvements (over 3:1 in Kenya and more than 2:1 in Rwanda); and third, those for which reported improvements and difficulties are similar (DRC and Mozambique).

The concerning patterns regarding the difficulty to obtain soap in Kenya and Rwanda were not clearly reinforced by key informant interviews, but the team can put forth some possible explanations. First, these countries reported the highest level of employment-related distress in the SMS surveys (see Figure 3), and thus affordability might be a much more pronounced problem there.

Second, notably for Rwanda, lockdown measures may have some lingering effects. The country implemented some of the strictest lockdown measures in Africa, decreasing the mobility of its citizens by about twice the average for the continent (see Figure 2). While the lockdown was progressively lifted after May 2020, temporary lockdowns in urban hotspots (e.g., Kigali city market, Nyabugogo market) continue to be re-introduced in response to episodic COVID-19 outbreaks. Retailers in rural areas depend on markets in Kigali, which is the central trade district, for a regular supply of consumer goods. The lockdown of urban markets, therefore, may also have had an adverse impact on the distribution of soap to rural areas. Based on anecdotal observations, key informants cited an increase in home-based production of liquid soap in rural areas for self-consumption and sale within the community/village since the start of the pandemic. Localized supply could be alleviating distribution challenges to an extent, but even those faced challenges early on during the strict lockdown period. One small-scale manufacturer in

Kigali reported that *"for two months (March and April), we stayed at home; we did not venture out at all, not even to sell our soaps."*

The assessment team found no evidence of sustained, widespread increases in consumer prices for hand hygiene products. Even as production and distribution costs rose, supply chain actors across the deep-dive countries generally reported avoiding raising consumer prices in response. In some cases, they reported competition from new local manufacturers; in others (such as Rwanda), the government actually intervened with decrees to keep consumer prices low.

The best available consumer survey information that the assessment team located during the deep-dive research is in line with the key informant interviews conducted. The Kenya COVID-19 Economic Tracker is analyzing ongoing phone survey data suggesting that bar soap prices have not risen in Kenya (perhaps even dropping slightly), based on over 17,000 household phone interviews in Siaya county, Nyanza province, in a series of 21 weekly surveys between the beginning of April and the end of August (Figure 12).

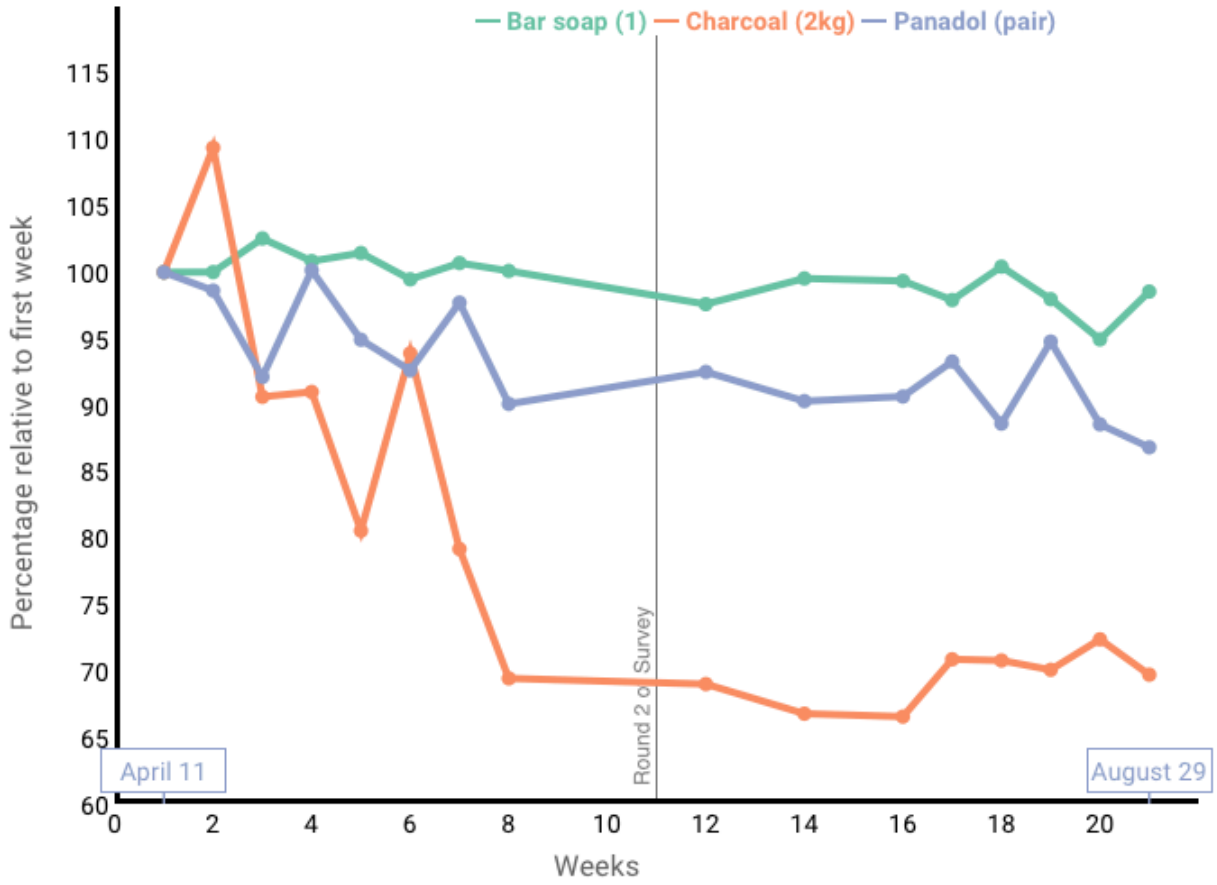

Figure 12. Prices of selected non-food items, reported by households contacted as part of the Kenya COVID-19 Economic Tracker.

Prices are expressed as a percentage of the value reported in the survey's first round in April.

7.0 SUMMARY OF ECONOMETRIC MODEL RESULTS

The assessment team's key informant interviews in deep-dive countries sought to examine supply-side disruption and how reduced revenue has affected service delivery, as well as how COVID-19 public health messaging has increased demand for handwashing inputs. The SMS surveys complement these interviews by collecting information directly from consumers as to how their service levels may have changed as a result of the pandemic. Both of these study elements allow some basic, forward-looking analysis of how WASH access could evolve in the near-term, presented in Section 8.

This section provides a summary of trend predictions in the context of COVID-19 based on an econometric model of wealth effects on WASH (described in Section 2.2). Appendix 3 provides details of model assumptions and results. In brief: the model examines the relationship between wealth in the form a wealth index measure following DHS procedure as the explanatory variable, and either water service level or sanitation service level, respectively, as dependent variables, as captured in DHS and MICS datasets.[7]

Having developed four different cross-sectional models, this section focuses on two of them. The first examines the simple relationship between wealth index and water (or sanitation) service level, exploring how a difference in wealth quintile predicts a difference in service level. The second model examines the same relationship but controls for neighborhood, education, and other household factors, asking the question: "*If a household is wealthier than its neighbors by a given amount, how likely is it to have superior water or sanitation service, and by how much*?"

Establishing the degree to which wealth controls water and sanitation access, albeit at a single point in time, allows a prediction of how that access might change in response to a decline in wealth, as might occur following an economic downturn. Relying on World Bank estimates of country-specific GDP growth declines for 2020, the assessment team ran the models for water supply in the 27 high priority and strategy-aligned countries for which there are water supply data available, and for sanitation in all 28 of the countries (see Table 5 and Table 9 in Appendix 3).

The model results suggest vastly lower service level declines for water supply than those indicated by the SMS survey results in the deep-dive countries, although they are more in line with the SMS surveys' sanitation results. Cumulatively across all these countries, the relationship between wealth and WASH indicators predicts that the pandemic's economic shock will cause nearly 29 million people to drop below JMP Basic sanitation levels and 1.9 million to drop below JMP Basic water service levels (with India constituting the majority in each case), relying on the model that does not control for neighborhood, education, and other household factors (Model 1). The map in Figure 13 displays these results, showing the effect size of the estimated pandemic income shock by country expressed as the proportion of the population falling below the JMP Basic for sanitation. The totals for sanitation drop to roughly 7.1 million people falling below JMP Basic for sanitation – with no effective change in JMP Basic for water – when controlling for neighborhood and the other factors (Model 2). For the country breakdown of these estimates, see Table 9 in Appendix 3.

[7] Although the income-WASH correlations presented here are not from an experiment, they do have the benefit of using nationally representative data from each high-priority or strategy-aligned country. Thus, although the team acknowledges the likely biases that arise in the estimates, results may be *less* biased than if the team had relied on careful experimental data from different settings. In a study of class size and private school effects on educational outcomes, Pritchett and Sandefur (2014) found that non-experimental estimates from the relevant context can be a better guide to policy than an experimental estimate from a different context.

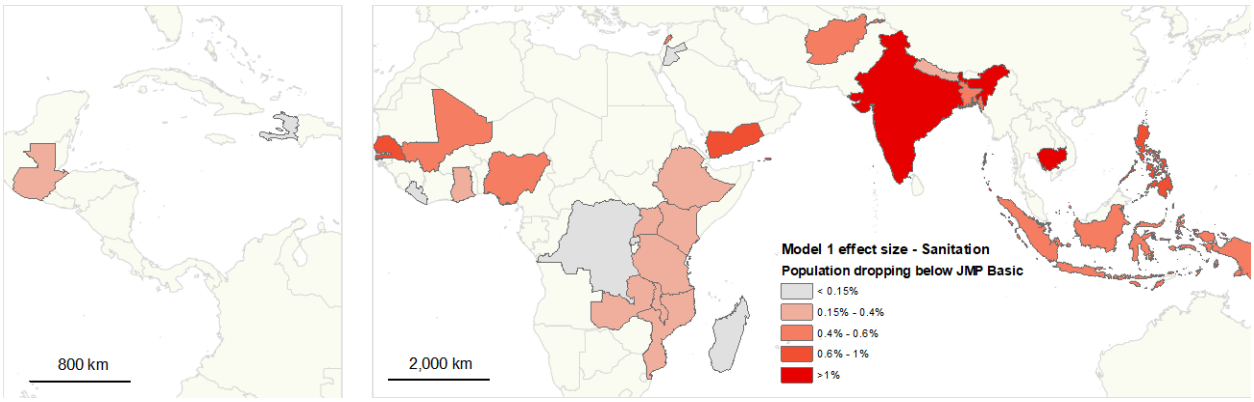

Figure 13. Results of Model 1 for sanitation – the effect size per country examining wealth effects only.

Values correspond to the proportion of a country's population falling below the JMP's Basic level for sanitation in response to the pandemic-induced economic shock, for all USAID WASH high-priority and strategy-aligned countries.

These results offer an approximation of how COVID-19 economic shocks could play out in terms of water and sanitation access in USAID's high priority and strategy-aligned countries, albeit with important limitations. First, there is reason to believe that the World Bank's estimates of GDP growth declines (a median of 6.2 percentage points across the 28 countries under study) may be an underestimate, given the results of the SMS surveys across six countries as well as an array of other individual data points suggesting much larger economic effects (see Appendix 3).

Second, declines in water access are driven not only by income shocks borne by consumers but also by financial pressures endured by WSPs as they suffer revenue shortfalls (a function of both government directives for free water provision and tariff collection difficulties). These financial pressures can result in immediate disruptions in water supply service, and could explain why consumer-reported water access difficulties so vastly exceeded those predicted by the models. By contrast, sanitation is not sensitive to sudden operational disruptions as can happen with water supply systems (with the exception of piped sewer service, whose profile matches that of piped water supply, but which is enjoyed by an exceedingly small fraction of the populations under study). The consumer-reported changes in sanitation service modality are much more comparable to what the statistical relationship between income and sanitation outcomes would predict.

Third, like any model, predictive power is constrained by the reliability of the model inputs and assumptions. While the results may be underestimates if the assessment's assumed GDP changes are too low, results could also *overestimate* effects because:

- The model predicts effect of a long-term income change, not of an episodic shock;
- Many utilities have not cut off service; indeed, many have offered varying periods of tariff suspension;
- People dislike giving up facilities they are used to: people may pay more to *keep* services than they would have initially paid to *gain* services (Kahneman et al., 1991); and
- Because improved water and sanitation often requires sunk costs, the estimates are especially likely to overstate the short-term water and sanitation effects of a reduction in household income. In other words, major investments in water and sanitation (e.g., the acquisition of a household water connection, the purchase of a pump, or the installation of an improved latrine) that occurred prior to the shock do not suddenly vanish when it occurs.

8.0 FUTURE WASH ACCESS TRENDS IN HIGH-PRIORITY AND STRATEGY ALIGNED COUNTRIES

The following is a synthesis of the team's findings across subsectors, integrating the findings of the key informant interviews, SMS consumer surveys, and econometric analysis of current conditions in an effort to make measured forecasts of future trends in access to WASH services and products in the period of COVID-19. Clearly, macro-level economic shocks bear upon water access, which is reflected in the econometric model results in Section 7. Notably, these modeled water supply effects are orders of magnitude lower than the losses reflected in the SMS surveys (see Figure 6), but the modeled sanitation effects may well be much more in line with survey results for sanitation.

A robust estimation of future trends must take into account both reasonable predictions of changes in wealth and factors related to the provision of services. Such factors are apparent in the team's deep-dive investigations, which, when combined with careful analyses conducted by WASH-FIN and others, reveal acute near-term issues, particularly with respect to water supply service. One such issue is that WSPs are in discouraging financial shape due to the inability to collect revenues for varying periods since the onset of the COVID-19 pandemic. As discussed, water supplier losses are driven by both consumer income shocks and government policies on tariff collection, both of which vary across the deep-dive countries (and certainly across the USAID high-priority and strategy-aligned countries as well). It is especially important here to recognize the very different ways in which water, sanitation, and handwashing products are delivered, as they bear upon how future trends should be considered.

8.1 WATER SUPPLY

For those populations whose water supply service relies on mechanized pumps, whether via piped conveyance or at a fixed point (e.g., a standpipe fed by an elevated tank), maintaining the financial resources to operate pumps (via grid electricity or diesel) is essential to keep water flowing and, in the case of sewered sanitation, to prevent wastewater from backing up into connected households. It also means that the potential catastrophic loss of service to large numbers of consumers can be sudden when power for running for pumps cannot be acquired if 1) a system operator runs out of cash and 2) is not either immediately financially rescued or provided electricity/fuel free of charge on credit. This quality is not shared by onsite sanitation, for which sudden losses of service across a geographic area do not occur.

The assessment team's interviews with water suppliers of varying sizes across seven countries, taken together with focused analyses of larger utilities conducted by others (particularly WASH-FIN), paint a picture of a fragile situation whereby speedy financial rescue has become essential to maintaining continuity of service. Some large utilities have received financial rescue in certain countries (DRC, Ghana, Kenya, Mozambique, and Senegal); whether the committed packages are sufficient to forestall liquidity crises by the large national asset owners and operators remains to be seen. This area should be monitored closely.

For smaller service providers, whether they be operators of piped systems, mechanized boreholes, kiosks, or providers of last-mile connections to households from larger systems (like small private network concessionaires or cart vendors of jerrycans), there is no possibility of direct rescue by bilateral or multilateral donors, given the sheer number of actors involved and the associated administrative and logistical challenges. In Kenya, WASREB is slated to administer World Bank support to 87 regulated water utilities across the country, 30 of which have fewer than 5,000 connections, which

at least affords the opportunity for a national-level aid recipient to channel support to individual small providers. In several countries, associations of WSPs are in place, but none appear to have the capacity currently to act as a conduit for significant financial support to smaller providers.

The assessment team's deep-dive key informant interviews, along with responses to the SMS surveys, confirm the initial hypotheses that small town and village-level piped providers and last-mile providers occupy a vulnerable middle between the largest utilities and the non-piped village-level sources (handpumps, shallow wells, and springs, which include self-supply). The former is most likely to receive financial bailout, and the latter is the least-sensitive to COVID-19 economic shocks (with the exception of handpumps, for which increased failure rate from deferred maintenance, although not yet widely observed, could emerge as a performance issue a bit further down the road). Depending upon the duration of both economic contraction and government directives for free water provision, these systems are the most at risk of service disruption, raising the essential question of how to keep them functioning. This is a matter of paramount importance given the size of the population these systems serve (often exceeding the populations served by large, national, and often-urban focused utilities).

The assessment team anticipates that the largest WSPs will largely avoid large-scale disruptions in the next 12–18 months as their financial positions are secured with assistance from the development banks and bilateral and multilateral aid institutions, continuing a pattern of major (and often hidden) subsidies that disproportionately benefit wealthier segments of urban populations. There are exceptions, such as the situation in DRC, where REGIDESO followed the country's two-month free water policy with a three- to four-fold increase water tariffs, prompting action by KfW to mitigate this increase in two Congolese cities.

Effects on non-piped water access in rural settings are also likely to be less pronounced, with the exception of deep lift handpumps, whose down time may well increase if the declining revenues limit the resources available for regular maintenance. Even in pre-pandemic circumstances, handpumps recovered only on the order of 10 percent of the operating costs (McNicholl et al., 2019).

The assessment team cautions that ***the vulnerable middle is currently at the greatest risk.*** Interviews with smaller system operators indicate that financial stress is widespread, although the severity of that stress varies. The associations of private water providers in Rwanda reported deep concern about their ability to sustain operations. In Mozambique, direct interviews with 30 small private operators yielded anxiety, although without many explicit expressions of concern about imminent shutdowns of their systems. In Ghana, however, the financial toll of the most widespread and longest-duration free water directive on the continent has resulted in reports of service disruptions already occurring among small town and rural piped providers as they had exhausted cash reserves to cover basic operating costs (such as for electricity), with substantially more system disruptions on the way if the pace of promised reimbursements by the central government is not expedited.

As economic conditions recover with the easing of movement restrictions, the team expects WSP revenue collection to rebound as well (as was reported in selected countries), although the speed with which revenues rebound is uncertain. The team is not in a position to forecast the rate of economic recovery, even as the comparatively low direct health burden of the pandemic throughout much of Africa along with a significant rollback of restrictions and restoration of movement and commerce as of the beginning of October 2020 do signal that recovery is underway.

8.2 SANITATION

The assessment team's SMS surveys of sanitation revealed minimal changes in sanitation service modality, changes much more in line with the findings of the economic model. Very small fractions of the population of the countries investigated are served by piped sewer—only 1.9 percent in Ghana, for

example, according to the 2017–2018 MICS—so the focus here is on onsite sanitation. Financial hardship suffered by consumers was universally reported to have dampened demand for the inputs for new latrine installation or upgrade, and businesses selling such inputs reported reduced sales. The limitations of the econometric model for water supply (specifically, accounting for the challenges of utility performance and the real risks of system-wide disruptions if basic operational functions couldn't be paid for) do not apply for sanitation. The team has more confidence in the ability of the model results to offer a reasonable estimate of how changes in sanitation service level will respond directly to income shocks.

Key informant interviews revealed that although sales of sanitation-related products as well as services (both installation and desludging) did drop in parallel with consumer spending in response to income losses, a recovery was also apparent. The sanitation sector's near term trajectory in high-priority and strategy-aligned countries is tied much more directly to economic conditions than the water sector, whose performance risks are compounded by extended periods of utility revenue declines. ***As economic activity restarts, the assessment team believes that rebounds in income will bring about a return to the markets for both sanitation inputs and desludging.***

8.3 HANDWASHING

This subsector is probably the most difficult to forecast, largely because the changes in handwashing behavior that are indicated by the SMS surveys and echoed by interviews with value chain actors are, to the team's knowledge, unprecedented. Although there are indications of a modest decline in self-reported handwashing, the team has no historical precedent on which to base an assumption that the decline will continue rather than the change in behavior becoming entrenched as a durable social norms shift.

What the team deems likely is that soap will become more affordable to consumers in response to income recovery from the COVID-19 shock. Markets have so far adapted well to maintain soap availability. Whether increased consumer spending power will result in sustained increases in soap sales (or returns to luxury brands at rates that restore the margins of manufacturers) is uncertain; indeed, it is possible that handwashing behaviors will decline again as the pandemic recedes. This is not supported by any strong evidence that the assessment team could find of how handwashing has either increased in response to a crisis (e.g., Ebola) or faded as the crisis diminishes. The team does not see declines in soap access outside of the affordability challenges of reduced incomes—indeed, soap prices remain stable across the deep-dive countries.

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APPENDIX 1. KEY INFORMANT LISTS

The tables below include the organizations with which the assessment's key informants are affiliated. To protect confidentiality, the tables do not include individual names. In numerous cases, the assessment team interviewed several key informants from the same organization. Additionally, the assessment team interviewed value chain actors who are sole proprietors of businesses who could be identified only as "anonymous vacuum truck operator" or the similar titles; these also are not included in the tables.

DRC

Category	Organization
Central Government	National Water and Sanitation Committee (*Comité National d'Action de l'Eau et l'Assainissement*)
Central Government	Department of Hygiene and Public Sanitation
Central Government	Directorate of Sanitation and Health
Central Government	Ministry of Water Resources and Electricity
Donor	KfW/*Deutsche Gesellschaft für Internationale Zusammenarbeit*
Donor	World Bank
Multilateral Institution	UNICEF
NGO	Food for the Hungry
NGO	ICRC
NGO	Mercy Corps
NGO	OXFAM
NGO	World Vision
Service Provider (Association)	Association of Pit Emptiers, Kinshasa
Service Provider (Association)	Association of Private Operators of Latrine Construction
Value Chain Actor	Ela Chemicals and Engineering;
Value Chain Actor	Établissement Shalom, distributor of toilet construction materials

GHANA

Category	Organization
Central Government	Community Water and Sanitation Agency
Financial Institution	Fidelity Bank
Local Government	Accra Metropolitan Assembly
Local Government	Cape Coast Metropolitan Assembly
Local Government	Effutu Municipal Assembly
Local Government	Ho Municipal Assembly
Local Government	Kumasi Metropolitan Assembly
Local Government	Offinso North District Assembly
Local Government	Prestea Huni Valley Municipal Assembly
Local Government	Saboba Municipal Assembly
Local Government	Tamale Metropolitan Assembly
Local Government	Tatale District Assembly
Local Government	Tema Metropolitan Assembly
Multilateral Institution	UNICEF
NGO	CONIWAS
NGO	Global Communities Ghana
NGO	iDE Ghana (Sama Sama), Tamale
NGO	IRC WASH
NGO	WaterAid Ghana

Category	Organization
NGO	WSUP Ghana
Researcher	Presbyterian University College
Researcher	Kwama Nkrumah University of Science and Technology
Sanitation Enterprise	Greater Accra
Service Provider	Asutifi North district, Brong-Ahafo Region
Service Provider	Fecal Sludge Truck Operator – Framcy Services
Service Provider	Fecal Sludge Truck Operator – J. Okoe Sanitation Company, Kumasi
Service Provider	Fecal Sludge Truck Operator, Achimota, Accra
Service Provider	Fecal Sludge Truck Operator, Kasoa – God First Septage Services
Service Provider	Fecal Sludge Truck Operator, Korle-Gonno, Accra
Service Provider	Fecal Sludge Truck Operator, Sekondi-Takoradi
Service Provider	iCESSPOOL
Service Provider	Samalex, Greater Accra
Service Provider	Sewerage Systems Ghana Limited FSTP
Service Provider	Zoomlion Ghana Limited
Service Provider (Association)	Environmental Service Providers Association
Value Chain Actor	Animbile Kayi Hardware, Northern Region
Value Chain Actor	Berrak Manufacturing Company Limited
Value Chain Actor	Clean Smell Limited
Value Chain Actor	Coppel Plumbing, Greater Accra
Value Chain Actor	Geosfier Hardware, Cape Coast
Value Chain Actor	Homesense Ghana
Value Chain Actor	Jekora Ventures Limited
Value Chain Actor	Morning Dew
Value Chain Actor	Proprietorship in Madina market, a peri-urban area in the Greater Accra region
Value Chain Actor	Sam Bennet Hardware, Brong-Ahafo Region
Value Chain Actor	Soap Proprietorship in Brong Ahafo, Western North and Bono regions
Value Chain Actor	Stonches Enterprises, small-scale soap manufacturer and grocery store in Sunyani city, Bono
Value Chain Actor	Tiwajo Industry Limited
Value Chain Actor	Wilmar International, Ghana

KENYA

Category	Organization
Central Government	WASREB
Local Government	Water, Environment, Energy & Natural Resources, County of Nakuru
Multilateral Institution	UNICEF
NGO	Afya Uzazi - Nakuru
NGO	Dandorra Transform League
NGO	Kenya Water and Health Organization
NGO	RHYCO
NGO	Sanergy
NGO	Sanivation
NGO	Umande Trust
NGO	World Vision
NGO	WSUP
Service Provider	"Master operators" - via KIWASCO
Service Provider	Busy Bee – Manual Pit Emptiers Kisumu
Service Provider	Gasia Poa – Manual Pit Emptying
Service Provider	Kalamaki Pit Emptiers Nakuru

Category	Organization
Service Provider	Kisumu Waste Water Association
Service Provider	Obunga Stars – Mechanized Pit Emptiers Kisumu
Service Provider (Association)	WSPA
USAID Program	KIWASH (DAI)
USAID Program	WASH-FIN (Tetra Tech)
Value Chain Actor	Anserer Limited Nakuru Sanitizers

MOZAMBIQUE

Category	Organization
Donor	Department for International Development (now the Foreign, Commonwealth & Development Office)
Donor	World Bank
Multilateral Institution	UNICEF
NGO	SNV
USAID Program	WASH-FIN (Tetra Tech)
Value Chain Actor	Maeva Group

In Mozambique, the assessment team also interviewed 30 private water system operators randomly selected from the SINAS dataset. Their locations are mapped in Figure 14 below.

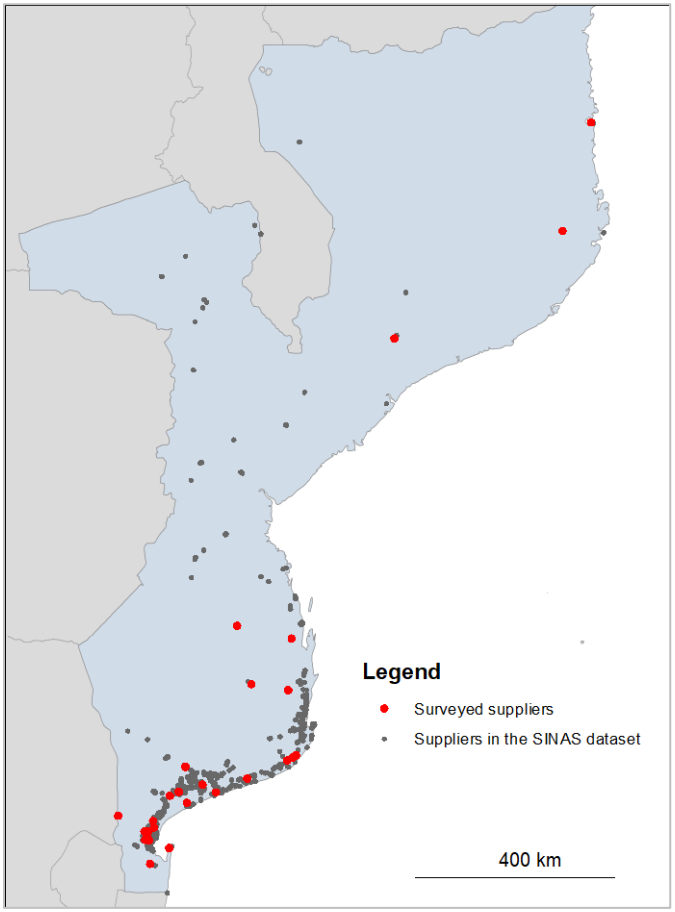

Figure 14. Distribution of 30 Mozambican small private water providers interviewed in August 2020.

*Data source: the SINAS dataset at **www.sinasmz.com**.*

NEPAL

Category	Organization
Central Government	Department of Water Supply and Sewerage Management
Central Government	Ministry of Health
Central Government	Ministry of Physical Infrastructure Development
Central Government	Ministry of Water Supply
Central Government	National WASH Cluster Secretariat
Donor	Asian Development Bank
Donor	Embassy of Finland
Donor	Islamic Development Bank
Multilateral Institution	UNICEF
Multilateral Institution	World Bank
Multilateral Institution	World Health Organization
NGO	Environment and Public Health Organization
NGO	iDE Nepal
NGO	KIRDARC (Karnali Integrated Rural Development and Research Center)
NGO	MHM Alliance
NGO	MITRA Samaj
NGO	Nepal Water for Health
NGO	OXFAM
NGO	Plan International
NGO	SAFAA PAANI
NGO	Save the Children
NGO	SNV
NGO	WaterAid
NGO	Women for Human Rights
Researcher	Tribhuwan University
Service Provider	Fecal Sludge Treatment Plant: Lubhu (Mahalaxmi)
Service Provider	Fecal Sludge Truck Operator
Service Provider	Janakpur Zonal Hospital, Janakpur, Province 2
Service Provider	Koshi Zonal Hospital, Biratnagar Province 1
Service Provider	Nepal CRS Company
Service Provider	Nilakantha Natural Spring Water
Service Provider	Rural Village Water Resources Management Project
Service Provider (Association)	Nepal Water Tanker Transportation Association & Siddhartha Khanepani Transportation Services
USAID Program	TAYAR (DAI)
Value Chain Actor	Asian Pharmaceutical Pvt. Ltd & Universal Formulation Pvt. Ltd
Value Chain Actor	Cement Distributor, Pokhara
Value Chain Actor	Gangajal Minerals Pvt. Ltd.
Value Chain Actor	Greenberry Minerals Industries
Value Chain Actor	Jasmine Hygiene
Value Chain Actor	Karmacharya Group
Value Chain Actor	Mahashakti Soap and Chemicals
Value Chain Actor	Mott McDonald
Value Chain Actor	Radha Paudel Foundation
Value Chain Actor	Sonapur Cement
Value Chain Actor	Unilever Nepal

RWANDA

Category	Organization
Donor	JICA
Donor	World Bank
NGO	Catholic Relief Services (CRS)
NGO	SNV
NGO	WaterAid
NGO / USAID Program	Gikuriru (CRS)
NGO / USAID Program	Isuku Iwacu (SNV)
Service Provider	WASAC
Service Provider (Association)	FEPEAR
Value Chain Actor	Iwacu Soap
Value Chain Actor	Mount Meru Soyco
Value Chain Actor	Sulfo Industries

SENEGAL

Category	Organization
Central Government	National Sanitation Office of Senegal
Central Government	National Water Company of Senegal
Central Government	Office of Rural Drilling
Donor	AFD
Multilateral Institution	UNICEF
NGO	OXFAM
NGO	World Vision
Service Provider	Delvic
Service Provider	FLEX'EAU
Service Provider	National Water Partnership Senegal - Global Water partnership West Africa
Service Provider	SEOH
USAID Program	ACCES (NRCE)

APPENDIX 2. SMS SURVEY INSTRUMENT

ENGLISH VERSION (USING THE GHANA SURVEY'S OPTION FOR LOCATION OF RESIDENCE)

Q #	Q Name	English	Skip Pattern
NA	Opt-In-Incentive	GeoPoll: Reply 1 to answer questions on Coronavirus and earn #TOPUP# ! No cost to reply. For help reply HELP	1 = BirthYear HELP = Help
NA	Help	GeoPoll is a global network of people shaping their community by answering short surveys. Free to respond. Reply STOP to Opt-Out. Visit GeoPoll.com for info	1 = BirthYear STOP = Refusal
NA	Refusal	Thank you for your time, you will be removed from today's survey. For more information or to register for future surveys please visit GeoPoll.com	End poll declined
NA	Ineligible	You are ineligible for this survey. For more information on Coronavirus prevention visit who.int	End poll ineligible
1	BirthYear	In what year were you born? Reply with a four-digit number like 1980.	1900-1919 = Ineligible 1920-2005 = Gender 2006-2020 = Ineligible
2	Gender	Are you male or female? Reply with 1 or 2. 1)Male 2)Female	1-2 = ADM-1
3	ADM-1	What Region do you currently live in? 1)Ashanti 2)Brong-Ahafo 3)Greater Accra 4)Central 5)Eastern 6)Northern 7)Western 8)Upper East 9)Upper West 10)Volta	1-10 = Urban/Rural
4	Urban/Rural	Do you live in a urban or rural area? Reply with 1 or 2. 1)Urban area 2)Rural area	1 = Migrate 2 = Employment
5	Migrate	Has COVID-19 and the lockdown led you to move to a new home? 1)Yes - Within my city/town 2)Yes - Outside of my city/town 3)No - I still live in the same place	1-3 = Employment

Q #	Q Name	English	Skip Pattern
6	Employment	Has COVID-19 changed your employment? 1)No - It is the same 2)Yes - I earn less money 3)Yes - I lost my job 4)Yes - I got a new job 5)Yes - I earn more money	1-5 = Business1
7	Business1	Before COVID-19, did you run a business (not a farm)? Reply with 1 or 2. 1)Yes 2)No	1 = Business2 2 = WaterChange
8	Business2	How has COVID19 affected your business? 1)More income 2)No change 3)Income dropped a little 4)Income dropped a lot 5)I closed my business	1-5 = WaterChange
9	WaterChange	Has COVID-19 made it more difficult to get your drinking water? Reply with 1 or 2. 1)Yes 2)No	1 = WaterChangeHow 2 = Toilet
10	WaterChangeHow	How is it more difficult to get your drinking water? 1)I have less money to pay for it 2)Prices are up 3)It is harder to find 4)I must travel further to get it	1-4 = PreWaterSupply
11	PreWaterSupply	Before COVID-19, how did you get your drinking water? 1)Piped connection 2)Well 3)Bottled water/sachet 4)Tanker 5)Cart vendor 6)Rainwater 7)Spring 8)River/pond	1 = PipeDetails 2 = WellDetails 3 = BottlewaterDetails 4 = CurrentWaterSupply 5 = VendorDetails 6 - 8 = CurrentWaterSupply
12	PipeDetails	Where is the pipe that you use? Reply with 1 or 2. 1)In my home or compound 2)I must walk to it	1-2 = CurrentWaterSupply
13	WellDetails	Where is the well that you use? Reply with 1 or 2. 1)In my home or compound 2)I must walk to it	1-2 = WellDetails2

Q #	Q Name	English	Skip Pattern
14	WellDetails2	How do you get your water from the well? 1)With a handpump 2)With a diesel pump 3)With a rope and bucket 4)Not sure/other	1-4 = CurrentWaterSupply
15	BottlewaterDetails	Has getting bottled or sachet water changed since COVID arrived? 1)More expensive 2)Less expensive 3)Harder to find 4)Easier to find 5)No change	1-5 = CurrentWaterSupply
16	VendorDetails	Has buying water from vendors changed since COVID arrived? 1)More expensive 2)Less expensive 3)Harder to find 4)Easier to find 5)No change	1-5 = CurrentWaterSupply
17	CurrentWaterSupply	How do you get your drinking water now? 1)Piped connection 2)A well 3)Bottled water/sachet 4)Tanker truck 5)Vendor 6)Rainwater 7)Spring 8)River	1-8 = WaterService
18	WaterService	What else makes getting water difficult now? 1)Fewer hours per day of service 2)Problems take longer to be fixed 3)I am afraid of waiting in a queue 4)No change	1-4 = WaterShort
19	WaterShort	In the past week, was there a day when you couldn't get enough water to meet your household's needs? Reply with 1 or 2. 1)Yes 2)No	1-2 = Toilet
20	Toilet	Before COVID arrived, what kind of toilet did you use? 1)A private one at home 2)One I share with a few other households	1-4 = Toilet2

Q #	Q Name	English	Skip Pattern
		3)A public community toilet 4)None	
21	Toilet2	What kind of toilet do you currently use? 1)A private one at home 2)One I share with a few other households 3)A public community toilet 4)None	1-3 = Toilet3 4 = Handwashing
22	Toilet3	Does the toilet you use most of the time include a septic tank or pit? 1)Yes 2)No 3)Not sure	1 = PitEmptying1 2-3 = Handwashing
23	PitEmptying1	Do you pay someone to empty your latrine pit or septic tank when it is full? Reply with 1 or 2. 1)Yes 2)No	1 = PitEmptying2 2 = Upgrade
24	PitEmptying2	Since COVID arrived, have you had trouble emptying your full latrine pit or septic tank? 1)Yes 2)No - I haven't tried to empty it 3)Pit/tank not yet full	1 = PitEmptying3 2-3 = Upgrade
25	PitEmptying3	How has emptying your latrine pit or septic tank changed since COVID arrived? 1)I cannot afford it 2)The service is no longer available in my area 3)Other	1-3 = Upgrade
26	Upgrade	Since COVID arrived, have you had trouble buying, installing, or upgrading a latrine? 1)Yes 2)No 3)Did not try to buy/install/upgrade since COVID arrived	1 = Upgrade2 2-3 = Handwashing
27	Upgrade2	How has buying, installing, or upgrading a latrine changed since COVID arrived? 1)I cannot afford it 2)I cannot find anyone who is selling what I need 3)Other	1-3 = Handwashing
28	Handwashing	Do you notice your neighbors and friends washing their hands with soap more often than before COVID-19? 1)Much more 2)A bit more 3)The same amount 4)Less	1-4 = Handwashing2
29	Handwashing2	How do you usually wash your hands? 1)With water	1-3 = Handwashing3

Q #	Q Name	English	Skip Pattern
		2)With water and soap 3)With water and sand/ash/other	
30	Handwashing3	Since COVID arrived, has it become easier or more difficult for your family to obtain any kind of soap to wash hands? 1)Easier 2)Harder 3)About the same	1 = Handwashing4 2 = Handwashing5 3 = Close-out-Incentive
31	Handwashing4	What has made it easier to obtain soap for handwashing? 1)Lowered prices 2)Free give-aways 3)Other	1-3 = Close-out-Incentive
32	Handwashing5	What has made it harder to obtain soap for handwashing? 1)Higher prices 2)Shops ran out of it 3)Shops don't sell it 4)Shops selling it have closed	1-4 = Close-out-Incentive
NA	Close-out-Incentive	GeoPoll: Thank you! You will receive #TOPUP# airtime credit within 2 days. For more information on Coronavirus prevention visit who.int	

APPENDIX 3. ECONOMETRIC MODEL

By estimating income effects on WASH access, the assessment team offers forecasts of changes in access to WASH services that result from COVID-19 economic shocks.

Historical correlations are not always helpful for predicting causal effects immediately after a decline in income. For example, wealthy, educated, and urban people tend to have better water and sanitation services; even after an income shock, these groups may well continue to enjoy favorable WASH outcomes. Similarly, when a poor rural migrant moves to the city, they may move to a slum with water and sanitation services below the urban average. In addition, piped water and sanitation to a home usually require a fixed cost, so access will not necessarily decline right away following a drop in income. As discussed in this report, utilities in many countries offered tariff holidays and/or are not shutting off connections for unpaid bills during the crisis. Finally, people develop habits and norms; many will work hard not to lose piped water and sanitation. They may pay more to **keep** services than they would have initially paid to **gain** services.

On the economic side, since the assessment team does not have recent income and WASH microdata from the high-priority and strategy-aligned countries, the team looked at wealth (asset ownership) to define an upper bound on income effects. On the WASH side, while many households in low-income countries may employ complex strategies to meet their water and sanitation needs, the assessment must largely rely on datasets that survey only a single drinking water source and a single sanitation source.

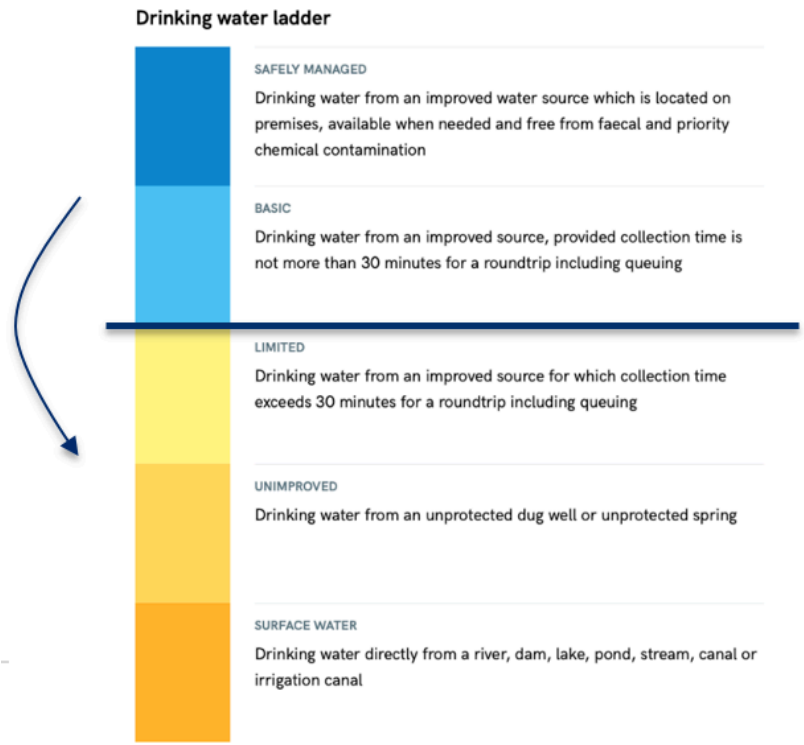

Figure 15. The UNICEF/WHO Joint Monitoring Program (JMP) water service ladder.

The arrow corresponds to the shift from above to below the threshold between "basic" and "limited" levels.

The assessment team assigned DHS and MICS water and sanitation modalities to JMP ladder rungs (Figure 15) as well as a numeric score, as indicated in Table 2 and Table 3.

Table 2. JMP Level and model numeric score associated with a MICS/DHS water supply category.

Modality	JMP Level	Numeric score
Piped into dwelling	Safely managed	1
Piped to yard/plot, tube well, rain	Basic or Limited	0.9
Piped to neighbor, bottled water	Basic or Limited	0.8
Public tap/standpipe	Basic or Limited	0.6
Water kiosk, sachet water	Basic or Limited	0.6
Protected well or spring	Basic or Limited	0.5
Tanker truck	Basic or Limited	0.5
Cart with small tank	Basic or Limited	0.4
Unprotected well	Unimproved	0.3
Unprotected spring	Unimproved	0
Surface water, other	Surface water	0

Table 3. JMP Level and model numeric score associated with a MICS/DHS sanitation category.

Sanitation access	JMP Level	Numeric score
Piped sewer	Safely managed	1
Septic tank	Safely managed	0.9
Ventilated improved pit latrine, Composting toilet	Basic or Limited	0.8
Pit latrine with slab	Basic or Limited	0.6
Flush to open drain or don't know where	Limited	0.5
Pit Latrine (slab not mentioned)	Unimproved	0.4
Pit latrine without slab/open pit	Unimproved	0.3
Bucket, hanging toilet, don't know	Unimproved	0.1
Open defecation, other	Open defecation	0

To estimate how COVID-19 has affected incomes, the assessment began with the World Bank's June 2020 forecasts of GDP. The income shock is expressed in percent changes. The wealth quintiles are in centiles of the wealth distribution. The assessment uses World Bank estimates of Gini coefficients[8] to capture the distribution of income,[9] simulating what percent change in income led to a quintile change in income matching each Gini coefficient. For example, Kenya's Gini coefficient of 40.9 is consistent with a decline in income of 8 percentage points, corresponding to roughly a 5 percent lower position in the income distribution, equal to about one-fourth of a quintile. (The team's results were not very sensitive to measures of inequality.) The team assumes that wealth quintile reflects that of the permanent income distribution; that is, long-run average income.

[8] The Gini coefficient was developed as a measure of inequality in an income distribution, with values theoretically ranging from 0 (where all incomes are equal) to 1 (where all income is collected by a single actor, and everyone else earns nothing). Gini coefficients are sometimes expressed in a range from 0 to 100. Corrado Gini, 1912. "Concentration and dependency ratios" (in Italian). English translation in *Rivista di Politica Economica*, 87 (1997), 769–789.

[9] Gini coefficients are drawn from: https://www.indexmundi.com/facts/indicators/si.pov.gini/map/africa, https://www.indexmundi.com/facts/nepal/indicator/SI.POV.GINI
Congo https://www.indexmundi.com/facts/congo/indicator/SI.POV.GINI
Kenya: https://wid.world/country/kenya/

The team specifies four models. The simplest, Model 1, captures the relationship between wealth and WASH:

$$\textit{numeric score (0 to 1)} = \beta\ \textit{wealth quintiles} \qquad (1)$$

The team also conjectured that WASH access score rises with wealth quintile in part because urban location correlates with both. Thus, the team employs Model 2:

$$\textit{numeric score (0 to 1)} = \beta\ \textit{wealth} + \gamma\ \textit{rural} \qquad (2)$$

The team further conjectured that WASH access score rises with wealth quintile partly because high education correlates with both. Thus, the team employs Model 3, which controls for education and other household factors:

$$\textit{numeric score (0 to 1)} = \beta\ \textit{wealth} + \gamma\ \textit{rural} + \delta_1\ \textit{wife \& partner education} + \delta_2\ \textit{HH size} + \delta_3\ \textit{\# children} + \delta_4\ \textit{male head of household} + \delta_5\ \textit{age of head of household} \qquad (3)$$

Finally, the team examines the role of neighborhood or village. Knowing someone's village or neighborhood allows reasonable predictions of their water or sanitation service level. For example, if a particular neighborhood or village is not served by piped water service, an change in wealth will rarely result in securing a piped connection.

The DHS and MICS collect multiple observations in a neighborhood or village (that is, they cluster observations in enumeration areas). In this model, Model 4, the team estimates the effect of wealth within a neighborhood or village, *n*, by permitting each neighborhood or village to have its own intercept, ϕ_n.

$$\textit{Numeric score} = \beta\ \textit{wealth} + \delta_1\ \textit{wife \& partner education} + \delta_2\ \textit{HH size} + \delta_3\ \textit{\# children} + \delta_4\ \textit{male head of household} + \delta_5\ \textit{age of head of household} + \Sigma_n\ \varphi_n \qquad (4)$$

This last model answers the question, "when a household is wealthier than its neighbors, how does its predicted water or sanitation access score change?" Finally: the team decides on an income shock, runs each model, and converts the predicted water and sanitation access scores changes into JMP ladder changes. The datasets used to establish the relationships are listed in Table 4.

Table 4. Model datasets employed for high priority and strategy-aligned countries.

Country	Dataset	# Households
Afghanistan	DHS 2015	24,395
Bangladesh	DHS 2014	17,300
Cambodia	DHS 2014	15,667
DRC	MICS 2017-18	20,810
Ethiopia	DHS 2016	16,650
Ghana	DHS 2019	5,799
Guatemala	DHS 2014-15	21,383
Haiti	DHS 2016-17	13,405
India	DHS 2015-16	601,509
Indonesia	DHS 2017	47,963
Jordan	DHS 2017-18	18,802
Kenya	DHS 2015	6,481
Lebanon	MICS 2011	5,190
Liberia	DHS (MIS) 2016	4,218
Madagascar	DHS (MIS) 2016	11,284

Country	Dataset	# Households
Malawi	DGS (MIS) 2017	3,729
Mali	DHS 2018	9,510
Mozambique	DHS 2018	6,196
Nepal	DHS 2016	11,040
Nigeria	DHS 2018	40,427
Philippines	DHS 2017	27,496
Rwanda	DHS 2017	5,041
Senegal	DHS 2018	4,592
South Sudan	MICS 2010	9,950
Uganda	DHS (MIS) 2018-19	8,957
United Republic of Tanzania	DHS (MIS) 2017	9,330
Yemen	DHS 2013	17,351
Zambia	DHS 2018	12,831

MODEL COEFFICIENTS

Table 5 presents all the USAID high priority and strategy-aligned country-specific coefficients from Model 1 and Model 4; Table 6 summarizes all models.

Table 5. Model coefficients and effect sizes for all USAID high priority and strategy-aligned countries.

Country	Coefficient (p.p. change in the top 2 JMP ladder rungs from a 1 quintile decline in wealth)				Effect Size (p.p. change in the top 2 JMP ladder rungs using GDP decline estimate)			
	Water, no controls	Water, within neighborhood	Sanitation, no controls	Sanitation, within neighborhood	Water, no controls	Water, within neighborhood	Sanitation, no controls	Sanitation, within neighborhood
Afghanistan	-0.03	-0.03	0.1	0.06	-0.17%	-0.17%	0.58%	0.35%
Bangladesh	-0.02	-0.05	0.13	0.04	-0.08%	-0.21%	0.54%	0.17%
Cambodia			0.18	0.03			1.01%	0.17%
DRC	0.04	0.02	0.04	0.03	0.13%	0.07%	0.13%	0.10%
Ethiopia	-0.02	0.02	0.08	0.02	-0.09%	0.09%	0.36%	0.09%
Ghana	-0.03	0.01	0.12	0.05	-0.08%	0.03%	0.33%	0.14%
Guatemala	-0.006	-0.019	0.09	0.03	-0.02%	-0.08%	0.37%	0.12%
Haiti	0.14	0.04	0.13	0.02	0.15%	0.04%	0.14%	0.02%
India	0.02	-0.02	0.18	0.04	0.18%	-0.18%	1.63%	0.36%
Indonesia	-0.04	-0.03	0.14	0.03	-0.17%	-0.13%	0.59%	0.13%
Jordan	-0.02	-0.05	0.02	0.02	-0.10%	-0.25%	0.10%	0.10%
Kenya	0.04	-0.01	0.11	0.04	0.10%	-0.02%	0.26%	0.10%
Lebanon	0.01	-0.06	0.05	0.09	0.09%	-0.55%	0.46%	0.82%
Liberia	0.04	0.05	0.16	0.02	0.02%	0.02%	0.06%	0.01%
Madagascar	0.06	0.01	0.04	0.02	0.22%	0.04%	0.15%	0.07%
Malawi	-0.01	-0.02	0.11	0.05	-0.02%	-0.04%	0.20%	0.09%
Mali	0.06	0.03	0.1	0.04	0.29%	0.14%	0.48%	0.19%
Mozambique	-0.02	0.01	0.15	0.07	-0.03%	0.01%	0.20%	0.09%
Nepal	-0.02	-0.03	0.06	0.03	-0.09%	-0.14%	0.28%	0.14%
Nigeria	0.02	-0.02	0.13	0.05	0.08%	-0.08%	0.49%	0.19%
Philippines	-0.04	-0.04	0.1	0.03	-0.30%	-0.30%	0.76%	0.23%
Rwanda	0.004	0.01	0.003	0.03	0.02%	0.04%	0.01%	0.13%
Senegal	0.03	0.007	0.18	0.04	0.11%	0.03%	0.67%	0.15%
South Sudan	0.01	0.03	0.04	0.05	0.04%	0.11%	0.14%	0.18%
Uganda	0.04	0.02	0.09	0.03	0.09%	0.04%	0.20%	0.07%
Tanzania	0.05	0.03	0.15	0.03	0.11%	0.06%	0.32%	0.06%
Yemen	-0.0001	-0.04	0.17	0.07	0.00%	-0.16%	0.68%	0.28%
Zambia	0.03	-0.01	0.11	0.03	0.09%	-0.03%	0.32%	0.09%
Mean	***0.013***	***-0.005***	***0.106***	***0.039***	***0.02%***	***-0.06%***	***0.41%***	***0.17%***
S.D.	***0.040***	***0.030***	***0.050***	***0.017***	***0.13%***	***0.15%***	***0.34%***	***0.15%***
Minimum	***-0.040***	***-0.060***	***0.003***	***0.020***	***-0.30%***	***-0.55%***	***0.01%***	***0.01%***
Maximum	***0.140***	***0.050***	***0.180***	***0.090***	***0.29%***	***0.14%***	***1.63%***	***0.82%***
Median	***0.010***	***-0.010***	***0.110***	***0.030***	***0.02%***	***-0.02%***	***0.33%***	***0.13%***
Pop.-weighted mean	***0.008***	***-0.017***	***0.146***	***0.038***	***0.07%***	***-0.13%***	***1.03%***	***0.25%***

Table 6. Model coefficients from the analyzed countries (27 for water and 28 for sanitation).

Values are medians, except where the team notes means for Models 1 and 4 and confidence intervals calculated via a random effects meta-analysis.[10]

	Decline in top 2 JMP ladder rungs (p.p. change due to 1 quintile loss in wealth)	Effect sizes for water score (0 to 1, for a 1 quintile wealth loss
A) Water		
Model 1: wealth only	0.01	0.07
Mean coefficient and 95% confidence interval	0.013 [-0.002 - 0.028]	0.062 [0.046, 0.078]
Model 2: wealth plus rural location		
• **wealth quintile**	0.01	0.06
• **rural**	-0.008	-0.07
Model 3: wealth plus education & household composition controls		
• **wealth quintile**	0.01	0.06
Model 4: wealth effects within neighborhood only		
• **wealth quintile**	-0.01	0.02
Mean coefficient and 95% confidence interval	-0.006 [-0.017 - 0.006]	0.02 [0.012 – 0.021]
# countries	27	27
B) Sanitation		
Model 1: wealth only	0.11	0.105
Mean coefficient and 95% confidence interval	0.106 [0.088 - 0.125]	0.105 [0.086 - 0.124]
Model 2: wealth plus rural location		
• **wealth quintile**	0.11	0.09
• **rural**	-0.02	-0.08
Model 3: wealth plus education & household composition controls		
• **wealth quintile**	0.08	0.08
Model 4: wealth effects within neighborhood only		
• **wealth quintile**	0.03	0.05
Mean coefficient and 95% confidence interval	0.038 [0.033 - 0.043]	0.54 [0.042 - 0.067]
# countries	28	28

[10] The team applied meta-analysis to identify the common effects across the 27 nations for the water analysis and the 28 nations for the sanitation analysis. Rather than compute a simple mean of the effect sizes, the team computed a weighted mean: With a random effects model, the team assumed that the true effect could vary from nation to nation. Thus the team assigned weight as $1/(\widehat{se_j}^2 + \hat{\tau}^2)$, where $\widehat{se_j}$ is the estimated standard error of each nation, $\hat{\tau}$ is the estimated true variance across nations. The mean effects from random effects meta-analysis are similar to the median effects across the nations. Results are robust to assuming a common effect and weighting by inverse standard errors.

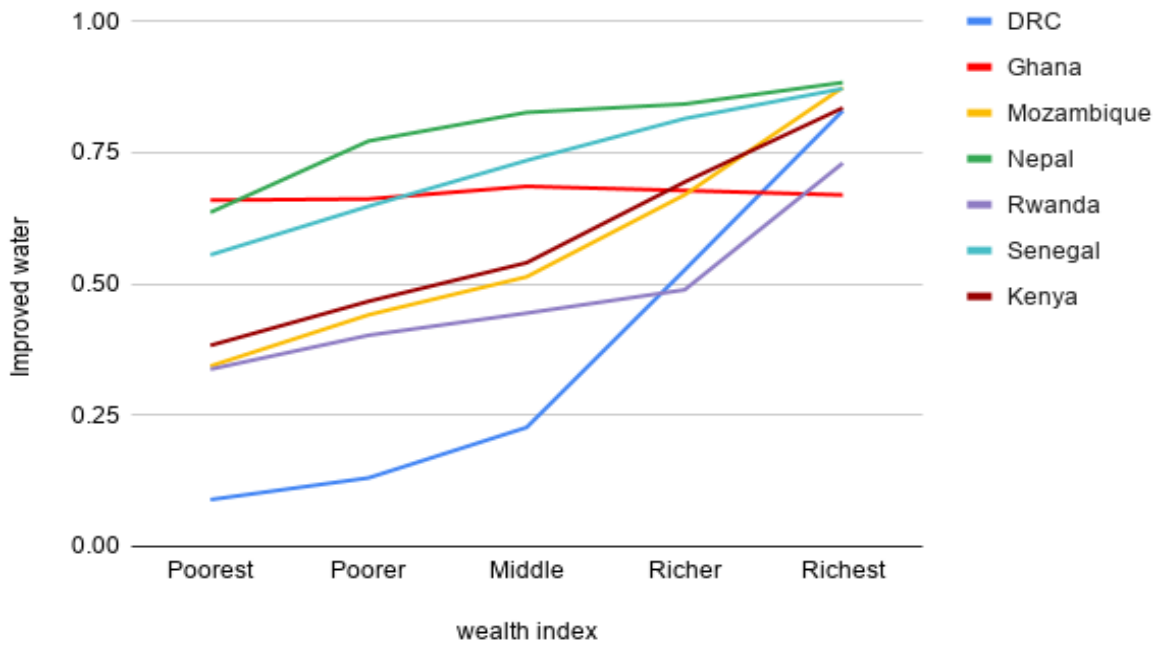

Figure 16. Water supply numeric score as a function of wealth quintile for the seven deep-dive countries.

As expected, both water and sanitation service levels tend to rise with wealth (see Figure 16 for the relationship for water supply score). These wealth effects are governed neither by residence in urban areas nor by education or other household effects, but they do appear to be strongly linked to neighborhood or village (although more so for water supply than for sanitation).

Across 27 countries, the median coefficient for water access score in Model 1, provided in both and Table 6, is 0.07, meaning that moving down from the bottom wealth quintile (quintile 1) up to quintile 2 increases a household's water access numeric score (see Table 2 and Table 3) by 0.07 (and moving from quintile 1 to quintile 5 predicts that a water score will rise by 0.28). In almost all the high-priority and strategy-aligned countries, this coefficient is positive.

For water supply, this access score response to wealth translates into JMP ladder change as follows: gaining one quintile in wealth predicts a one percentage point increase in the likelihood of water service level being Safely Managed or Basic (the top two rungs of the JMP ladder). For sanitation, the model finds that gaining one quintile in wealth predicts an 11 percentage point increase in the likelihood of sanitation service level being Safety Managed or Basic.

The effects of rural location on both water are very modest; the wealth effect on water access is slightly smaller in rural than urban areas (with the coefficient dropping from 0.07 to 0.06 for water and from 0.105 to 0.09 for sanitation). Importantly, Model 2 reinforces the point that the improvement in water or sanitation service level that comes with increased wealth is *not* due to the benefits a household might enjoy from urban residence vs. rural residence.

Model 3's results indicate that the wealth effect on service level is *not* a proxy for education.

Critically, the wealth effect nearly disappears within neighborhoods. Model 4 reinforces that if a household suffers a critical job loss but does not move out of their village or neighborhood, its water service level likely did not change. *There is a stronger wealth effect within neighborhoods for sanitation than for water, however. This result is consistent with the likelihood of more homogeneity of water access within a neighborhood than sanitation access within a neighborhood. That is, if some people in a neighborhood have piped*

water, very often they all do—a pattern that is likely less common for higher-quality sanitation, in particular when the service modality is onsite containment rather than piped sewer.

The team notes that estimates for JMP water ladder shifts are near zero (and often of an unexpected sign) because the assessment's specification registers no change for moving from piped water to a borehole (for example), making no distinction in terms of service quality. For example, Bangladesh has more piped water and less use of surface water for the top two quintiles than the bottom three, as expected; nevertheless, access to the top two JMP water ladder rungs is higher for the *bottom* three quintiles than the *top* two. That unexpected result holds because 94 percent of bottom three quintiles in Bangladesh rely on boreholes. ***Because of this pattern, especially for water, it is important to consult the coefficient for the assessment's numerical access score in addition to that for access to the top two JMP ladder rungs. (For sanitation, the coefficients for the two measures are very much in line).***

SIZE OF THE INCOME SHOCK

Although the exact size of the income shock from COVID-19 is unknown, one approach for estimating it is to compare the World Bank's estimate of GDP growth in 2019 versus their forecast (as of 8 June 2020) for growth in 2020. Table 7 presents those comparisons. The median 2019 estimated growth was 5.0 percent, while the median forecast for 2020 was -1.7 percent. The median country-specific year-on-year decline was 6.2 percentage points (slightly larger than the decline in the median).

Table 7. World Bank forecast GDP growth for USAID high-priority and strategy-aligned countries (as of 8 June 2020)[11]

Country	2019 GDP Estimate	2020 GDP Forecast	Estimated GDP Decline	Gini Coefficient	Population
Afghanistan	3.9	-5.5	9.4	40.95 [b]	32,890,171
Bangladesh	8.1	2	6.1	32.4	169,435,234
Cambodia	7.1	-2	9.1	40.95 [b]	15,288,489
DRC	4.4	-1.7	6.1	48.9	91,994,000
Ethiopia	9	2.3	6.7	35	100,829,000
Ghana	5.8	1.1	4.7	43.5	30,955,202
Guatemala	3.8	-3.5	7.3	48.3	16,858,333
Haiti	-1.4	-3.1	1.7	41.1	11,743,017
India	4.2	-9.6	13.8	35.7	1,368,145,959
Indonesia	5	-1.6	6.6	38.1	269,603,400
Jordan	2	-5.5	7.5	33.7	10,786,232
Kenya	5.4	1.5	3.9	40.8	47,564,296
Lebanon	-6	-19.2	13.2	31.8	6,825,442
Liberia	-2.3	-2.9	0.6	35.3	6,825,442
Madagascar	4.9	-1.2	6.1	42.6	26,251,309
Malawi	4.4	1.3	3.1	44.7	19,129,952
Mali	5.1	-2	7.1	33	20,250,833
Mozambique	2.2	-0.4	2.6	54	30,066,648
Nepal	7	0.2	6.8	32.8	29,996,478
Nigeria	2.2	-4.1	6.3	43	206,139,587
Philippines	6	-6.9	12.9	44.4	109,266,718
Rwanda	9.4	2	7.4	43.7	12,663,116
Senegal	5.3	-0.7	6	40.3	16,705,608
South Sudan			6.2[a]	46.3	13,249,924

[11] https://www.worldbank.org/en/publication/macro-poverty-outlook/mpo_ssa

Country	2019 GDP Estimate	2020 GDP Forecast	Estimated GDP Decline	Gini Coefficient	Population
Uganda	6.8	3.1	3.7	42.8	41,583,600
Tanzania	5.8	2.5	3.3	37.8	57,637,628
Yemen			6.2[a]	36.7	29,825,968
Zambia	1.4	-4.5	5.9	57.1	17,885,422

Notes:

[a] *The team imputed Gini coefficients for nations lacking an estimate (Afghanistan and Cambodia) as the median of the other nations.*

[b] *The team imputed GDP decline for nations lacking a GDP forecast (Yemen and South Sudan) as the median of other nations. Results were robust to dropping nations with missing data.*

The decline in growth forecast by the World Bank is similar to the IMF change in forecasts from January 2020 to June 2020 for all of sub-Saharan Africa.[12] This consistency provides some confidence in the World Bank forecasts, but economic forecasts are often inaccurate, even without a global pandemic. Forecasting in a time of COVID-19 is particularly challenging.[13]

The assessment team's position is that it is likely the economic shock (and resulting GDP decline) was larger than the World Bank June 2020 forecast. For example, the International Labour Organization estimates that earnings of informal sector workers in Africa would decline by 81 percent[14] in the first month of the crisis. Similarly, in April 2020 (after a month of lockdown) a telephone survey in Senegal found 88 percent of respondents reported lower incomes due to COVID-19.[15]

The assessment team's SMS phone surveys included a question on employment effects (see Figure 3). While phone and SMS surveys tend to oversample the literate and (by definition) those with telephones or charged cellular phones, they tend to miss the poorest. With that caution in mind, the median value for those reporting they had lost their employment entirely due to COVID as of August 2020 was 29 percent.

Unless the COVID-19 crisis is very brief, the large income declines found in these surveys suggests a larger decline in GDP than the World Bank June 2020 forecasts. Consistent with this hypothesis of a worse shock, the IMF in June 2020 forecast GDP growth in India for 2020 at -4.5 percent.[16] Since then, India reported a "23.9% decline in gross domestic product in the June quarter from a year ago… [which] prompted banks like Nomura Holdings Inc. to downgrade their full-year forecasts for this year to -10.8%."[17]

South Africa also had a terrible second quarter of 2020: "Compared with the second quarter last year, South Africa's gross domestic product plummeted by 17.6%."[18] Consistent with what the assessment

[12] https://www.imf.org/en/Publications/WEO/Issues/2020/06/24/WEOUpdateJune2020

[13] https://www.imf.org/en/Publications/WEO/Issues/2020/06/24/WEOUpdateJune2020

[14] https://www.ilo.org/wcmsp5/groups/public/@dgreports/@dcomm/documents/briefingnote/wcms_743146.pdf

[15] https://www.cgdev.org/blog/five-findings-new-phone-survey-senegal

[16] https://www.imf.org/en/Publications/WEO/Issues/2020/06/24/WEOUpdateJune2020

[17] Anirban Nag, "India faces dwindling policy options after record GDP slump," Sept. 1, 2020. https://economictimes.indiatimes.com/news/economy/indicators/india-faces-dwindling-policy-options-after-record-gdp-slump/articleshow/77875349.cms

[18] Aaisha Dadi Patel and Gabriele Steinhauser, "South Africa's Economy Shrinks 51% as Lockdown Restrictions Hurt Businesses." *Wall St. Journal*. Sept. 8, 2020. https://www.wsj.com/articles/south-africas-economy-shrinks-51-as-lockdown-restrictions-hurt-businesses-11599563965?mod=searchresults&page=1&pos=2 Last accessed Sept. 8, 2020.

team found in the deep-dive countries, a nationally representative survey in South Africa "found that 27% of workers lost their income in April, while 47% of households ran out of money to buy food."[19]

More generally, the October 2020 IMF World Economic Outlook forecasts worse growth of GDP in 2020 in India than it did in July (by a very large -6.6 percentage points), but slightly *better* growth in sub-Saharan Africa (by +0.2 percentage points).[20]

If the actual income declines in high priority and strategy-aligned countries is twice the World Bank estimates in Table 7, then the team's prediction about how WASH access will decline will also be twice as large. Given the especially high decline in earnings reported in the SMS surveys in Figure 3, the GDP declines could easily be even larger.

The assessment team also cautions that GDP does not include remittances from abroad. Before COVID-19 struck, Nepal received about 25 percent of GDP as remittances.[21] Although India hosted the majority of Nepalese workers, migrant workers in Malaysia and the Middle East sent back the bulk of remittances, and Nepali press reports suggest very large declines in remittances.[22] If so, household income will fall faster than GDP in Nepal, perhaps almost doubling the size of the shock to incomes compared to the forecasted 6.8 percentage point decline in GDP reflected in Table 7.

In Africa, the World Bank expects the COVID shock to reduce remittances from abroad by less than 1 percent of GDP.[23] If so, the fall in remittances will not be as large as in the other high-priority and strategy-aligned countries as in Nepal. Ghana has the largest share of remittances among the African high-priority and strategy-aligned countries—about 5 percent of GDP in 2019. If remittances decline by 23 percent (as the World Bank forecasts for sub-Saharan Africa), the COVID-19 shock will lower household incomes in Ghana by an additional 1.2 percent of GDP (in addition to the -6.8 percentage point forecast decline in GDP reported in Table 7). In short, it is quite plausible that the decline in GDP in many nations is 50–100 percent larger than the estimates that the team employed in model calculations.

PREDICTED DECLINES IN WASH ACCESS DUE TO LOWER GDP

Table 8 highlights the median and population-weighted means of COVID-19 economic shock changes in water and sanitation access (which also appear in the bottom of Table 5). These are computed by multiplying the DHS or MICS cross-sectional estimates of how wealth predicts water and sanitation access (from Table 5) by the World Bank estimates of GDP changes (from Table 7). The team then converts percent changes in income into quintile changes in wealth. Model 1 estimates have no covariates, capturing how changes in permanent income predict water or sanitation. Model 4 estimates adjust for education and consider within-neighborhood effects only.

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[19] Aaisha Dadi Patel and Gabriele Steinhauser, "South Africa's Economy Shrinks 51% as Lockdown Restrictions Hurt Businesses." *Wall St. Journal*. Sept. 8, 2020. https://www.wsj.com/articles/south-africas-economy-shrinks-51-as-lockdown-restrictions-hurt-businesses-11599563965?mod=searchresults&page=1&pos=2 Last accessed Sept. 8, 2020.

[20] IMF, *World Economic Outlook*, Oct. 2020, p. 9. https://www.imf.org/~/media/Files/Publications/WEO/2020/October/English/text.ashx?la=en.

[21] "COVID-19 and Reverse Migration in Nepal" Upasana Khadka June 10th, 2020 https://blogs.eui.eu/migrationpolicycentre/covid-19-reverse-migration-nepal/

[22] For example, Gill and Sapkota suggest up to a million Nepalese are trying to repatriate. Peter Gill and Janak Raj Sapkota. "COVID-19: Nepal in Crisis." *The Diplomat.* June 29, 2020 https://thediplomat.com/2020/06/covid-19-nepal-in-crisis/ See also Meenakshi Ganguly. "Nepal Abandons Migrant Workers in Fight Against COVID-19" Human Rights Watch. March 31, 2020. https://www.hrw.org/news/2020/03/31/nepal-abandons-migrant-workers-fight-against-covid-19

[23] Kalantaryan, S. and S. McMahon, "Covid-19 and Remittances in Africa." European Commission Joint Research Center Technical report, 2020. https://publications.jrc.ec.europa.eu/repository/bitstream/JRC121055/remittances_in_the_context_of_covid_19_africa_12062020_final_online_clean.pdf

Table 8. Estimated decline in water and sanitation access (based on estimates from DHS or MICS cross section multiplied by World Bank estimates of income changes).

	Change in the top 2 JMP ladder rungs	
	Model 1: no controls	Model 4: effects w/in neighborhood only
Water Effects		
Median	0.02%	-0.02%
Pop.-weighted mean	0.07%	-0.13%
Sanitation effects		
Median	0.33%	0.13%
Pop.-weighted mean	1.03%	0.25%

These results provide a feel for the effect of a permanent loss in income equal to that forecast by the World Bank. Looking at Model 1 estimates with no controls (ignoring omitted variables, the time it takes to move to a new location, etc.), across nations, the median estimate of the COVID-19 shock is a change of 0.33 percent increase in the population falling below JMP basic sanitation levels (with a population weighted mean of just over 1 percent), and little to no change in access to the top two JMP water access ladder rungs. When results across the 27 nations for which the assessment team has water supply data and the 28 for which the team has sanitation data in Table 7, Model 1 estimates predict that 28.8 million people across the high-priority and strategy-aligned countries would drop below JMP Basic sanitation levels and 1.9 million would drop below JMP Basic water service levels (with India constituting the majority).

A perhaps more realistic short-run estimate, assuming no relocation and controlling for education and household size, is the Model 4 result of about 7.1 million people dropping below JMP Basic for sanitation and a no effective change in JMP Basic for water.

Table 9. Estimates of population dropping below JMP "Basic" service levels for water and sanitation. Deep-dive countries are highlighted in gray.

Country	Model 1 - Water	Model 4 - Water	Model 1 - Sanitation	Model 4 - Sanitation
Afghanistan	(56,956)	(56,956)	189,854	113,912
Bangladesh	(141,546)	(353,864)	920,048	283,092
Cambodia	-	-	153,781	25,630
DRC	123,693	61,846	123,693	92,769
Ethiopia	(89,543)	89,543	358,172	89,543
Ghana	(25,908)	8,636	103,631	43,179
Guatemala	(4,106)	(13,001)	61,584	20,528
Haiti	17,130	4,894	15,906	2,447
India	2,481,787	(2,481,787)	22,336,087	4,963,575
Indonesia	(453,623)	(340,217)	1,587,679	340,217
Jordan	(10,903)	(27,257)	10,903	10,903
Kenya	45,653	(11,413)	125,545	45,653
Lebanon	6,217	(37,302)	31,085	55,953
Liberia	724	905	2,895	362
Madagascar	57,729	9,622	38,486	19,243
Malawi	(3,464)	(6,928)	38,105	17,321
Mali	58,620	29,310	97,700	39,080
Mozambique	(8,004)	4,002	60,026	28,012
Nepal	(27,792)	(41,688)	83,375	41,688
Nigeria	155,263	(155,263)	1,009,211	388,158
Philippines	(330,618)	(330,618)	826,544	247,963
Rwanda	2,219	5,548	1,664	16,644
Senegal	18,620	4,345	111,719	24,827
South Sudan	4,695	14,086	18,781	23,476
Uganda	36,884	18,442	82,988	27,663
Tanzania	60,845	36,507	182,535	36,507
Yemen	(120)	(47,996)	203,982	83,993
Zambia	15,455	(5,152)	56,669	15,455
Total	1,932,953	(3,621,757)	28,832,649	7,097,792
Total excluding negatives	3,085,534	287,685	28,832,649	7,097,792
Mean	69,034	(129,348)	1,029,737	253,493
Std. Dev.	487,933	474,919	4,192,743	928,944
Minimum	(453,623)	(2,481,787)	1,664	362
Maximum	2,481,787	89,543	22,336,087	4,963,575
Median	1,472	(2,576)	100,665	37,794

APPENDIX 4: SANKEY DIAGRAMS FROM SMS SURVEYS

The Sankey figures presented below represent the change in water service type resulting from the COVID-19 pandemic, as reported by respondents of the SMS surveys. At left of each figure is the reported breakdown of supply modalities pre-COVID, and at right is the reported breakdown at the time the survey was administered. Modalities are arrayed vertically in decreasing levels of water service. Upward sloping curves from left to right indicate an increase in service level, and downward sloping curves indicate a decrease in service level. The steeper the curve, the more dramatic the service level change. Numbers within the columns refer to the total number of respondents reporting a particular service modality either pre-COVID (at left) or at present (at right).

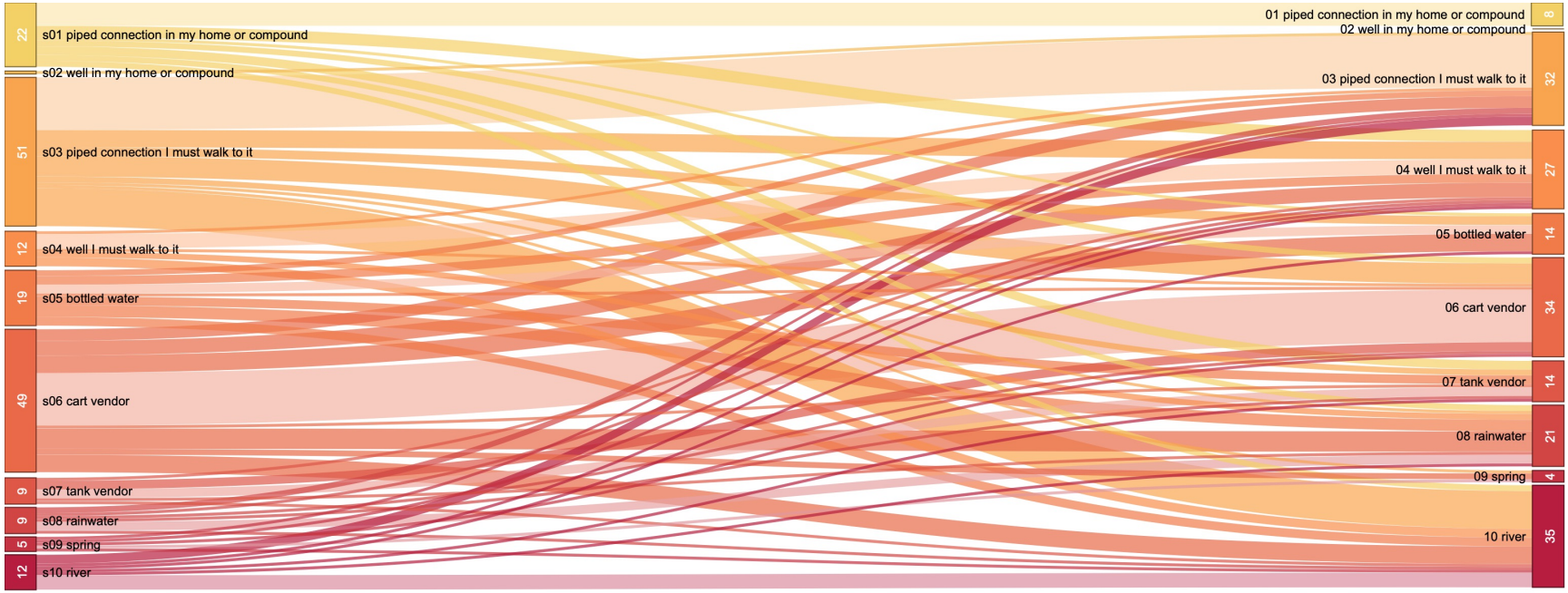

Figure 17. Kenya Sankey diagram.

Water modality changes reported by respondents to the SMS survey in Kenya among the subset of respondents who reported pandemic-driven water supply difficulties. The team notes the comparatively large number of respondents who reported moving from piped service, either to their home or nearby, to "river," in addition to a significant decline in reported use of cart vendors, split fairly evenly between those moving up on the ladder (to nearby standpipes – possibly those operated by water service providers on an emergency basis) and those moving down to surface waters.

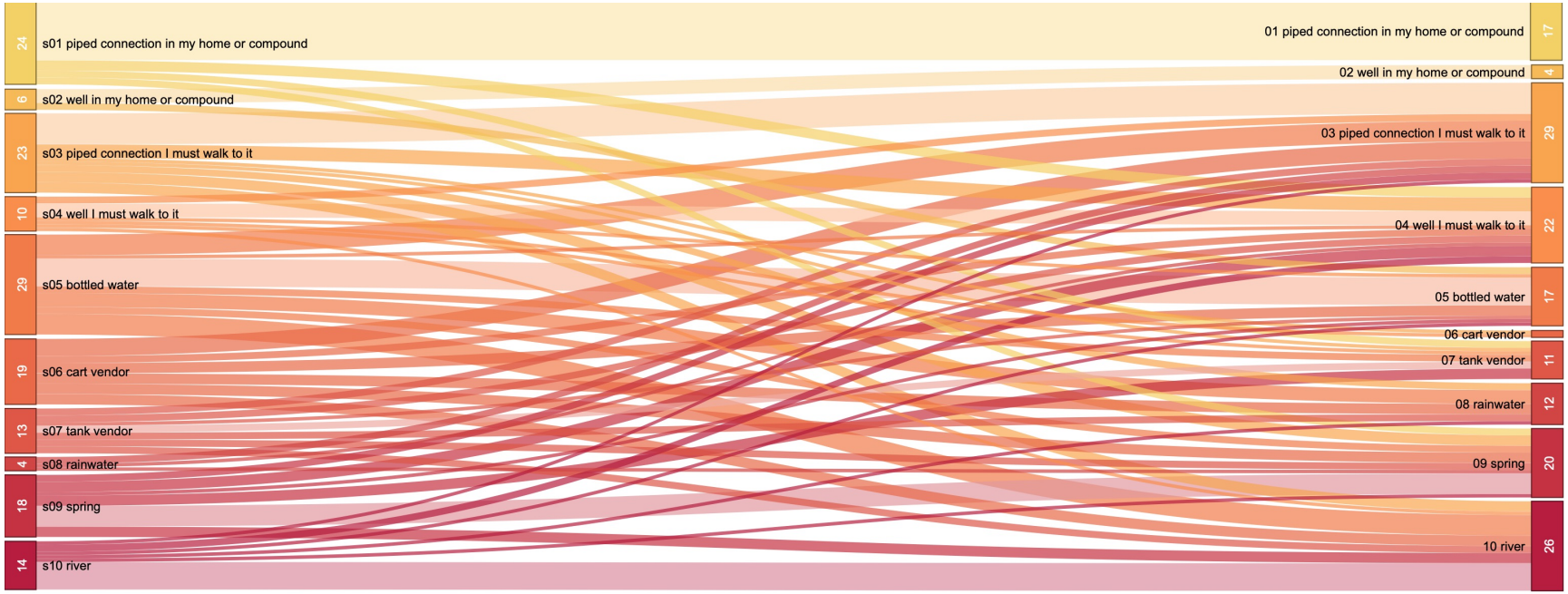

Figure 18. Rwanda Sankey diagram.

Water modality changes reported by respondents to the SMS survey in Rwanda among the subset of respondents who reported pandemic-driven water supply difficulties. The team notes, in addition to those reporting movement away from piped systems, the comparatively large number of respondents who reported corresponding increases in service level, particularly to piped connections within walking distance (possibly due to increased provision at emergency distribution sites).

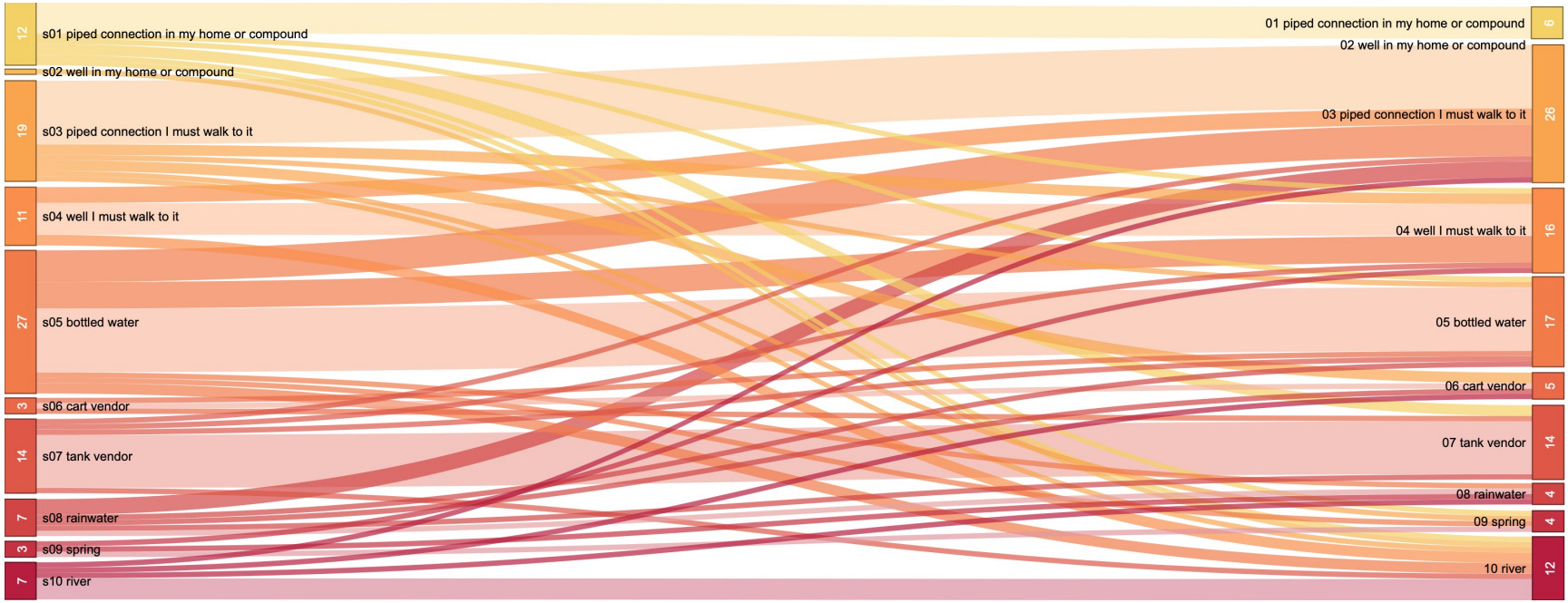

Figure 19. Ghana Sankey diagram.

Water modality changes reported by respondents to the SMS survey in Ghana among the subset of respondents who reported pandemic-driven water supply difficulties. Ghanaians reported the lowest amount of pandemic-linked water access difficulty of any of the deep-dive countries. What is notable here is the frequency of upward sloping curves in this subset – those who report water access difficulty but who have experienced an improvement in service level. The movement away from the bottled water category (more often "sachet" water in Ghana) is also notable, largely in the direction of standpipes or wells.

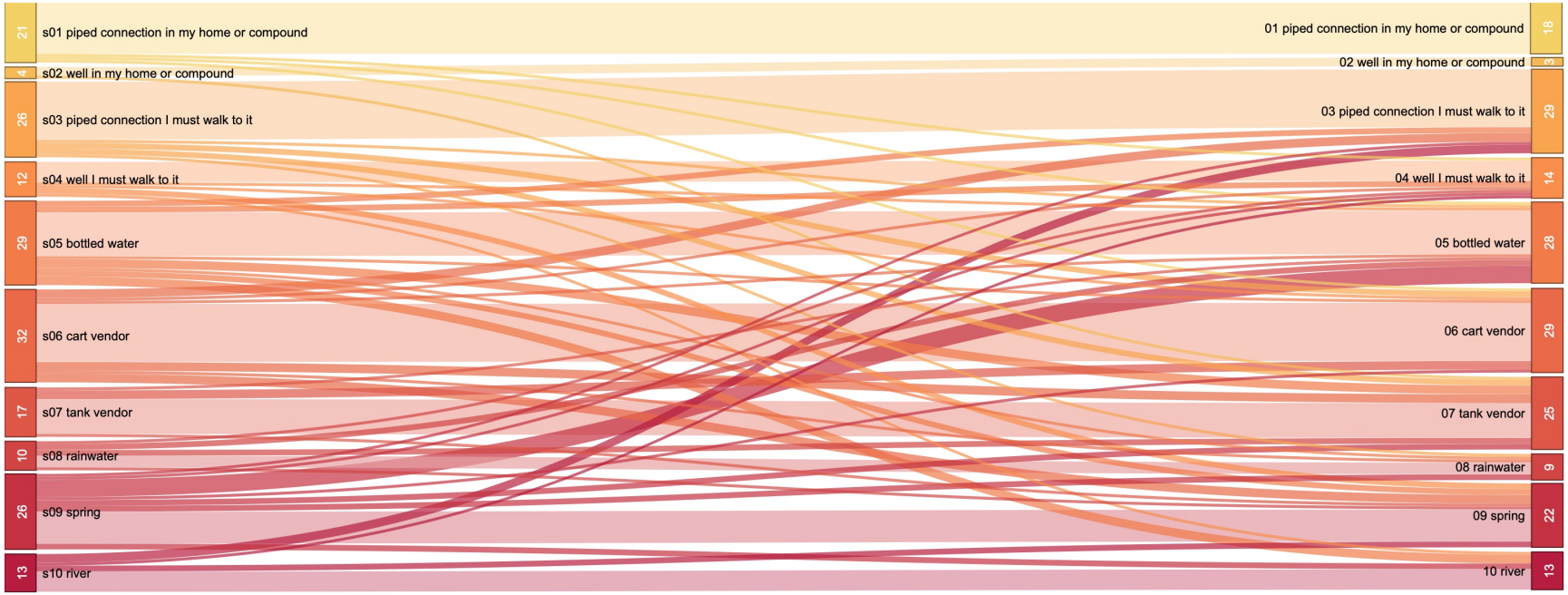

Figure 20. DRC Sankey diagram.

Water modality changes reported by respondents to the SMS survey in DRC among the subset of respondents who reported pandemic-driven water supply difficulties. The team notes how comparatively little change Congolese report compared to the patterns in the other countries.

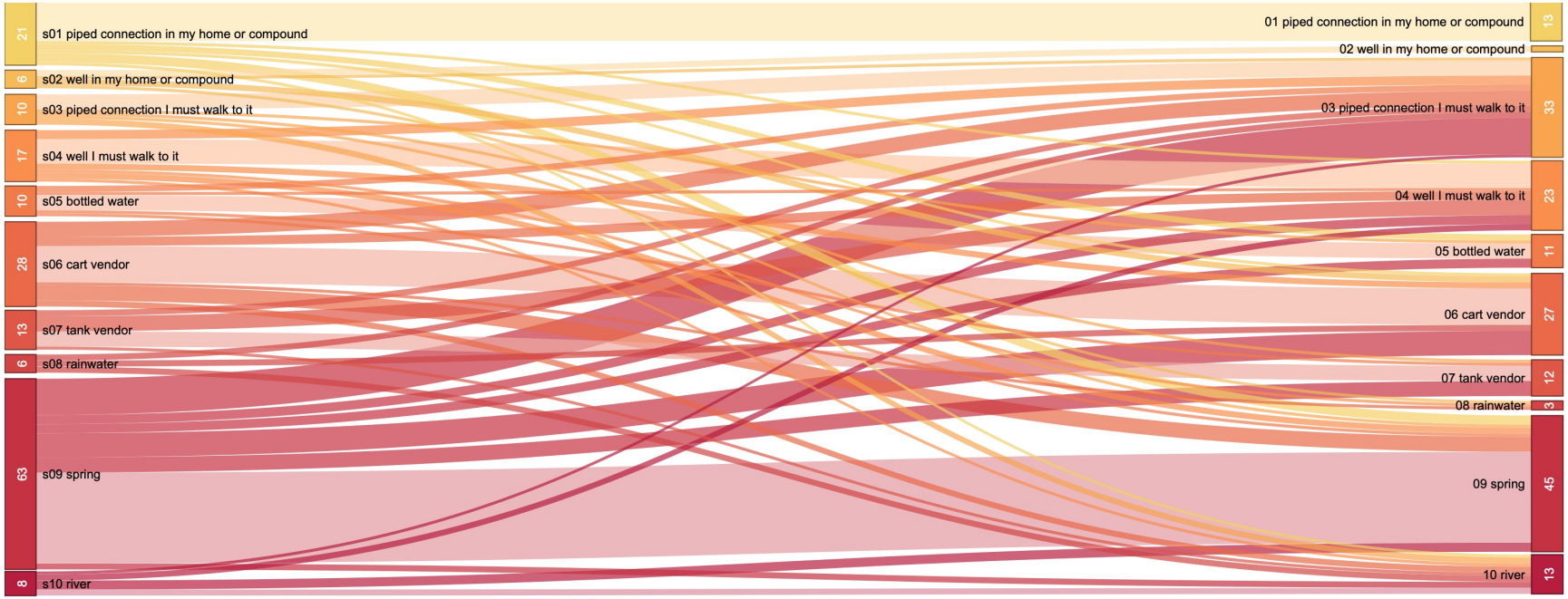

Figure 21. Mozambique Sankey diagram.

Water modality changes reported by respondents to the SMS survey in Mozambique among the subset of respondents who reported pandemic-driven water supply difficulties. The pattern in Mozambique is largely driven by progress up the ladder (away from springs in rural Mozambique and in the direction of standpipes), but also modest amounts of decrease in service level below the JMP "Basic" level (the Spring and River categories at left).

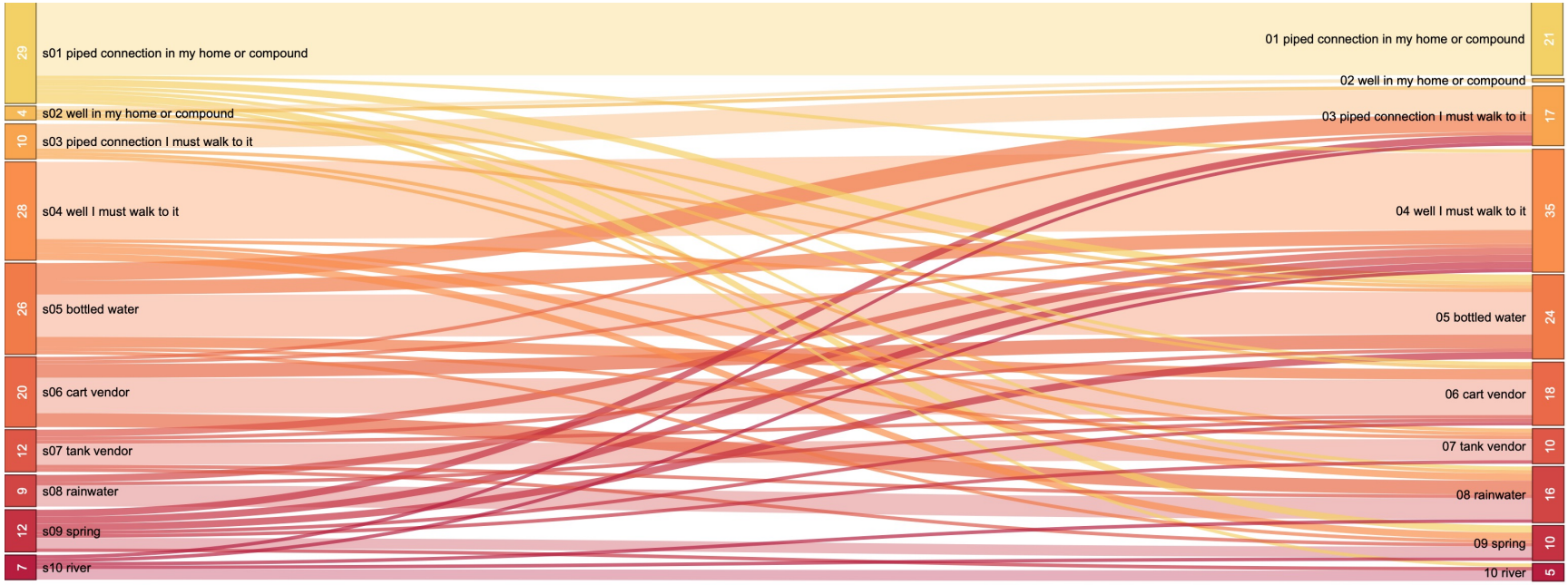

Figure 22. Senegal Sankey diagram.

Water modality changes reported by respondents to the SMS survey in Senegal among the subset of respondents who reported pandemic-driven water supply difficulties.

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