# Performance-based Funding for Reliable Rural Water Services in Africa

Working Paper | May 2019

## About 'Uptime'

**Uptime** is a global consortium working to deliver drinking water services to millions of rural people through long-term, performance-based funding to achieve Sustainable Development Goal 6.1.

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# Executive Summary

A graveyard of failed water supply infrastructure across Africa points to the legacy of well-meaning but poorly-executed investments. The enduring problem is that providing maintenance services to rural and remote populations is not financially viable in many contexts. Without credible data on observed delivery costs, government, donors, private finance or other investors cannot allocate current funding efficiently.

Despite financial risks and operational challenges, multiple service providers are innovating on service delivery approaches to improve financial and operational performance in "last mile" contexts. We report on major improvements in functionality of rural water infrastructure in Burkina Faso, Central African Republic, Kenya and Uganda achieved by performance-based providers where rural water users pay a share of the costs. This study provides preliminary evidence to support the case for a long-term, multi-country funding facility for SDG 6.1 delivery that "leaves no one behind".

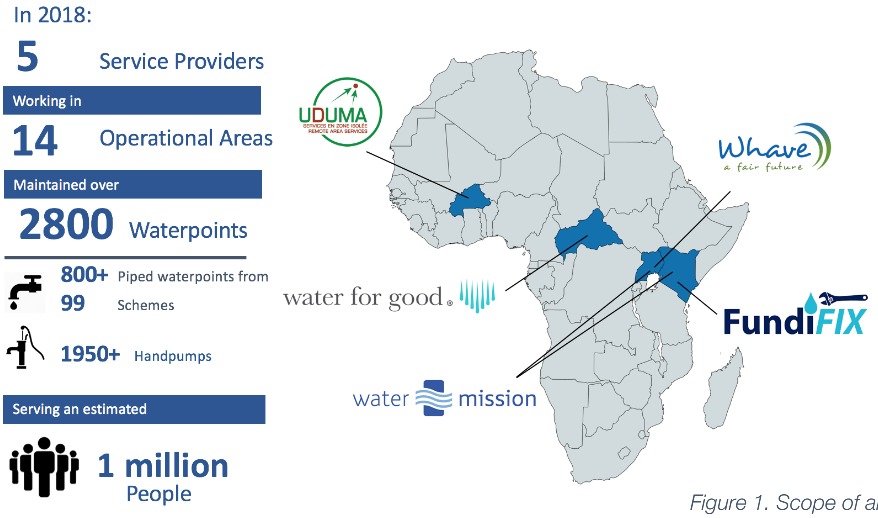



*Figure 1. Scope of analysis*

## Findings

### Waterpoints maintained by service providers were functional over 90% of the time, significantly outperforming the regional average.

Available figures indicate that service providers outperformed the regional functionality average by approximately 20 percentage points. Furthermore, service providers that provide rapid breakdown response in their service model repaired over 90% of breakdowns within 3 days.

### Rural water users paid some but not all of the costs.

Rural water users paid the service providers approximately USD 310,000 in 2018. Payment indicates there is demand for these services, but the revenue is insufficient to cover the full operating costs. Service providers incurred a combined shortfall of approximately USD 890,000. This analysis provides a local and short-term measure of financial sustainability (see methods, p.18).

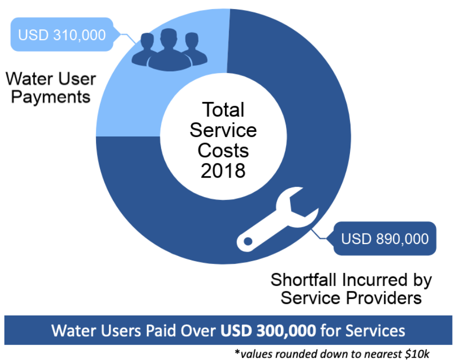



*Figure 2. Water user payments for services*

**Multiple factors influence levels of cost-recovery and most service areas do not break even on operating costs**. Working ratio calculates the proportion of operating costs covered by local customer revenues. Analysis includes the total direct and indirect costs incurred by an operational unit, excluding capital costs. Piped schemes show a range of working ratios, with some approaching or achieving operational cost-recovery. Handpump service areas show a financial shortfall in all cases, but remain a common source of water in rural areas where service providers operate. The range of observed working ratios also differs depending on other factors including payment methods and contracting arrangements.

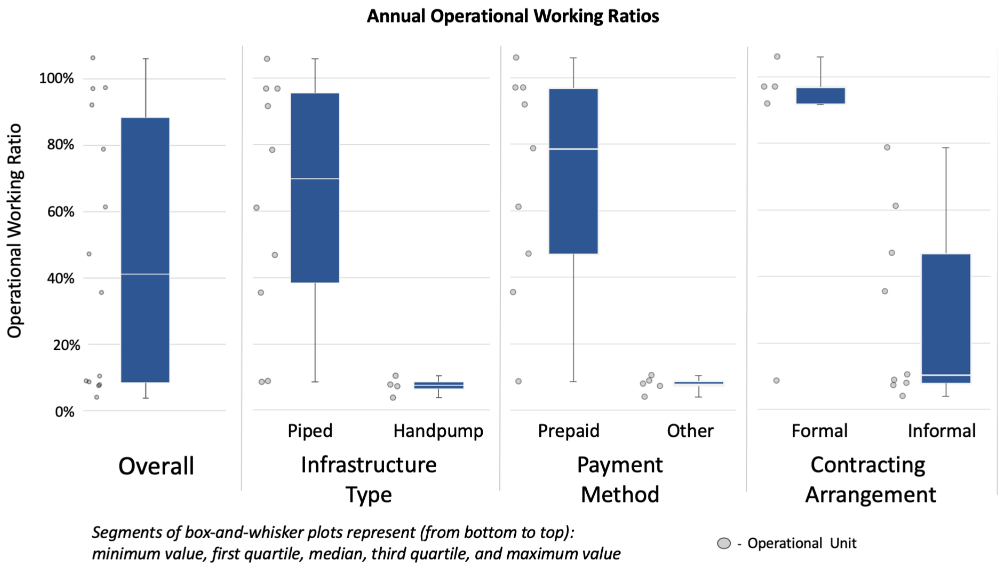



*Figure 3. Range of annual operational working ratios*

**Institutional design is a key determinant of operational and financial performance**. Where a service provider has a contracted delivery plan with government in an exclusive service delivery area, an acceptable tariff and clear performance targets the operational working ratio is more likely to break even. This applies to piped water systems where the known advantages of population density, on-site or nearby connections, water treatment and economies of scale provide comparative advantages to other alternatives. More generally, many service providers operate in contexts where government permits competition and provides no long-term commitment to the providers, creating operational uncertainty and reducing financial sustainability.

**The investment case must consider financial, economic and social impacts**. Commercial finance with positive returns is limited, except for particular conditions most applicable to piped water schemes, which do not apply to much of rural Africa. Selective bias to the minority of financially-attractive cases will limit prospects for universal service delivery. The positive social impacts of reliable water systems for women, pastoralists, children in schools and the sick at clinics, particularly in times of drought or places of conflict, underline significant non-financial benefits in the investment case for universal delivery.

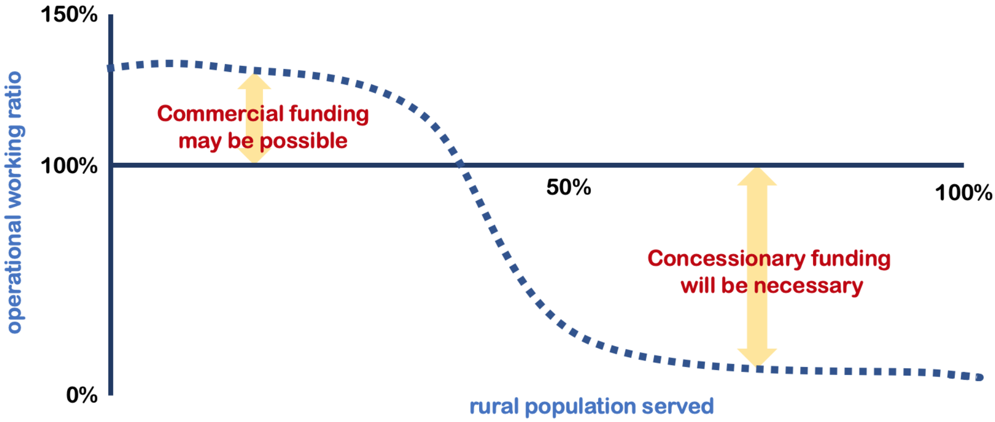



*Figure. 4. Funding characteristics by working ratio measures and progress to universal services*

## Conclusion

Sustainable financing of reliable rural water services requires three conditions to be satisfied: 1) appropriate institutional arrangements; 2) effective maintenance contracts; and 3) robust operational data. Fulfilling these requirements and implementing robust revenue collection systems could deliver high-quality services with concessional funding targeted towards areas of greatest need. Our analysis shows that all three requirements are achievable but not widely realized. If policymakers and funders commit to fulfilling these requirements, leaving no-one behind could become a reality.

# Background


**Sustainable Development Goal 6**: Ensure availability and sustainable management of water and sanitation for all

**Target 6.1**: By 2030, achieve universal and equitable access to safe and affordable drinking water for all

**Indicator 6.1.1**: Proportion of population using safely managed drinking water services

People do not value taps, pipes, pumps or kiosks; they want reliable, safe and affordable water every day. Maintenance services will be critical for achieving SDG 6.1. Whereas the Millennium Development Goal for water targeted access gains, the SDG goal commits to sustaining services – even in rural and remote areas. Reliable services will not happen automatically; maintenance is required, and maintenance requires resources (Figure 1).

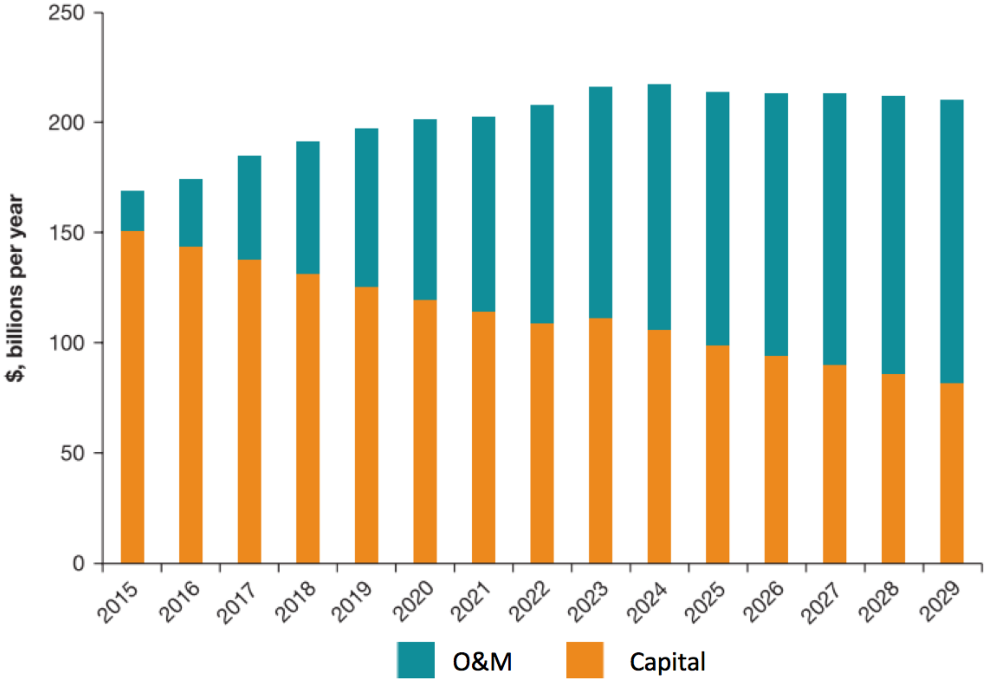



*Figure 1 – Projected need for increase in operations and maintenance (O&M) funding as capital investment needs decline towards 2030 (Hutton and Varughese, 2016)*

Maintenance may not be glamorous, but it is crucial. Infrastructure without maintenance undermines infrastructure investments, yet operations and maintenance services are commonly under-resourced. Part of the problem is that the true cost implications of wear and tear are difficult to measure and are often forgotten, even in more developed economies (*The Economist*, 2019). Without credible data on observed delivery costs, current funding is unlikely to be allocated efficiently or effectively by governments, donors, private finance, or other investors.

The enduring challenge is that providing maintenance services to rural and remote populations is not financially viable in many contexts. Gaps in resources for operations and maintenance persist with the expectation that costs will be fully borne by water users, even in remote and marginalized areas. This expectation is often unrealistic. The result is that, in sub-Saharan Africa, new waterpoints can break even within a year of being installed, and an estimated one quarter of handpumps do not work at any one time (Foster *et al*., 2019).

Extensive investment in now non-functional infrastructure represents both a challenge and an opportunity. The challenge is that most current maintenance efforts are not effective enough to safeguard reliable water services, and unreliable water services directly affect the poor and marginalized in rural areas. The opportunity is that, if maintenance efforts can be supported to work at scale, reliable rural water services could be ensured for hundreds of millions of people, disproportionately benefiting women, children and other vulnerable groups. For example, a woman is six times more likely to collect water in rural Africa than a man (UNDESA, 2015).

### Defining the challenge

A central challenge for investing in rural water maintenance is the lack of clear investment options that can guarantee results. Well-defined costs, benefits, and risks are needed to give funders of all types the confidence that they know what their money is buying. The need for clarity applies equally to both public and private funding sources, although the risk-return profiles differ. Currently, no scalable mechanism exists to invest in rural water maintenance to achieve reliable service outcomes.

> **Box 1: Definitions – Funding and Investment**
>
> This work pursues the goal of minimising the financial subsidy required to sustainably deliver improved water services in rural areas. The term 'investment', as used in this report, describes the funding required to deliver social, economic and environmental returns associated with SDG 6.1.

### Our central hypothesis

We believe that a maintenance-focused funding mechanism can attract investment and motivate higher levels of service provider performance to ensure reliable rural water services at scale. On the resource side, a clearly quantified opportunity to finance SDG outcomes could attract greater investment; on the service provider side, performance-based funding with the right incentives could motivate maintenance providers to both deliver results and continuously improve both services and cost-effectiveness.

### The immediate problem

The first problem is about information: a lack of reliable performance data obscures potential opportunities for translating resources into service outcomes. Any investment opportunity needs to quantify the outcomes, costs, and risks. Data on rural water services do exist, but these data are isolated and are not standardised, making it difficult to pool opportunities and risks into combined options for investing in SDG outcomes. One result is that limited information translates into limited investment.

### Study hypothesis

This study addresses issues of data gaps and standardisation. We believe it is possible to aggregate consistently-defined operational and financial performance data across different service providers in multiple contexts, and that quantifying the investment case is a first step towards the broader goal of financing reliable rural maintenance services at scale.

# Aim and questions

The study examines 12 months of operational and financial data from five service providers across four African countries to address two questions:

1. What data are available to assess the financial and operational performance of rural maintenance providers?
2. What performance metrics can be compared to inform an investment case to deliver SDG 6.1?

## Approach

This assessment was conducted over a three-month period from January-March 2019. Five service providers participated in this study by sharing quarterly operational and financial data for 2018. The five service providers are: FundiFix, UDUMA, Water for Good, Water Mission, and Whave. Analysis focused on fourteen discrete ‘operational units’ within these service providers in Burkina Faso, Central African Republic, Uganda, and Kenya.

**Service provider countries of operation**


**Approximate population served c. 1 million**

Although all service providers maintain rural water infrastructure, their operational units consist of different types of infrastructure, maintenance models, management models, and service mandates.

A proposed framework is used to briefly describe the characteristics of each service model:

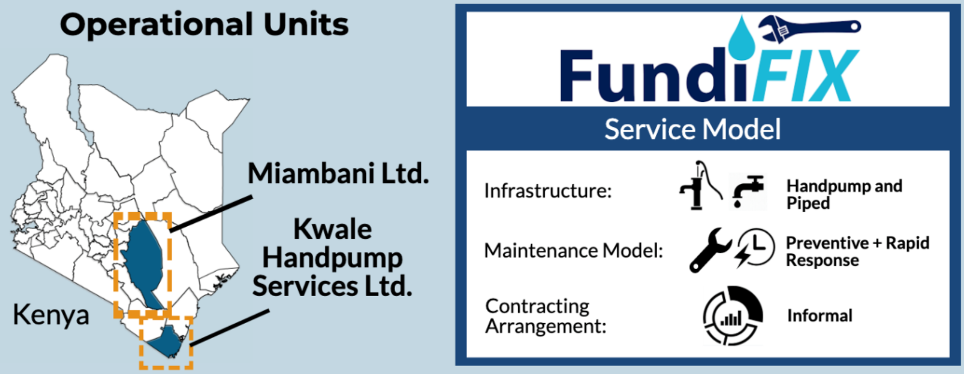
- Infrastructure – The types of technology being managed
- Maintenance model – The approach to providing services
- Contracting arrangement – The exclusivity and responsibilities in service delivery

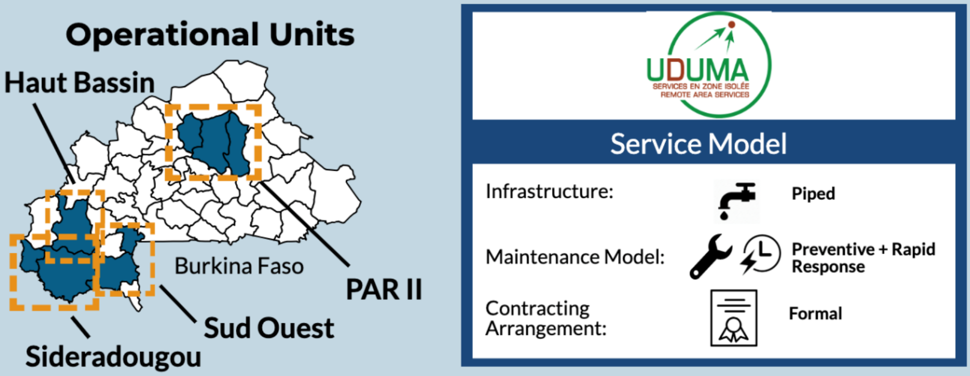
## Characteristics of Services

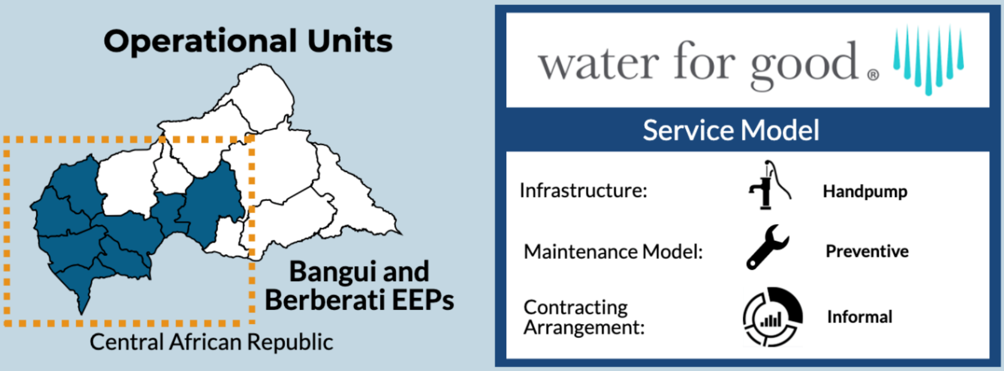
| | | |
|---|---|---|
| Infrastructure | **Handpump**<br>Manually operated handpumps | **Piped**<br>Piped water to households and communal waterpoints |
| Maintenance model | **Preventative**<br>Maintenance is performed regularly to prevent breakdowns | **Preventative + Rapid Response**<br>Regular maintenance AND rapid response to breakdowns |
| Contracting arrangement | **Formal**<br>Formal and enforced agreements with the government give the service provider exclusive rights and responsibilities | **Informal**<br>Service provider has ad hoc contracts with no defined service area and unclear regulation. Open to competition. |

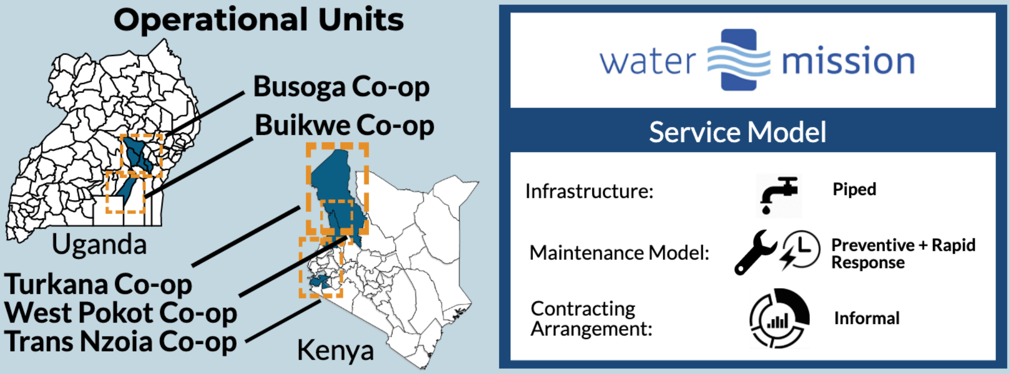
## Service Providers

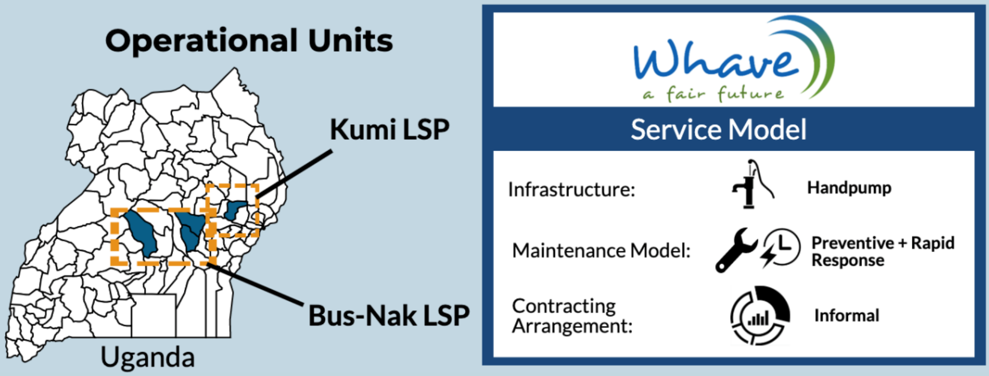
Fourteen operational units within five service providers are analysed in this study. Additional details about each service provider are provided in Appendix A.






# Findings

The findings are based on data that were provided by service providers and confirmed for accuracy to the extent possible, but some uncertainties remain due to the various data collection systems used by service providers and the inability to independently verify reported data. To aid the reader, we qualify the findings using levels of confidence as defined by the IPCC[1]: very high, high, medium, low, and very low.

| Confidence | Very High | High | Medium | Low | Very Low |
|---|---|---|---|---|---|

Findings first consider the suitability of various performance metrics based on the availability, accuracy, and potential ability to verify data. These performance metrics are then applied to the fourteen service provider operational units to assess their overall operational and financial performance.

1 Risbey & Kandlikar, 2007

## Data Availability

*Study Question 1: What data are available to assess the financial and operational performance of rural maintenance providers?*

Each service provider has its own unique data management systems, and assessment of these existing systems considers which indicators could form the basis for common analysis. Three aspects of existing data were considered to identify potential performance indicators: 1) alignment with SDG 6.1.; 2) scope of monitoring; and 3) frequency of monitoring. The result is a matrix of data availability that informs selection of key performance indicators for subsequent assessment (Appendix B).

### Reliability, as measured by uptime and repair time, is proposed as the key operational performance metric

Both uptime and breakdown duration are calculated from records of breakdown incidents and their durations. Uptime calculates the time that infrastructure is functional out of the total time possible, and breakdown duration calculates how quickly non-functional infrastructure is repaired. These metrics are superior to functionality spot checks because calculating both uptime and breakdown durations requires a continuous record of whether infrastructure is functional.

Uptime – The proportion of time that infrastructure is functional out of the total time possible.

Breakdown duration – Breakdown records can be analysed in several ways, including the calculation of the proportion of total breakdowns that are repaired in a given time period.

Both uptime and breakdown duration are needed to produce a reliability assessment. Uptime is a useful metric because it demonstrates the benefit of preventive maintenance, but a small number of long breakdowns might be hidden by an otherwise high overall uptime value. Breakdown duration therefore provides complementary analysis by assessing how many breakdowns remain unresolved over which length of time. Together, uptime and breakdown duration can determine whether infrastructure is reliably functional and whether faults are being managed promptly.

### Scale of services can be quantified by number of waterpoints and population metrics

The two other relevant operational performance metrics are number of waterpoints and estimated population served. These metrics consider the scale of services delivered.

Number of waterpoints – This metric simply counts the amount of infrastructure being managed by a service provider. Waterpoints in this study are either handpumps or distribution points in a piped network, which can be either communal or private. Counting infrastructure is straightforward; the challenge is determining what is included in a service program. This number can be dynamic for service providers working in a context of informal contractual arrangements where infrastructure is included or dropped from a service program on a rolling basis.

Population – Every service provider can produce a population estimate, but the accuracy of these values is unconfirmed. Reporting 'beneficiary' populations is a common practice in the water sector, and therefore might have relevance, but the uncertainty around these figures needs to be transparent. Margins of error can represent huge variation when considering services at scale.

### Additional performance metrics could be assessed in future work

Additional data could be gathered in future work. Other metrics, such as production volume on handpumps, could begin to be collected in the near future with investment in technology and data collection systems.

Infrastructure location – All service providers have geospatial data on the waterpoints they manage. Future reporting could include the number of waterpoints serving institutions such as schools and health centres.

**Production volume** – Piped schemes in the study typically have flow meters but handpumps do not. Piped water volume can be quantified, but a total volumetric value is not provided in this study because of uncertainty in handpump volume estimates. Future work could explore how the application of both new and existing technologies might either measure or accurately estimate handpump volumetric use at scale (see Box 2).

**Water quality** – All service providers measure water quality to varying degrees, even if they are not explicitly responsible for water quality in their service mandates. Differences in methods and sampling frequency would make aggregating water quality metrics challenging, but data that are available could be reported.

### Equity is not easily assessed across contexts

Tracking tariffs might help consider the affordability of services, but affordability itself is a challenging metric because of its variability across individuals and contexts. Some organizations are considering equity and conducting analyses specific to their programs, but no available, objective, and accurate metric is currently apparent for assessing equity performance at scale.

## Performance Indicator Summary

Table 2 summarizes the indicators that are assessed in this study and those that could be included in the future based on the availability, accuracy, and potential verifiability of data. Future work will prioritize quantifying the number of waterpoints at schools and improving volumetric data on handpump use.

| Performance Indicators | Unit |
|---|---|
| **Currently Available** | |
| *Number of Waterpoints* | # of handpumps, piped waterpoints, and piped schemes |
| *Uptime* | % of time working out of total possible |
| *Breakdown Duration* | # of breakdowns and their durations |
| *Estimated Population Served* | # of people |
| *Working Ratio* | % of costs recovered through end user payments |
| **Could Be Available in Near Future** | |
| *Number of institutional Waterpoints* | # of waterpoints at schools and health centres |
| *Water Quantity Produced* | $m^3$ |
| *Water Quality Indicators* | Various - targeting priority microbial and chemical contamination |

*Table 2 – Summary of performance indicators assessed in this study and those that could be included in the near future*

# Service Provider Performance

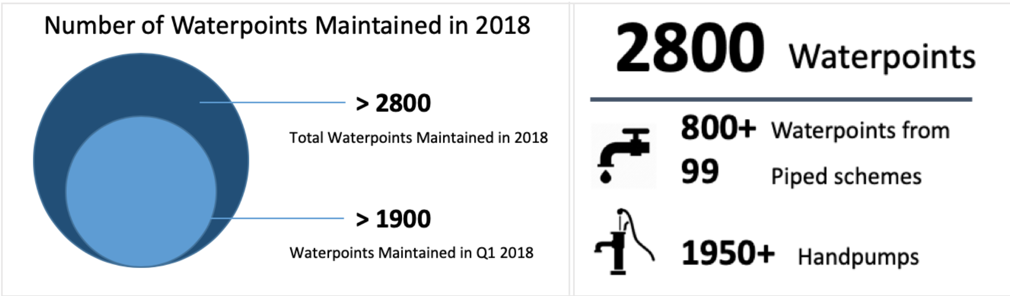
*Study Question 2: What performance metrics can be compared to inform an investment case to deliver SDG 6.1?*

The currently available performance indicators were used to assess the performance of the five service providers in 2018 in all fourteen operational units. Analysis focuses on overall performance and disaggregation by technology type and other service characteristics rather than direct comparisons between providers. Although future work could aim to produce direct comparisons, other contextual and historical factors beyond the scope of this study would need to be considered in order to meaningfully compare operational units directly.

## Operational Performance

### Service providers are managing a large and growing scale of operations

*Waterpoints* – Number of waterpoints provides the most objective quantification of scale. Waterpoints includes both handpumps and piped connections (both household and communal). The total number of waterpoints serviced by providers grew by nearly 50% in 2018 to reach a total of over 2800 waterpoints (Figure 3).

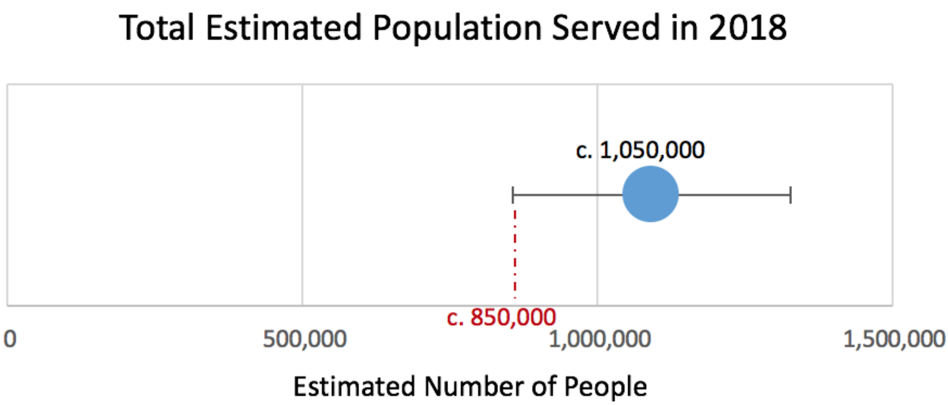



| Confidence | Very High | High | Medium | Low | Very Low |
|---|---|---|---|---|---|

*Figure 3 - Total number of waterpoints managed in 2018 (right) and growth from Q1 2018 (left)*

The major challenge with quantifying the number of waterpoints is not confirming whether infrastructure exists but confirming the record of which waterpoints are under the mandate of a service provider at any given point. This is a challenge with dynamic services that include or exclude waterpoints based on customer demand and other service conditions on a rolling basis.

*Population* – The total population served can also be estimated. Estimates indicate that the total population reached by service providers is over one million people, but the potential margin of error could be as large as 200,000 (Figure 4). Population figures draw on the estimated population served by each service provider, and their self-reported estimate of the margin of error in their population figures




| Confidence | Very High | High | Medium | Low | Very Low |
|---|---|---|---|---|---|

*Figure 4 – Total and lowerbound estimate of population served in 2018*

A key challenge with population estimates is knowing how many people are actually accessing a service, even if the area population is large. Population is therefore reported to illustrate an order of magnitude, but number of waterpoints provides a more robust indication of scale. We recognize but do not estimate livestock and other productive uses of the waterpoints. Population provides an imperfect and elusive measure of demand in comparison to volume produced

*Volumetric consumption* – The availability of volumetric measurements differs by infrastructure type. All piped services include metering technology, whereas less than 4% of the over 1950 handpumps included in the study have sensors to estimate volumes. Estimates for handpump use can be produced based on assumed populations and rates of consumption, but the accuracy of such estimates cannot be confirmed. Consequently, volumetric values are reported for piped water and for the handpumps monitored in FundiFix service areas, but the total volume of water produced by these services in 2018 cannot be reliably estimated with available data (Figure 5). The level of confidence in the data therefore ranges from high to low depending on the type of infrastructure.

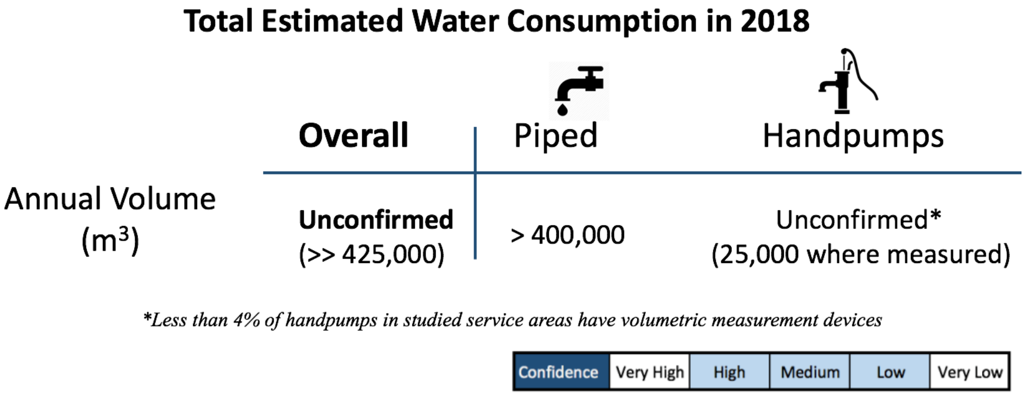



*Figure 5 - Volumetric use of waterpoints by infrastructure type. Volumetric data is not collected on the majority of handpumps at present.*

## Waterpoints maintained by service providers significantly outperform the regional functionality average

*Uptime* – Uptime is calculated by compiling records of infrastructure breakdowns from all service providers to determine the total time that infrastructure was functional out of the total time possible. The total uptime for all infrastructure maintained by service providers was greater than 94%.

Recent functionality estimates indicate that approximately one quarter of rural handpumps in sub-Saharan Africa are non-functional (Foster *et al*., 2019). If functionality is assumed to correspond to uptime, the level of reliability achieved by service providers outperforms the status quo by approximately 20 percentage points (Figure 6).

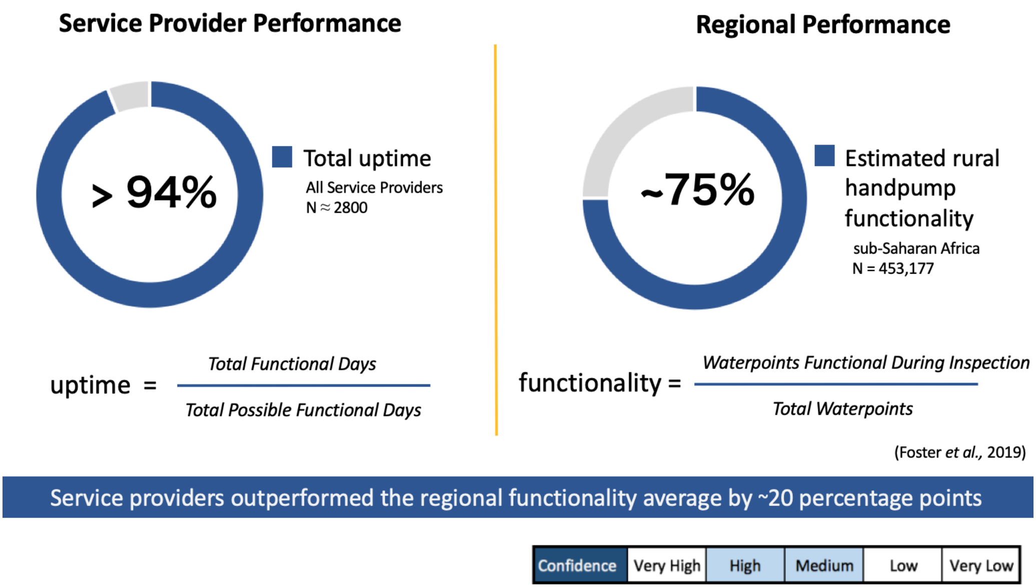



*Figure 6 – Uptime performance of infrastructure maintained by service providers and comparison against Business as Usual*

Conversely, the overall uptime of handpumps can be compared to recent regional functionality estimates by assuming that the uptime of 94% corresponds to approximately a 6% non-functionality rate (Figure 7). Comparison suggests that the service providers significantly outperform the regional functionality benchmark.

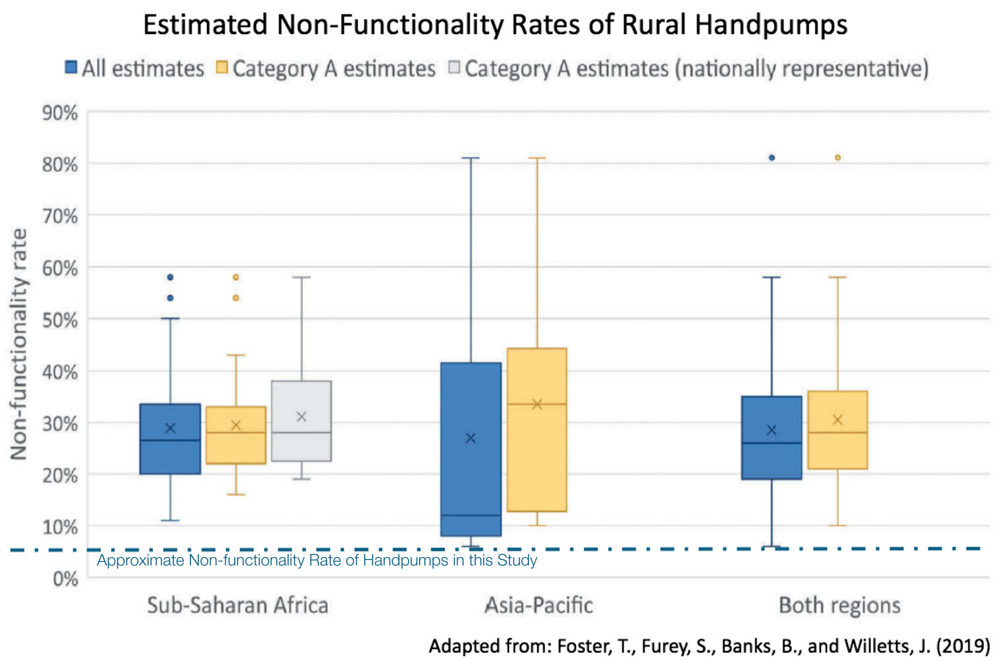
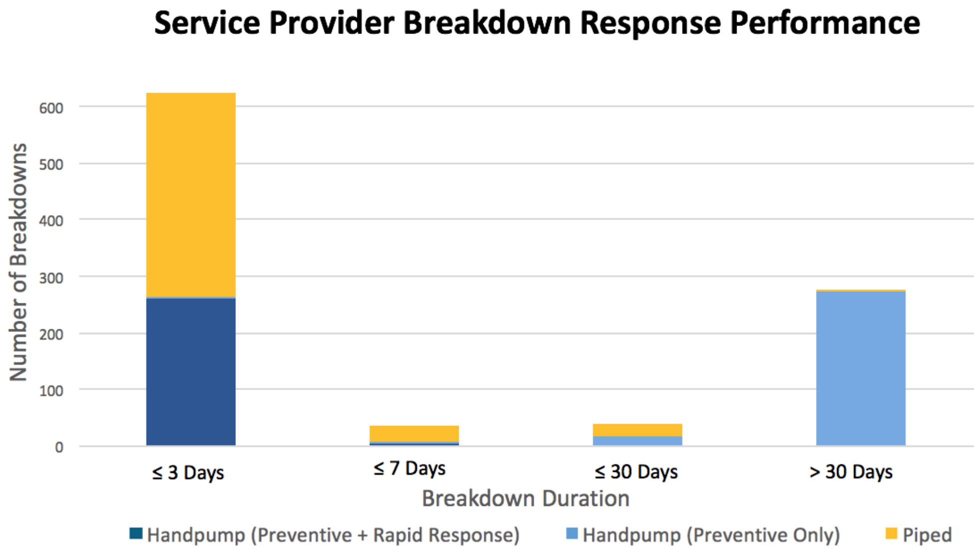



*Figure 7 – Comparison of service provider performance to rural handpump functionality rates in Africa and Asia*

*Breakdown duration* – Breakdown duration examines the complete record of infrastructure breakdown events and their duration. The distribution of breakdown durations is key. A large number of service failures that are repaired quickly may be a more desirable service than one with fewer faults that are unattended to for long periods (Reynolds, 1992; Thomson and Koehler, 2016). Analysis finds that, for providers that commit to rapid breakdown response in their service model, over 90% of breakdowns are repaired within 3 days (Figure 8). Longer breakdowns are observed in the 'preventive only' maintenance model that performs periodic handpump servicing but is not designed to respond immediately to breakdowns.




**> 90%** of piped scheme and handpump (preventive + rapid response) breakdowns **repaired within 3 days**

| Confidence | Very High | High | Medium | Low | Very Low |
|---|---|---|---|---|---|

*Figure 8 – Histogram of breakdown durations under service provider management*

By comparison, estimated breakdown durations for rural waterpoints in Ghana, Kenya, Malawi and Zimbabwe range from 13 to 214 days with a modal estimate of approximately 30 days (Kleemeier, 2000; Chowns, 2015; Hoko, 2009; Foster and Hope, 2017; Hope, 2015; Whittington et al., 2009; Nagel *et al*., 2015). These estimates are drawn from Malawi, Zimbabwe, Kenya, Ghana, and Rwanda, respectively. Service provider performance represents an order of magnitude improvement over the regional modal breakdown duration of 30 days (Figure 9).

Repair time has implications for user payments, and vice versa. Research shows that users are willing to pay for reliable services (Koehler *et al*., 2015), and user payments appear contingent upon fixing repairs in four days or less (Hope, 2015). User payments, in turn, positively affect waterpoint functionality. A study of 25,000 handpumps in Liberia, Sierra Leone and Uganda indicates that waterpoint functionality is significantly higher when water users collect fees (Foster, 2013). In Kenya, a multi-decadal data estimate that when water users pre-pay downtime is 21 days less than post-pay systems (Foster and Hope, 2017).

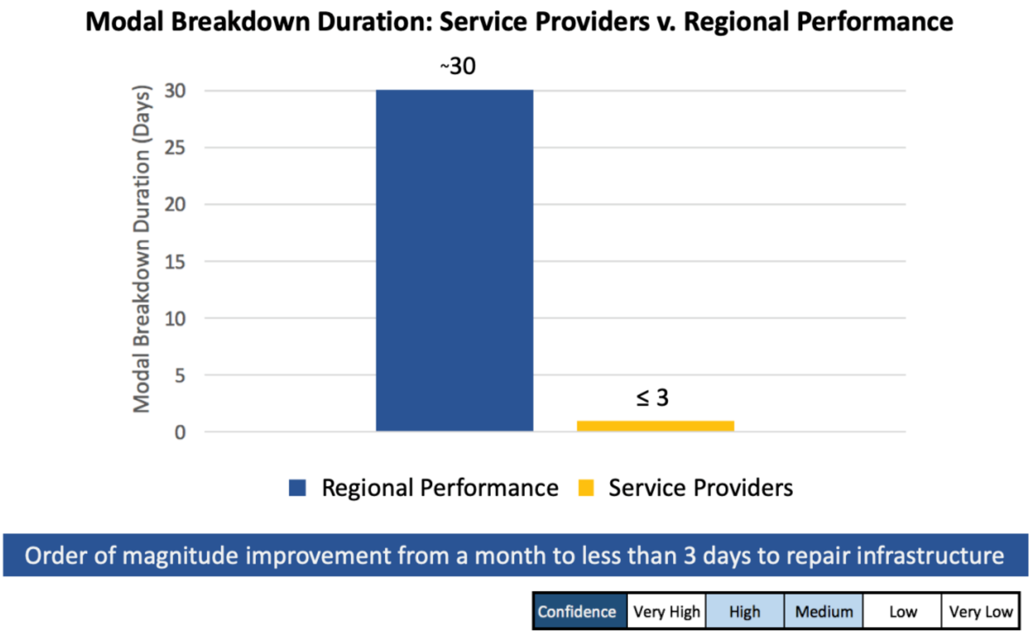



*Figure 9 – Distribution of breakdown durations under service provider management compared to regional performance*

## Financial Performance

### Water users pay some but not all of the costs

Water users paid service providers approximately USD 310,000 in 2018. Payment indicates there is demand for these services, but the revenue is insufficient to cover the full operating costs. Service providers incurred a combined shortfall of approximately USD 890,000 in 2018 (Figure 10).

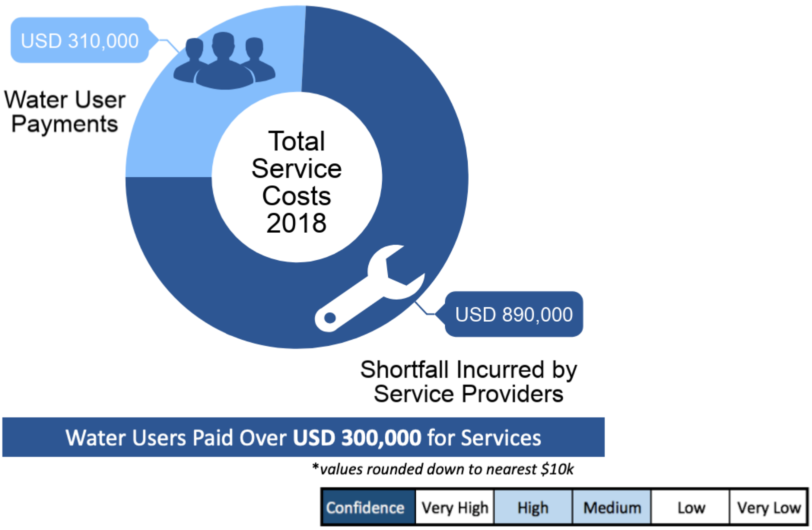



*Figure 10 – Total end user payments and net shortfall incurred by service providers in 2018*

## Most service areas do not fully recover operational costs from user revenues

Cost recovery is analysed by calculating 'working ratios' for each service provider operational unit. The working ratio is the proportion of costs recovered through payments from water users. Different working ratios can be calculated depending on the costs that are included in analysis. This analysis focuses on the 'Operational Working Ratio' as defined in Figure 11.

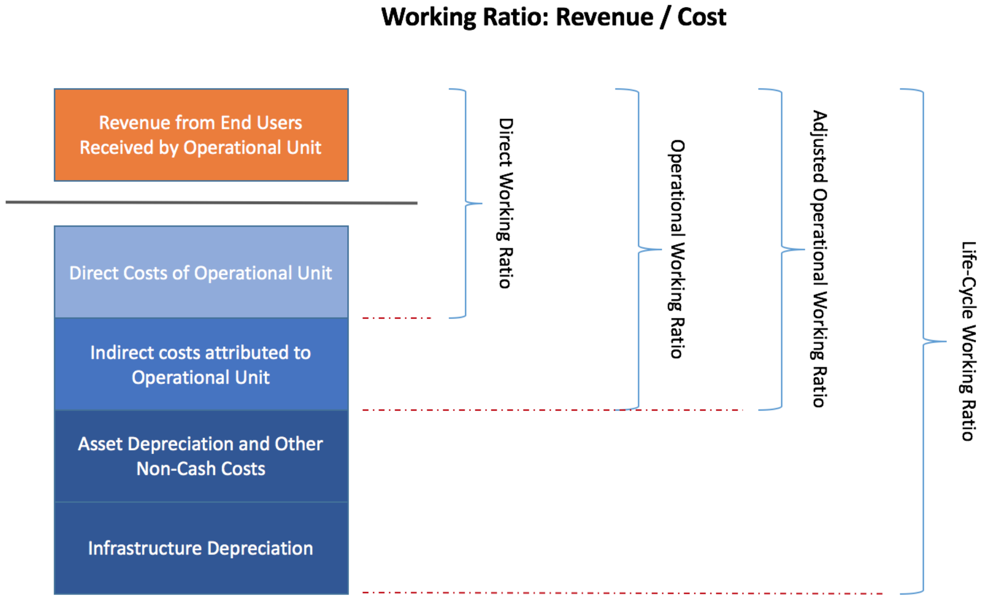



*Figure 11 – Definition of working ratios for analysis of service provider financial performance (World Bank, 2017)*

Alternative working ratios might consider only the direct costs incurred by a service area (Direct Working Ratio), the full costs of infrastructure CapEx and company assets over their lifecycle (Life-Cycle Working Ratio), or adjust the operational working ratio to account for costs and activities that are beyond the scope of maintenance provision (Adjusted Working Ratio).

Financial analysis of service providers in this study focuses on the 'Operational Working Ratio'. The Operational Working Ratio is the total revenue from water users received by an operational unit divided by the fully-burdened cash cost of providing services, excluding major asset purchases. In WASHCost terminology, these costs include both operations and maintenance expenditure (OpEx) and expenditure on direct support (ExpDS)[2].

| | Included | Excluded |
|---|---|---|
| **Revenues** | • water user payments | • donor grants<br>• in-kind contributions |
| **Costs** | • maintenance costs<br>• operational costs<br>• direct support costs<br>• indirect support costs | • capital investment<br>• company asset depreciation<br>• infrastructure depreciation |

*Table 3 – Operational working ratio overview*

**2** See IRC. (2012). Costing sustainable services - Module one

The annual operational working ratio of each operational unit is analysed separately to determine the range of cost-recovery achieved for each infrastructure type (Figure 12). Most service areas did not fully recover operating costs from end user revenues in 2018. Analysis of working ratios by aspects of service models including infrastructure type, revenue collection methods, and market structure shows multiple factors may significantly impact working ratios, and more analysis is needed to understand the full implications of context on service provider financial performance.

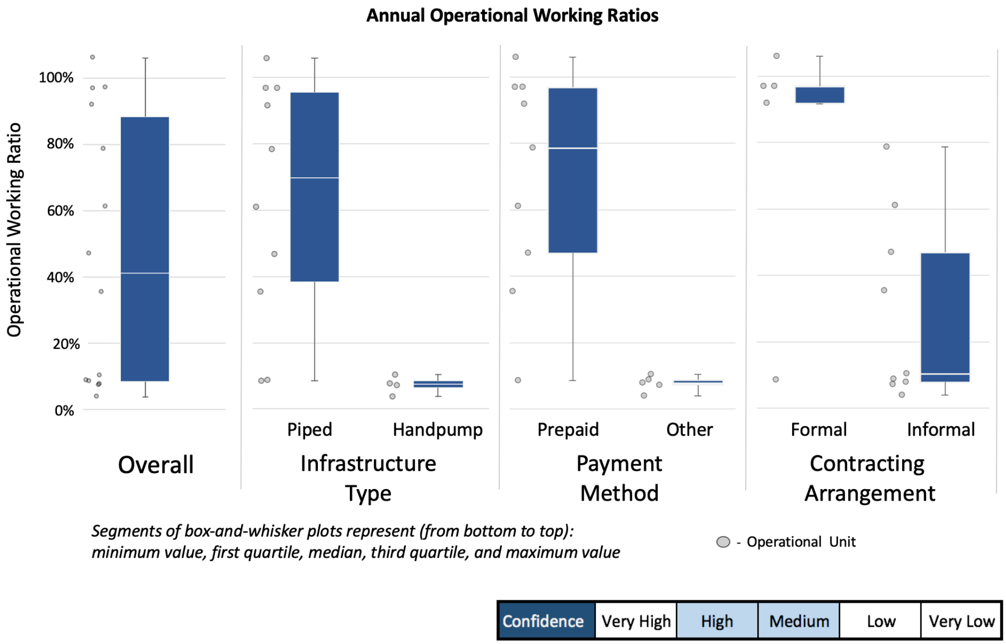



*Figure 12 – Operational working ratios by infrastructure type, payment method and contracting arrangement*

Findings prompt questions about how datasets might be expanded or combined with other sources to enrich analysis. A key issue is context. There are myriad factors that affect operational performance and working ratios, and deeper understanding of these factors may help develop models for predicting what levels of cost-recovery can be achieved in a given context. This report provides a platform to examine these factors more fully in the future.

### Contextual factors to consider include but are not limited to:

- User demand – population density; seasonality of water use; productive uses of domestic water; alternative infrastructure; waterpoint density; affordability of tariffs; revenue collection and storage
- Institutional and political – contractual arrangements between institutions and service providers; regulation and monitoring; policy and legal context; political salience of water; cultural norms and practices; state fragility and accountability
- Environment – resource availability; aquifer depth; water quality and hazards to health; rainfall variability, extremes and recharge; resource competition
- Infrastructure – extent and distribution of existing capital stock; quality of installation; availability and cost of spare parts; costs of operation
- Financial – government, donor and user funding; public finance provision and performance; stability of sector funding; funding for facility services, schools and clinic

Working ratios also show variation by quarter. Conclusions in this report therefore focus on the annual working ratio because the costs and revenues in a given quarter may not accurately represent the overall financial performance of an operational unit. Figure 13 illustrates the maximum and minimum quarterly operational working ratios for each operational unit and shows that some of the highest-cost recovery areas also have the greatest quarterly range of working ratios.

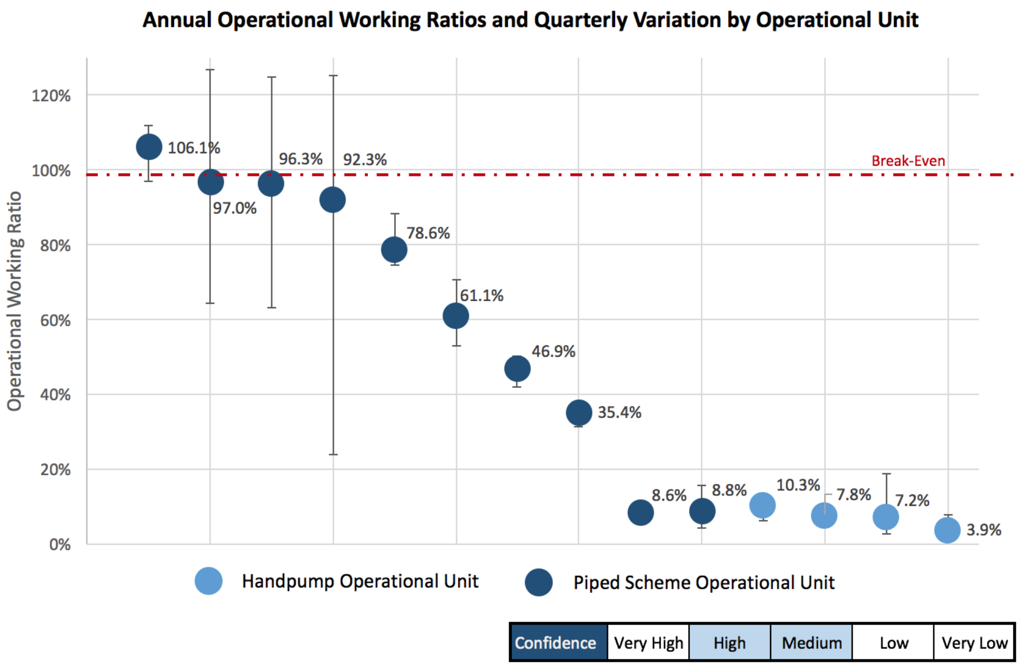



*Figure 13 – Range of quarterly working ratios by operating unit: piped scheme variability, handpump stability?*

Working ratios might change over years. Analysis presents a snapshot of 2018 data rather than tracking how service provider performance changes over time. Service providers in this study argue that their working ratios can probably improve, that they are motivated to do so, and that the analytical process of this study has helped highlight opportunities for development. The true level of performance possible in a given context can only be confirmed empirically: by providing a service and evidencing what can be achieved. This study has provided a common basis for service providers to assess financial performance and offers the potential to empirically demonstrate how working ratios might change in coming years.

## Service Provider Performance Summary

- **Service providers are managing a large and growing scale of operations**. Over 2800 waterpoints were maintained in 2018 that served a population of approximately one million people
- **Rural waterpoints maintained by service providers function more reliably than other rural water infrastructure**. Service providers outperform the regional functionality average by approximately 20 percentage points and achieve an order of magnitude improvement over typical breakdown durations for waterpoints in rural Sub-Saharan Africa
- **Water users pay some but not all of the costs**. Water users paid service providers over USD 300,000 in 2018, mostly in piped water service areas, but service providers still incurred a combined shortfall of approximately USD 890,000

- **Most service areas do not fully recover operational costs from user revenues**. Service areas achieve a range of working ratios, and most do not fully recover operating costs from water user revenues. Levels of cost recovery are influenced by a variety of factors that require further analysis to understand how service model design and accounting for contextual factors can minimise the subsidy needed in a given area to ensure that reliable rural water services leave no one behind
- **Providers delivered reliable rural water services for approximately 1 million people at an annual operational cost of approximately USD 1.20 per person.** Although service providers collectively incur a shortfall, their overall level of performance suggests that maintenance services can provide a cost-effective opportunity for sustaining reliable rural water services at scale

# Discussion and Implications

**Limited or absent financial and operational data on rural water service delivery has hindered progress to improve policy and practice in Africa for decades**. The findings from the first phase analysis of this multi-country dataset identify four priority themes for more detailed analysis and discussion. To our knowledge, it is the most comprehensive data available on actual service provider operational and financial data in rural Africa.

**Institutional implications – Institutional design is a key determinant of operational and financial performance**. Where a service provider has a contracted delivery plan with government in an exclusive service delivery area, an acceptable tariff and clear performance targets the operational working ratio is more likely to break even. This applies to piped water systems where the known advantages of population density, on-site or nearby connections, water treatment and economies of scale provide comparative advantages to other alternatives. More generally, many service providers operate in contexts where government permits competition and provides no long-term commitment to the providers, creating operational uncertainty and reducing financial sustainability. The situation is often further undermined by NGOs, donors and other stakeholders who operate independently of government without being accountable for long-term service delivery.

**Information implications – Information is critical to guide institutional design and performance**. Creating a common methodology to report and compare operational and financial data has revealed how contextual factors in performance can be identified and potentially improved. For example, we document the convergence of low working ratios for handpumps in all service areas. This refutes the theoretical arguments around full cost-recovery proposed by many and provides guidance to first-loss investors, such as governments and donors, to ensure remote and scattered populations are not left behind. Information innovations emerging in remote monitoring or cashless payments from some of the consortium also point to how accountability, planning and investments may be improved. Above all, the information reveals the significant operational improvements in uptime and repair times provided by the consortium partners setting new standards for service delivery in rural Africa.

**Infrastructure implications – Piped water infrastructure does not guarantee better financial sustainability**. The range of piped working ratios observed in this study points to strong dependence on other factors such as population density, revenue collection efficiency, and institutional arrangements, amongst other factors, that determine the level of cost recovery achieved by piped services or any other type of infrastructure. Depending on context, maintaining existing handpumps may be more cost effective than investing further capital into piped services that will not be financially viable everywhere. Further work is needed to characterise the conditions that make different infrastructure types operationally and financially appropriate in a given context.

**Investment implications – The investment case for rural water must consider financial, economic and social impacts**. Commercial finance with positive returns is limited except for particular conditions, mostly applicable to piped water schemes, which do not apply to much of rural Africa. Selective bias to the minority of financially-attractive cases will limit prospects for universal service delivery (Figure 14).

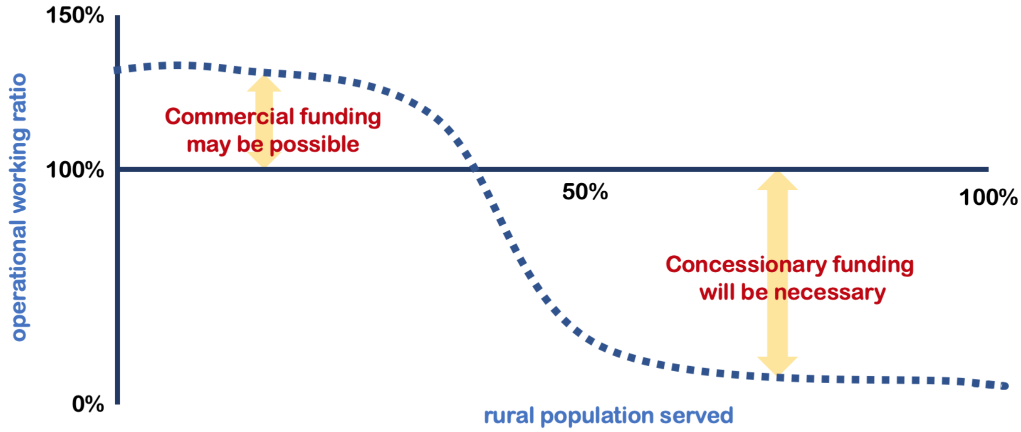



*Figure 14 – Progress towards universal services will require concessionary funding for rural areas*

Economic arguments point to the hundreds of millions of dollars invested in existing infrastructure and the opportunities to keep this infrastructure working as intended. The relatively low but important investments by water users illustrate that, where services create value, people will pay. This may be a fraction of the overall cost, but the value proposition may be improved over time to increase these returns. The social impacts of reliable water systems that accrue to women, pastoralists, children in schools and the sick at clinics, in particular in times of drought or in places of conflict, underline the public benefits of reliable water services and the need to progressively improve the data that support the investment case to meet and sustain SDG 6.1.

# Further Work

This study highlights two major areas for further work: establishing a scalable funding mechanism for rural water maintenance services and improving the availability of information to guide investment.

## Development of a performance-based funding mechanism to sustain reliable maintenance services at scale

No mechanism currently exists for financing reliable rural water services at scale. Professional rural water services can potentially reduce the cost for capital maintenance, which is crucial for long term sustainability of rural water supply infrastructure and a precondition for attracting new funding for extending the infrastructure and reaching the SDGs. As this study has shown, operational cost recovery is not being achieved by most providers delivering reliable services. Concessionary resources should target the areas of greatest need, and a robust platform is needed for translating resources into results

Funding rural water service providers on a performance basis provides would have several advantages:

- Funding conditions could be designed to motivate service providers to improve working ratios and their scale of services without compromising on service reliability;
- Pooling funding for multiple service providers across regions and contexts could help to minimize risk; and
- Establishing clear processes and verifiable performance metrics might help attract more resources for investment in rural water services.

The funding mechanism would also need to ensure that any concessionary resources directed towards rural water services do not undermine opportunities that could potentially access more commercial sources of finance.

A current funding mechanism already exists at a smaller scale in the Kenyan water sector (Figure 16). The Water Services Maintenance Trust Fund is financed by both public and private partners with the shared goal of investing in rural water service outcomes. The Trust Fund provides concessionary performance-based funding to maintenance service providers – currently two franchises of FundiFix included in this study – in order to bridge shortfalls between costs and revenues. The Trust Fund demonstrates that a funding mechanism for reliable rural water maintenance services can work in practice.

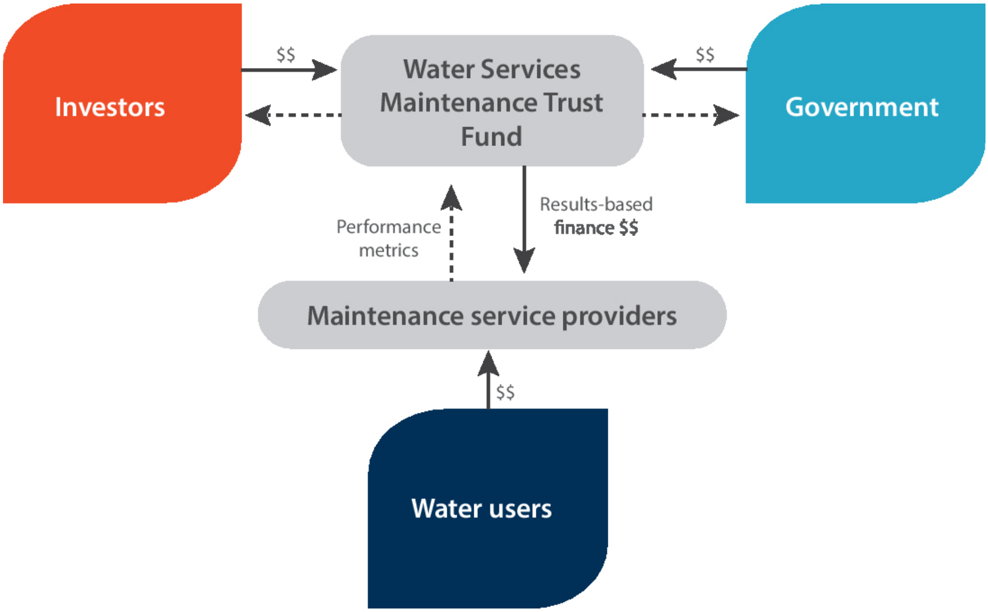



*Figure 15 – Conceptual illustration of the Kenyan water services maintenance trust fund*

Other publications have also discussed the need for continued subsidization and funding for maintenance to leave no one behind (Nagpal *et al*., 2018). Further, other sectors have managed to attract significant funds from non-traditional sources (e.g. the UNITAID airline levy[3]). Advocacy and evidence in support of creating a scalable funding mechanism is not new; the challenge lies in actually creating it.

3 For additional examples see: Nagpal, T., Malik, A., and Eldridge, M. (2018). Mobilizing Additional Funds for Pro-Poor Water Services. Urban Institute and Johns Hopkins School of Advanced International Studies. p. 6

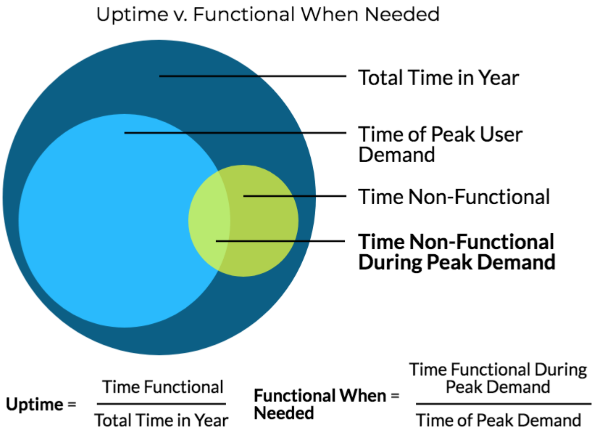
## Strengthen data availability, quality, and analysis to inform investment decisions

Limited investments in continuous monitoring means that accountability is low and investment decisions are hidden from scrutiny. Professional services require transparent data. Major advances in sensors, mobile networks and satellite systems increase the feasibility of smart monitoring in well-designed sample populations. This could not only improve resource allocation but also unlock non-traditional funding sources that require verification. We propose four main areas for further work in data capture, verification, and analysis:

*Streamline data capture systems* – Existing data collection systems already established with service providers in this study should be strengthened to continue building the available data set. Continued data collection will improve the potential for longitudinal analysis and the potential for partners to begin reporting on other service areas with minimal effort.

*Expand data capture to include other indicators* – Other relevant indicators such as population density, waterpoint density, and qualitative indicators such as payment methods and contracting arrangements should be added to the existing dataset to improve the potential for future analysis.

Future work could aim to improve understanding of peak demand periods, possibly based on seasonality, to improve the precision of reliability metrics. For example, uptime is an improvement over spot functionality and could be further improved by considering whether waterpoints are functional at times of peak demand. Evidence shows that waterpoint usage can be affected by rainfall (Thomson et al., 2019). More precise analysis would consider the proportion of time that a waterpoint is functional out of the time of peak user demand.



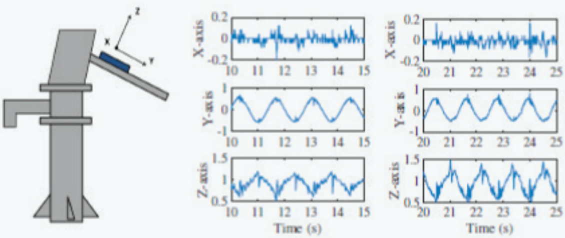

*Test systems for verification and remote data monitoring* – Analysis tied to investment decisions will require higher levels of scrutiny, and therefore more robust verification. Technological advances are creating new possibilities that might be relevant to objective performance monitoring, and four such service provider technologies are highlighted (Box 2). Even a representative sampling of waterpoints with appropriate sensing technology could provide valuable insights into the quality and reliability of services.

*Extend analysis to consider contextual factors and their effect on service provider performance* – Factors such as waterpoint density, payment methods, institutional arrangements, and other factors should be analysed within larger data sets to develop insights around the conditions that support service providers to highly perform. Some of these factors could reasonably be added to existing data sets to enable further analysis. The ability to draw stronger conclusions about the influence of contextual factors on working ratios will also require data from a larger number of operational units in a variety of contexts..

## Box 2: Monitoring technologies developed by service providers

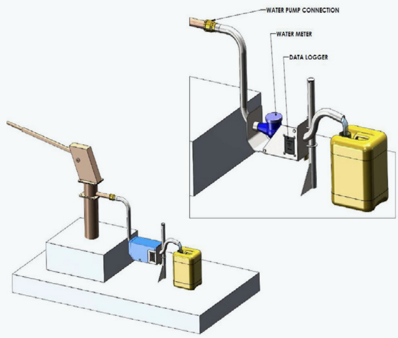
### FundiFix | University of Oxford

Water Point Data Transmitter (WDT) – The WDT is attached to the pump handle and measures movement using an accelerometer. This movement is converted into an estimate of hourly volume abstraction which is then transmitted over a GSM network (Thomson et al., 2012). Advantages include: straight-forward installation; the device does not interfere with maintenance; and it can be easily adapted for use on different pump types. Work is currently underway to use the high frequency information captured by the accelerometer to monitor pump condition and open up the possibility of failure prediction.




### UDUMA

Handpump flow meter – This adaptation for India Mk II handpumps enables data capture of flow rates. Water is piped through a curved extension to remove air from the flow column, and flow data are metered and stored in a data logger for later collection. A similar water flow meter and datalogger are also being used on the Vergnet-Hydro pumps, although these are fully integrated into the pump design.

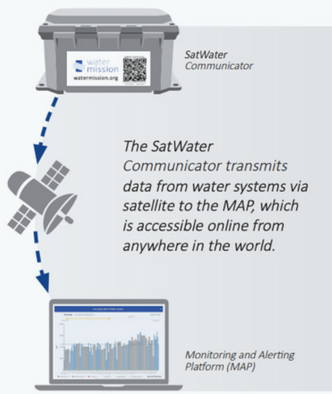



### UDUMA

Cashless handpump payment collection – This technology aims to improve data collection of revenues and transactions for handpumps by using NFC cards for transactions at the waterpoint. A prepaid card is recharged at dedicated kiosks in cash or with mobile money. Users then pay with the card and revenue and transaction data are synchronized to the service provider database.

### Water Mission

SatWater Communicator – This device remotely monitors flow, borehole water level, ORP, and pressure of rural piped water schemes. The satellite-based communicator logs and transmits data from off-the-shelf analog and digital sensors from any global location where the satellite modem receives coverage.



# Conclusion

This study aimed to address the information gap that hinders investment in rural water services. Evaluating and improving service models depends on data. Data exist but will have limited ability to inform investment decisions in their current fragmented state. The data deficit needs to be closed in order to build a stronger investment case to advance progress towards achieving and maintaining SDG 6.1.

Financial performance of individual operational units differs depending on multiple factors including infrastructure type, payment methods, and contracting arrangements. Simply comparing handpumps with piped systems is insufficient without consideration of other contextual factors. More analysis is needed to understand which factors are most significant and what implications they have for service model design in a given context. Factors including population size, density, demand, and water quality are all important and remain poorly understood.

We argue sustainable financing of reliable rural water services requires three conditions to be satisfied:

1. appropriate institutional arrangements;
2. effective maintenance contracts; and
3. robust operational data.

Fulfilling these requirements and implementing robust revenue collection systems could deliver high-quality services with minimised subsidies targeted towards areas of greatest need. Our analysis shows that all three requirements are achievable but not widely realized. If policymakers and funders commit to fulfilling these requirements, leaving no-one behind could become a reality.

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# Appendix A:  Service Provider Summaries

| | | | |
|---|---|---|---|
| Name: | FundiFix | | |
| Established: | 2014 | Head Office: | Nairobi, Kenya |
| Legal Structure: | Private company with 100% Kenyan ownership and staff | | |
| Parent: | FundiFix Ltd. | Subsidiaries: | Miambani Ltd.<br>Kwale Handpump Services Ltd. |
| Operational Areas: | Kitui County and Kwale County. | | |
| Overview: | FundiFix is a not for profit social enterprise and operates county-based franchises that offer preventive maintenance and repair service for existing rural water infrastructure serving communities, schools, and health facilities. The FundiFix model is guided by an insurance logic to pool financial and operational risks at scale. The model has four components: a) professional services, b) smart monitoring, c) financial sustainability and d) institutional coordination. Incubated in collaboration with the University of Oxford, it has led to the establishment of Water Services Maintenance Trust Funds providing performance-based payments supported through action research and financial support by Kenyan companies. | | |
| Web: | www.fundifix.co.ke | | |

| | | | |
|---|---|---|---|
| Name: | UDUMA | | |
| Established: | 2015 | Head Office: | Ingré, France |
| Legal Structure: | Private Company, a simplified joint stock company | | |
| Parent: | Odial Solutions | Sister Company: | Vergnet Hydro |
| Operational Areas: | Burkina Faso and Mali | | |
| Overview: | UDUMA manages concession and affermage contracts for service delivery in exchange for user fees paid by volume. Technology, including flow meters and cashless payment systems are used to organize revenue collection, improve transparency and efficiency, and reduce operational costs in order to target a return on investment that can attract private funding for CapEx investment. | | |
| Web: | www.uduma.net<br>www.vergnet-hydro.com | | |

water for good®

| | | | |
|---|---|---|---|
| Name: | Water for Good | | |
| Established: | 2003 | Head Office: | Warsaw, Indiana USA |
| Legal Structure: | NGO with cost-recovery service programme | | |
| Parent: | None | Subsidiaries: | None |

**Operational Areas:** Central African Republic

**Overview:** Water for Good employs local technicians to provide preventative circuit-rider maintenance services across a network of over 1700 unique rural water points (hand pumps) in CAR and collects payments from rural water users for the services. The technicians complete electronic reports on-site during each visit, verifying functionality, location, user payment, part usage, and other indicators. Water for Good also has borehole drilling capacity, and has drilled and installed over 775 new water points in CAR.

**Web:** www.waterforgood.org

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water mission

| | | | |
|---|---|---|---|
| Name: | Water Mission | | |
| Established: | 2001 | Head Office: | North Charleston, USA |
| Legal Structure: | NGO with cost-recovery service programme | | |
| Parent: | None | Subsidiaries: | None |

**Operational Areas:** Water Mission has supported projects and programs in over 55 countries. This analysis focuses on operational units called Rural Water Cooperatives in Kenya and Uganda.

**Overview:** Rural Water Cooperatives either directly manage solar powered piped water systems or provide technical and administrative support for communities to manage the systems. Revenue is generated through pre-paid tariffs, with cash handled manually or by prepaid water meters. Performance data are obtained via satellite-based remote monitoring systems. Financial analysis considers the fully-burdened cost of service delivery and support services, both direct and indirect.

**Web:** www.watermission.org

| | | | |
|---|---|---|---|
| **Name:** | Whave Solutions Ltd. | | |
| **Established:** | 2012 | **Head Office:** | Kampala, Uganda |
| **Legal Structure:** | Private company with a non-profit resolution. | | |
| **Parent:** | None | **Subsidiaries:** | None |
| **Operational Areas:** | Whave provides services in Uganda through four regional offices called 'Local Service Providers' (LSPs). Two of these offices are currently one cost centre / operational unit with single management, and one is not analysed in this study because it is in an early stage of preparation, with emphasis on infrastructure. | | |
| **Service Model Overview:** | Whave is a Ugandan non-profit social enterprise working with local government and rural communities to provide water build-operate-transfer and maintenance services and to develop practical Public-Private Partnership regulation in rural water supply. Whave's technicians perform regular checks and respond immediately when worn parts threaten a breakdown. Communities pay a small annual service fee, and government provides regulation and support | | |
| **Web:** | www.whave.org | | |

# Appendix B: Summary of Data Availability

## Scope of monitoring Definitions:

- Measurement – all data are directly collected
- Sampling – a portion of data are sampled
- Estimate – values are estimated using proxy indicators
- None – values cannot be confidently estimated

## Frequency of Monitoring Definitions:

- Continuous – ongoing data collection (regular and consistent)
- Spot check – periodic data collection (irregular and consistent)
- Infrequent – irregular and inconsistent data collection

Assessment of existing data also considered the future potential for verifying reported data. Data in this study are self-reported by the participating service providers, and future work can explore how reported data might be verified by a third-party. Based on availability of data that either already exist or could reasonably be gathered in the near future, performance indicators are divided into four categories: available, partially available, available but unreliable, and unavailable.

*Table 1 – Summary of data availability and SDG indicators*

SDG 6.1 By 2030, achieve **universal** and **equitable access** to **safe** and **affordable** drinking water for all.

| SDG 6.1 | Potential Indicator | FundiFix | UDUMA | Water Mission | Water for Good | Whave | Verification Potential |
|---|---|---|---|---|---|---|---|
| Universal | Number of Waterpoints | Continuous | Continuous | Continuous | Continuous | Continuous | High |
| | Population | Spot check | Infrequent | Spot check | Spot check | Spot check | Low |
| Equitable | Equity? | Infrequent | Infrequent | Infrequent | Infrequent | Infrequent | Low |
| Access | Functionality | Continuous | Continuous | Continuous | Spot check | Continuous | Medium |
| | Reliability | Continuous | Continuous | Continuous | Spot check | Continuous | Medium |
| | Volume | Continuous | Continuous | Continuous | Infrequent | Spot check | Medium |
| | Distance to source | Infrequent | Infrequent | Infrequent | Infrequent | Infrequent | Low |
| Safe | Free of faecal contamination | Spot check | Spot check | Spot check | Infrequent | Spot check | Low |
| | Free of priority chemical Contamination | Spot check | Spot check | Spot check | Infrequent | Spot check | Low |
| Affordable | Tariff charged to users | Continuous | Continuous | Continuous | Continuous | Continuous | High |

## Available indicators:

- No. of waterpoints
- Functionality
- Reliability
- Tariffs

## Partially Available Indicators:

- Volume
- Microbial and chemical water quality

## Available but Unreliable:

- Population

## Unavailable Indicators:

- Equity
- Distance to source

| Scope of Monitoring |
|---|
| Measurement |
| Sampling |
| Estimate |
| None |

| Frequency of Monitoring |
|---|
| Continuous |
| Spot check |
| Infrequent |

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