Research Report

Sustainable WASH Systems Learning Partnership

A ROADMAP FOR SYSTEM STRENGTHENING FOR PROFESSIONALIZED RURAL WATER MAINTENANCE SERVICES

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SUSTAINABLE WASH SYSTEMS
A LEARNING PARTNERSHIP

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Front cover: FundiFix mechanics fix a hand pump in Kenya. Photo credit: Nancy Gladstone

About the Sustainable WASH Systems Learning Partnership: The Sustainable WASH Systems Learning Partnership is a global United States Agency for International Development (USAID) cooperative agreement with the University of Colorado Boulder (UCB) to identify locally driven solutions to the challenge of developing robust local systems capable of sustaining water, sanitation, and hygiene (WASH) service delivery. The consortium of partners — Environmental Incentives, IRC, LINC, Oxford University, Tetra Tech, WaterSHED, Whave, and UCB — are demonstrating, learning about, and sharing evidence on systems-based approaches for improving the sustainability of WASH services in four countries.

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Acronyms

AMS	Asset Management System
ASP	Area Service Provider
CBM	Community-Based Management
CBO	Community-Based Organization
DWO	District Water Office
ETB	Ethiopian Birr
HPM	Hand Pump Mechanic
HPMA	Hand Pump Mechanics Association
KES	Kenyan Shilling
MWE	Ministry of Water and Environment
NWSC	National Water and Sewerage Corporation
OECD	Organization for Economic Cooperation and Development
O&M	Operation and Maintenance
ONA	Organizational Network Analysis
OWNP	One WASH National Program
PPP	Public-Private Partnerships
SDGs	Sustainable Development Goals
SNNPR	Southern Nations, Nationalities, and Peoples
SWS	Sustainable WASH Systems Learning Partnership
SWSSB	Sub-Country Water Supply and Sanitation Boards
UCB	University of Colorado Boulder
UGX	Ugandan Shilling
USAID	United States Agency for International Development
WASH	Water, Sanitation, and Hygiene
WASHCO	Water, Sanitation, and Hygiene Committees

WASREB	Water Services Regulatory Board
WSMTF	Water Service Maintenance Trust Fund
WUAs	Water User Associations
WUC	Water User Committee

Glossary

Actor	A stakeholder that directly or indirectly influences the WASH system. Actors may be specific individuals or organizations (e.g., water operators, water committees, NGOs, and government agencies) or international entities with less direct links to the local system.
Asset	The physical components of water supply facilities such as boreholes, pipes, pumps (manual and motorized), meters, generators, storage tanks, and valves.
Collective Action	A structured process in which sector stakeholders regularly convene and take joint actions to address shared problems, in which: problems are complex, and their solutions require deliberation and action by many actors; members agree on a shared vision and shared problem definition; and stakeholders clarify responsibilities and hold each other accountable for actions.
Decentralization	The transfer of authority and responsibility for public functions from the central government to subordinate or quasi-independent government organizations and/or the private sector. Types of decentralization include political, administrative, fiscal, and market decentralization.
Delegation	The contractual relationship between a water asset owner and a service provider conferring responsibility for one or more components of the operation, management or maintenance of a water supply scheme. Delegation requires a legal entity to act as a contracting authority (this may be the asset holder, a local government, or national government entity for example).
Downtime	The time that a WASH facility or scheme is non-functional; normally expressed as hours per day or days per month.
Factor	A non-human element, aspect, or component of a system that directly or indirectly influences system functioning or outcomes. Examples include technology, regulation, or financing.
Hub	The entity that manages the logistics, facilitation, leadership, and administrative functions of collaborative processes.
Infrastructure asset management	The processes and decisions that ensure services are maintained at agreed levels and that the value of assets is maintained by ensuring the maximum functional life.
Learning alliance	A series of interconnected multi-stakeholder platforms at different institutional levels (national, district, community, etc.), aiming to speed up the process of identification, development, and scaling up of innovations.
Management model	The combination of an operator (e.g., the actor responsible for performing day-to-day operations of a water supply service, often including some element of maintenance), the service authority (the institution with the legal mandate to

	ensure water supply services are planned and delivered), and the associated enabling environment factors (i.e., regulation, monitoring, policy frameworks).
O&M	Operation and maintenance of rural water facilities includes both corrective and preventive tasks that aim to ensure the continued, optimum functioning of physical infrastructure.
Political economy	Refers here to the power dynamics within which a system operates and the process of decision-making for the distribution of resources relating to water supply.
Preventive maintenance	The regular inspection and servicing, including replacement of consumable spare parts, to preserve assets and minimize breakdowns carried out on a regular schedule according to the requirements of components of the scheme.
Professionalized maintenance	Trained personnel working within clear legal, policy, contractual, and accountability frameworks, which are monitored against performance indicators and with agreed financing arrangements and transparent, regulated pricing structures to carry out repair and support services of different types, on rural water infrastructure.
Regulation	Setting rules, monitoring whether those rules are complied with, enforcing them, and adjusting them over time. Rules are in place to protect human health and ensure economic and environmental sustainability of services. The overall objectives of regulation are that water services are provided in an efficient, fair, and sustainable manner.
Scale	The spatial boundaries within which decisions are made and policy can be enacted. For example, a river basin, a country, a district, and the coverage area of a water supply scheme are all different (and overlapping) spatial and administrative scales. In the case of maintenance, this also refers to the unit of scale at which economies of scale can be reached.
Service authority	Entity legally responsible for WASH services in a defined area. A service authority must ensure the quality of the service and the performance of the service provider; it may hold delegated functions of regulatory power.
Service delivery	The quality or standard of service, measured by criteria set by national standards and/or the norms for Sustainable Development Goal 6. The criteria for water include quantity, quality, reliability, and accessibility.
Service levels	The normative set of attributes that describe the water service received. These typically include the quantity, quality, distance, and continuity of the supply. These can be grouped into a service ladder.
(Maintenance) service provider	The institutions or individuals that deliver water to the users. They are responsible for the either corrective or preventive maintenance tasks. Such providers may be community organizations, social enterprises, private operators, public sector utilities, companies, NGOs, or faith-based organizations.
Sustainability	The definition of Abrams (1998) describing sustainability as: "whether or not something continues to work over time" (meaning, in this case, the indefinite

	provision of a water service [with certain agreed characteristics] over time).
Systems	For water supply, the system is taken to encompass the actors and factors that work together to deliver, manage, and regulate services. The system boundary can be described either geographically or administratively and can apply at the national level and may include both water service delivery and water resource management, but more specifically at the level of decentralized local government.
(Maintenance) subsystem	A small system that is part of a larger system. For maintenance the subsystem is part of the water supply system that can support improved maintenance services.
Tariffs	Funds contributed by users of WASH services for obtaining the services. In the Organization for Economic Cooperation and Development (OECD) "3T" typology, tariffs include two types of funding: tariffs for service provided and households' out-of-pocket expenditure for self-supply.
Transfers	Funds from international donors and international charitable foundations (including NGOs, decentralized cooperation, or local civil society organizations) that typically come from other countries contributed either in the form of *grants*, *concessionary loans* (i.e., through the grant element included in a concessionary loan, in the form of a subsidized interest rate or a grace period), or *guarantees.*
Taxes	Funds originating from domestic taxes channeled to the sector via transfers from all levels of government, including national, regional, or local. Such funds would typically be provided as *subsidies*, for capital investment or operations. "Hidden" forms of subsidies may include tax rebates, *concessionary loans* (i.e., at a subsidized interest rate) or subsidized services (such as subsidized electricity).

Executive Summary

Despite significant progress in advancing first time access to basic water services, with coverage in rural areas increasing from 69 percent to 82 percent at a global level between 2000 and 2020,[1] reliability and **sustainability** of service provision have long been a challenge to the sub-sector. Non-functionality rates of 30 percent to 40 percent are commonly cited, with a recent Government of Uganda report indicating that more than half of hand pumps are inoperable.[2] The challenges of maintaining services for large numbers of fragmented and geographically dispersed community-managed water facilities are well documented.[3] Conventional approaches to maintenance have largely been based on voluntary arrangements with communities taking on the burden of maintenance themselves. This model has struggled to ensure that rural water supply infrastructure is adequately maintained, leading to small technical problems becoming more complex and costly, resulting in unnecessary downtime and service disruption.[4]

The Sustainable WASH Systems Learning Partnership (SWS) is a 5-year global United States Agency for International Development cooperative agreement testing **systems**-based approaches, concepts, and tools to improve water service sustainability. SWS is unique in applying such a range of tools across local contexts in four countries,[5] and presents the largest exercise of its kind in the rural water sector that the researchers are aware of to date. The University of Colorado Boulder (UCB) led the partnership, which emphasizes learning for catalytic change in the sector, testing new ideas, approaches, and tools to overcome systemic barriers to improving water service sustainability. One of the core areas of learning is maintenance of water services. SWS uses the term **professionalized maintenance**[6] to bring greater commonality to the dialogue around rural water provision; it is associated with a number of key characteristics (see glossary).

The principal hypothesis of SWS is that failure to provide long-term, sustainable services is not one of inadequate technology, spare parts supply chains, or **management models**; it is a *systems failure.* This is to say a failure of institutions, policies, and **regulation** — and their application through financing, laws, actors, politics, and incentives — to allow for the effective functioning of rural water services. Effective and efficient maintenance forms a critical component of **service delivery** once initial capital investments are made. SWS works with partners that are actively engaged in both the delivery of, and research into, improved maintenance provision. These partners are: IRC, operating in two regions of

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[1] United Nations Children's Fund/World Health Organization. 2021. Progress on Household Drinking Water, Sanitation and Hygiene 2000–2017. Special Focus on Inequalities. New York: United Nations Children's Fund (UNICEF) and World Health Organization (WHO). Database accessed 16.07.2021https://washdata.org/data/household#!/dashboard/new

[2] Ministry of Water and Environment (MWE). 2021. Access and Coverage Statistics Uganda. Available at: http://wsdb.mwe.go.ug/index.php/reports/ national

[3] World Bank. 2017. "Sustainability Assessment of Rural Water Service Delivery Models: Findings of a Multi-Country Review." Washington, D.C.: World Bank, http://documents.worldbank.org/curated/en/558871503590535744/Sustainability-assessment-of-rural-water-service-delivery-models-findings-of-a-multi-county-review

[4] Sustainable WASH Systems Learning Partnership (SWS). 2020. "Maintenance Approaches to Improve the Sustainability of Rural Water Supplies." SWS, University of Colorado (UCB), USAID Research Brief: https://www.globalwaters.org/resources/assets/sws/maintenance-approaches-rural-water-supplies

[5] In addition to Ethiopia, Kenya, and Uganda, SWS also had a program in Cambodia that drew upon the principles of collective impact and systems thinking to facilitate locally led and owned efforts to strengthen rural sanitation and hygiene service delivery that was completed in early 2019.

[6] Lockwood, H. 2021. Professionalized Maintenance for Rural Water Service Provision: Toward a Common Language and Vision, SWS, UCB Concept Note; USAID. professionalized_maintenance_for_rural_water_service_provision_concept_note_20210308.pdf (globalwaters.org)

Ethiopia and one district in Uganda focusing on government-led maintenance systems; FundiFix, a social enterprise, working in two counties in Kenya with support from the University of Oxford; and Whave, which also operates as a social enterprise in 10 districts across all four regions of Uganda.

This report brings together SWS project partners' learnings generated based on primary data, interview transcripts, network analyses, operational reports, and other published reports. It also draws on UCB graduate student research into different aspects of systems analysis and applied methodologies, including system dynamics modeling and qualitative comparative analysis. In total this meta-analysis involved review and coding of 98 SWS project documents and other SWS raw data and learning outputs against 14 different themes, resulting in an analysis of common trends, gaps, and lessons of the **factors** and system behaviors relating to maintenance provision.

Findings

Based on the analysis of experiences and learning across the SWS partnership, a pathway or roadmap toward professionalization of maintenance provision has been developed. The roadmap, shown in figure 1 below, illustrates broad sets of system elements that need to be in place that appear to support the emergence and scaling of professionalized maintenance provision. These include validation of system factors that are already widely recognized, as well as new insights into the importance of desirable behaviors and dynamics between actors that are essential to professionalization of maintenance provision.

First, SWS identified a set of three foundational factors, or pillars, that are essential to underpinning the operation of professionalized maintenance providers. These reflect the classic separation of functions between service delivery (maintenance provider), the policies governing the arrangements and financing of the sector, and regulation of services. The three factors are as follows:

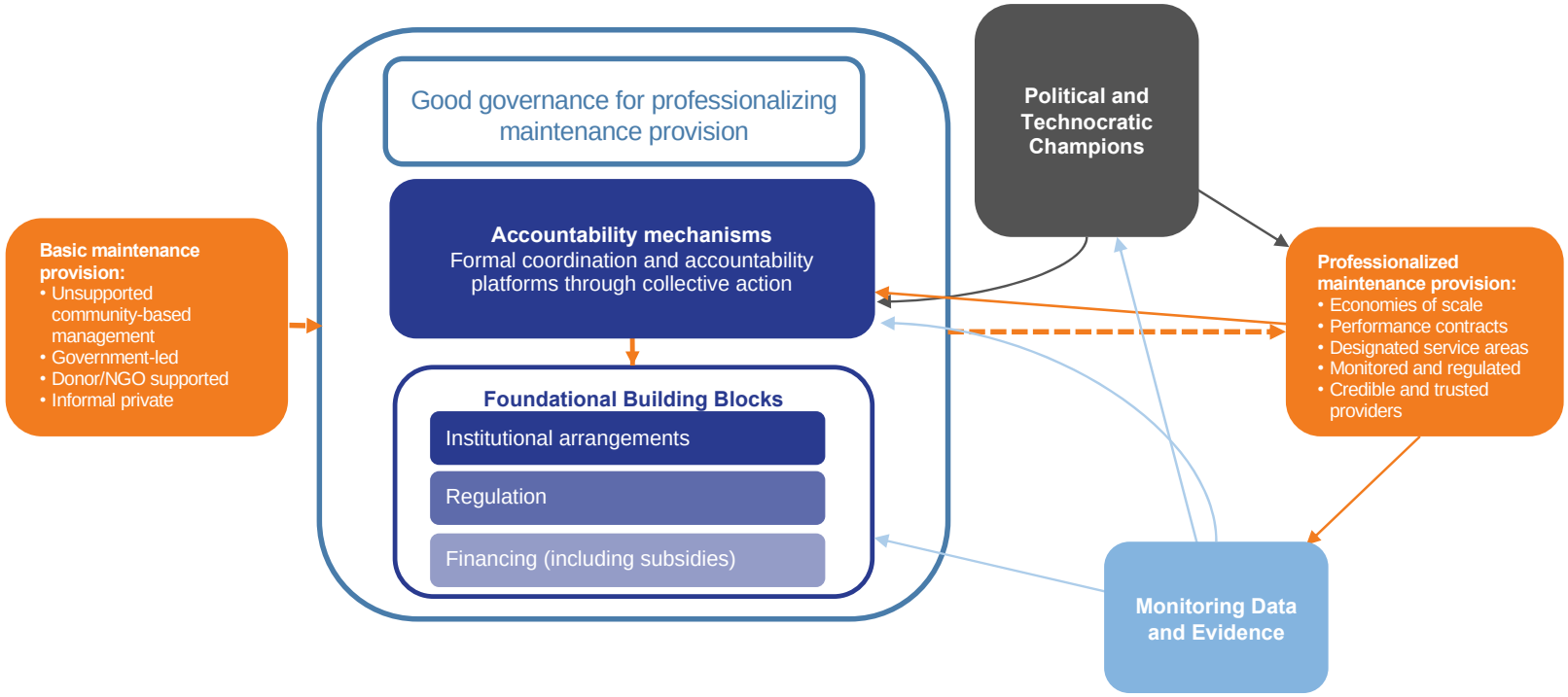
- Robust **institutional arrangements** determining which entities can provide maintenance services, establishing legal mechanisms for registering providers, and delineating exclusive service areas. Public entities, social enterprises, or private operators may provide these services; evidence shows that the logical **scale** of operation is at the decentralized local government level. SWS experience indicates that local governments play a key role at this scale by facilitating supportive environments for maintenance to take place; for example, they set and enforce local bylaws and leverage public financing (albeit to a limited extent) and put in place supportive measures such as removing barriers to consumer entry.

- As professionalized maintenance providers become established, more formalized **regulatory frameworks** are needed to protect consumer interests and monitor performance, particularly in cases where private entities provide the services. Of the three SWS countries, only Kenya has an independent regulator in place, but even in this case it has only a nascent presence for rural water service regulation. In Kenya and Uganda SWS partners have partially addressed the requirement for regulation by working with national protocols and supporting local government in its delegated regulatory functions to employ contracts for maintenance providers with explicit and measurable performance indicators.

- The third foundational pillar in the roadmap is **financing,** recognizing that consumer revenue alone cannot pay for maintenance provision. For example, data from FundiFix in Kenya indicate tariff income as a proportion of operational working costs ranges from only 16 percent to 21 percent, even though functionality rates of 98 percent have been achieved along with repair times of under 2 days. SWS findings suggest that subsidies will be required at least in the medium term to support high quality services. Transparent financing mechanisms with the ability

to deliver subsidies based on measurable performance metrics have been proven to work as part of the SWS learning; one such example is a trust fund mechanism established at the county level in Kenya, which provides a means of pooling funding from different sources, including aid **transfers** and potentially public financing, to fill the gap between tariff income and operational costs of private maintenance operators.

Figure 1. Systems roadmap for professionalizing maintenance services



The second set of system elements that SWS learning has highlighted concerns accountability between actors and the dynamics around perceptions and trust between consumers and professionalized providers.

Formal structures of reporting, flows of information, and decision-making exist in all national sectors in which SWS partners operate. The authority of sector line ministries to influence in a more "vertical" form of control is one dimension of such coordination, but across all three cases coordination at the *local water system level* emerges as being most important. In all cases, partners have promoted **collective action** approaches as a core part of their system strengthening efforts, ranging from IRC-supported **learning alliances** in Ethiopia and Uganda to the Kitui WASH forum in Kenya and Whave's quarterly public-private partnership review meetings in Uganda.

These are all examples of mechanisms that can hold different actors accountable to one another and facilitate dialogue, sharing of information, and the building of trust. Champions — both political and technocratic — can play an instrumental role in either enabling or undermining such accountability mechanisms. The importance of such accountability was a common and often cited learning across different SWS interventions. Strong accountability measures influence the credibility and perceived value of professionalized maintenance services for consumers. This is particularly important in societies where paying for service is interwoven with a set of dynamics and norms around the value of water, trust, the role of the state, political influence, and coherence among different stakeholders, including **service providers**, government, and external aid projects.

Accountability mechanisms are instrumental to socializing and establishing a common vision around maintenance provision, having open dialogue about challenges, and jointly discussing potential solutions. Such mechanisms also allow the space to share data, establish common agreements, and build consensus around terms and language used for maintenance, as well as working toward a common vision or desired outcome. They can provide a neutral platform to air grievances, even where an asymmetry in power relations exists among actors. Many rural communities still look to government or third-party NGOs or aid projects to step in and provide free repairs, which has proven to be a barrier to uptake of more professionalized approaches. SWS learning points to the importance of investing in and supporting regular fora or platforms that bring stakeholders together to facilitate open dialogue, share differing views, and work toward common goals.

The roadmap highlights feedback pathways that can become reinforcing over time. For example, the value of reliable data and information products generated by regular performance monitoring can provide evidence for both political leaders and technocrats. Such evidence can in turn provide legitimacy to the approach and enhance the ability of the system to generate more data.

Supporting Professionalized Maintenance: Where to Begin?

This report presents lessons for policy makers, funders, and implementers, illustrating the need for both a solid grounding in institutional, regulatory, and financing arrangements, as well as the critical importance of the "softer" processes for accountability and building trust. What emerges is a complex challenge with many potential entry points to strengthen a local rural water system; the key question is where to begin? Who can, and should, do what?

Different system stakeholders will be able to address distinct elements of the local system in support of improved maintenance, from governments who can control policy levers and funding streams, to donors and NGO development partners who can work in greater alignment toward a common vision of improved rural water services. One dimension is the *time* it may take to achieve the shift from existing maintenance arrangements to more professionalized solutions working at scale. Although no fixed blueprint exists, SWS learning suggests that such efforts are likely to take at least a decade, which is in line with time frames of most system-strengthening interventions. This has

implications for the funding cycles of donors, which are generally much shorter but should account for the sustained support required to achieve changes of this nature.

A critical starting point for any **actor** is to map and fully understand the local system before making any decisions about intervening. Different methods can be used to carry out a systems assessment, ranging from **political economy** tools, **asset** inventories, life-cycle costing, and organizational network analyses. Any system mapping should include key elements such as legislation and sector policies, institutional arrangements and capacities, system boundaries and actors, regulatory oversight, financing, and the role of subsidies. Additionally, important contextual factors should be well understood, such as demand and consumption patterns, cultural practices, seasonality of supply, the perception of households and communities about roles for maintenance, and the participation of non-state actors.

Recommendations for Funders

Before committing to major capital investments in the rural water sector, funders should ensure adequate arrangements are in place for **professionalized maintenance**. Where efforts are underway to establish and scale professionalized maintenance, it is critical to ensure that any new infrastructure or rehabilitation work does not disrupt existing arrangements, for example by undermining established tariff structures. If funding entities still have doubts about how water supply services will be maintained or if community end users are left to manage without support, they should include interventions to address policy gaps around water system maintenance. These could include supporting government efforts to draft new frameworks that allow different types of operators to enter the market, establishing an independent regulatory agency, or devolving regulatory functions to local governments.

Funders can also support the research and development of common contracting templates or define performance metrics to be used as key indicators for reporting. Funders can influence governments to strengthen these key elements and can also convince other donors to engage with national government ministries and politicians to push for greater public expenditure to support maintenance. Funders may also consider setting up or contributing to funding mechanisms, which can provide long-term financing for results-based subsidies through pooled or revolving funds. Lastly, funders should require grantees or contractors to begin professionalizing maintenance provision, particularly for those who may still be mainly working with voluntary, community-based approaches to service delivery.

Recommendations for Development Partner Implementing Agencies

The size and experience of implementing organizations can vary widely, from large-scale engineering or consulting companies managing multimillion dollar procurement contracts, to international NGOs and much smaller local charities. Regardless of scale, implementers should always coordinate with local government authorities within the system boundary and inform them of planned interventions. Implementers should also look to build capacity of local government while respecting and aligning with official protocols and operational guidelines. Critically, implementers should make themselves aware of tariff regimes and subsidy mechanisms and never undermine locally or nationally established levels of payment for maintenance. Implementers should actively participate in coordination platforms and in any form of collective action processes.

Implementers should always share data with local government and other actors in the system and avoid establishing parallel monitoring frameworks or data platforms that will not integrate with national frameworks. They should also respect existing institutional arrangements, regulations, and local bylaws that deal with rural water provision in general and maintenance provision specifically. For example, implementers should not promote management models that run counter to government-led efforts to reform rural maintenance provision. Implementing organizations should not intervene if major doubts exist about how water supply services will be maintained.

Recommendations for Advocacy Organizations

Civil society groups or coalitions of NGOs can play an important role in holding governments accountable and lobbying for improved services, particularly for the poorest and most marginalized. Recommendations for this group of stakeholders include engaging with government on policy reform to encourage and approve a wider range of maintenance providers and advocating for legislation or regulatory frameworks that can support improved approaches to rural water service delivery, including establishing the conditions for professionalized maintenance. Advocacy organizations can also directly lobby national and local governments to allocate a greater share of public funding to support long-term service delivery. Working with politicians, cultural, and business leaders at all levels is critical to socialize evidence about the importance of long-term professionalized maintenance and to build alliances for changes in policy. Documenting and disseminating well-researched and tested approaches to sustaining rural water service delivery can contribute to expanding sector knowledge and adoption of good practices.

Introduction

Background to the Rural Water Supply Challenge

Significant progress has been made in advancing first time access to basic water services, with coverage in rural areas increasing from 69 percent to 82 percent at a global level between 2000 and 2020.[7] However, this global figure masks geographic disparities, given that half of the 771 million people still lacking basic services in 2020 lived in sub-Saharan Africa. These household figures do not include schools and health care facilities; for example, data from 38 countries reporting to the Joint Monitoring Programme in 2019 indicate that only 55 percent of health care facilities in least developed countries had a drinking water service on premises from an improved source (a basic water service at such facilities).[8] Although water access challenges primarily affect low and lower-middle-income countries, high-income countries also face access gaps. For example, as recently as 2017, 3 percent of the rural population of the U.S. — around 1.75 million people —reported relying upon an unimproved water source.[9]

A further challenge for those in rural areas is maintaining both functionality and the expected levels of service. Although large-scale quantitative insights are insufficient to convey the magnitude or the nature of poor performance of rural water schemes, non-functionality figures of between 30 percent and 40 percent are often cited in various studies over the last two decades.[10,11,12,13,14] These figures refer particularly to water points fitted with hand pumps. Research into data from 47 countries in sub-Saharan Africa and the Asia-Pacific region suggest that approximately one in four handpumps in sub-Saharan Africa are non-functional at any point in time, which in 2015 was roughly equivalent to 175,000 inoperative water points.[15] Recent studies from Uganda found more than half of hand pumps to be non-functional, with another third not working adequately based on measures of design yield, extent of **downtime**, and water quality criteria compared with national standards.[16,17]

Conventional approaches to maintenance have largely been based on voluntary community-based management (CBM) with communities taking on the burden of maintenance themselves, with limited, if any, support from external agencies or local government.[18] This CBM model has struggled to ensure that rural water supply infrastructure is adequately maintained for a range of reasons, including lack of follow-up support, low technical capacity, poor levels of tariff collection leading to the inability to carry out repairs, and breakdown of management structures.[19,20,21] The default

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[7] UNICEF/WHO. 2021.
[8] UNICEF/WHO. 2019. WASH in Health Care Facilities: Global Baseline Report 2019. Geneva: WHO and UNICEF.
[9] UNICEF/WHO; 2019. Database accessed 05.06.2020 https://washdata.org/data/downloads#USA
[10] Baumann, E. 2009. "May-day! May-day! Our Hand Pumps are Not Working!" St. Gallen, Switzerland: Rural Water Supply Network (RWSN), Perspective No. 1.
[11] Sutton, S. 2005. "The Sub-Saharan Potential for Household Level Water Supply Improvement." Presented at 31st Water, Engineering and Development Centre (WEDC) International Conference, Kampala, Uganda.
[12] RWSN. 2009. "Myths of the Rural Water Supply Sector." St. Gallen, Switzerland: RWSN.
[13] Lockwood, H. and Smits, S. 2011. "Supporting Rural Water Supply: Moving Towards a Service Delivery Approach." Rugby, UK: Practical Action Publishing.
[14] World Bank. 2017
[15] Foster, T., Furey, S., Banks, B. and Willetts, J. 2019. "Functionality of Hand Pump Water Supplies: A Review of Data from Sub-Saharan Africa and the Asia-Pacific Region". *International Journal of Water Resources Development*, https://www.tandfonline.com/doi/abs/10.1080/07900627.2018.1543117?journalCode=cijw20
[16] MWE. 2019. "National Framework for Operation and Maintenance of Rural Water Infrastructure in Uganda", Directorate of Water Development, Rural Water Supply and Sanitation; MWE, Uganda.
[17] Owor, M., MacDonald, A.M., Bonsor, H.C., Okullo, J., Katusiime, F., Alupo, G., Berochan, G., Tumusiime, C., Lapworth, D., Whaley, L., Lark, R.M. 2017. UPGro Hidden Crisis Research Consortium — Survey 1 Country Report — Uganda. British Geological Survey (BGS) Open Report
[18] Lockwood and Smits. 2011.
[19] Schouten, T. and Moriarty, P. 2003. "Community Water, Community Management: From System to Service in Rural Areas" Practical Action Publishing. https://www.developmentbookshelf.com/doi/book/10.3362/9781780441061
[20] Lockwood and Smits. 2011.

approach of "fix on failure" often means that small technical problems become more complex and costly to repair, resulting in more downtime and service disruption.

With the adoption of the Sustainable Development Goals (SDGs) in 2015 and the ambitious aim of providing safely managed water for all, the water sector is at a pivotal point in its progress toward both closing the access gap and ensuring that services are maintained. By focusing only on the former challenge and continually building more infrastructure without adequately addressing effective long-term operation and maintenance, progress will be illusory, and the sector will fail to meet the SDG for rural populations. With only 9 years to go until the target date of 2030, it is critical to find more effective and durable solutions to the challenge of poor or intermittent functionality of infrastructure and limited sustainability of water services. Without a step-change in existing approaches, future government and donor investments are not likely to yield the expected impacts and benefits for health and livelihoods.

The Sustainable WASH Systems Learning Partnership

The failure to provide long-term, sustainable services is not only one of inadequate technology or management models at the point of delivery; it is a *systems failure.* Achieving sustained improvements in services will ultimately only come about by addressing the weaknesses of local and national systems that underpin water service delivery. The Sustainable WASH Systems Learning Partnership (SWS) is a 5-year global United States Agency for International Development (USAID) cooperative agreement testing systems-based approaches to improve service sustainability[22] of tools across local contexts in four countries,[23] and presents the largest exercise of its kind in the rural water sector that the researchers are aware of to date. The University of Colorado Boulder (UCB) leads the partnership, which emphasizes learning for catalytic change in the sector, testing new ideas, approaches, and tools to overcome systemic barriers to improving water service sustainability. Using systems-based analytical tools and processes to develop an understanding of local water systems can lead to the identification of interventions that strengthen these systems and to improved quality and durability of local services over time. More specifically, the project works with several partners that are actively engaged in operational delivery of, and iterative research into, improved maintenance provision, namely: IRC, operating in two regions of Ethiopia and one district in Uganda working closely with the government; FundiFix, working in two counties in Kenya with support from Oxford University; and Whave, which operates as a social enterprise in 10 districts across all four regions of Uganda.

In addition to partner engagement with maintenance at local and national levels, the project has identified professionalizing maintenance as a cross-cutting learning theme for USAID and other development partners working in the water sector. SWS is, therefore, looking at learning outcomes across its partners to better understand maintenance systems and the enabling — or limiting — factors that appear to be common across different contexts.

Objectives and Intended Audiences of This Report

This report presents the main findings from SWS and is structured around a roadmap for strengthening systems that can support professionalized maintenance provision. The intention is to use the findings to illustrate the most important elements of such systems, as well as the dynamics and behaviors that can positively support the emergence of viable professional maintenance providers. The analysis draws primarily on the extensive experience of SWS project partners from

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[21] Chowns E. 2015. "Is Community Management an Efficient and Effective Model of Public Service Delivery? Lessons from the Rural Water Supply Sector in Malawi"; in Public Administration and Development volume 35, 263–276.
[22] For further information on the SWS learning partnership, see: https://www.globalwaters.org/SWS
[23] In addition to Ethiopia, Kenya, and Uganda, SWS also had a program in Cambodia that drew upon the principles of collective impact and systems thinking to facilitate locally led and owned efforts to strengthen rural sanitation and hygiene service delivery that was completed in early 2019.

Ethiopia, Kenya, and Uganda, as well as insights from other global efforts to strengthen maintenance.[24] The main purpose of the report is to provide insights and knowledge for organizations, including governments, who are interested in supporting such arrangements. The report provides evidence to policy makers and funders of the value of investing in maintenance systems as an alternative to the existing paradigm: capital investment followed by premature loss of functionality and then repeated re-investment, sometimes referred to as "build, fail, and re-build." The main audiences of this report are:

1. Funders and policy makers from multilateral and bilateral donors, specifically USAID's Water Team and country staff who support rural water supply and are interested in sustaining and maximizing aid investments by strengthening local maintenance systems.
2. International and national NGOs and charities working in new construction, rehabilitation programs, or who currently support maintenance efforts based on the voluntary CBM paradigm who would benefit from information and evidence to consider alternatives, while retaining community decision-making and control.
3. Civil society advocacy groups and other sector stakeholders who need the evidence and arguments for investing more public funding into long-term service delivery and maintaining reliable water supplies.

Defining Professionalized Maintenance

Maintenance of any water supply scheme is a basic and essential intervention in preventing individual component failure, extending the useful life of such components, limiting deterioration of **service levels**, minimizing disruptions in services, lowering the costs of sustaining access levels to water in rural areas, and ultimately ensuring the continued operation of the scheme over time.

Maintenance is a subset of activities that fall under a broader umbrella of **infrastructure asset management**, a well-tested practice applied largely by utility operators in many countries, including low and lower-middle-income countries. However, these practices are less common in the rural water sub-sector, where even basic information on the location, age, and composition of water supply infrastructure is either not available or incomplete. Performance of regular maintenance is often lacking, meaning that small problems can quickly turn into much more costly and major technical challenges, resulting in extended service disruption.[25]

In terms of maintenance interventions, two main categories can be identified: (1) **preventive maintenance** involving regular inspection and servicing, including replacement of consumable spare parts, to preserve assets and minimize breakdowns carried out on a regular schedule according to the requirements of components of the scheme; and (2) corrective maintenance encompassing repair and replacement of broken and worn-out parts to sustain reliable facilities. This category can also include what is sometimes referred to as "crisis maintenance," implying a catastrophic failure, which requires an unplanned or emergency response to breakdowns and user complaints.[26]

Over the years different terms or labels have been used to capture maintenance activities, sometimes explicitly, but often rather loosely and interchangeably; these include periodic, preventative, preventive and/or corrective maintenance, reactive, effective maintenance, guaranteed maintenance services, and scheduled maintenance. SWS uses the term **professionalized maintenance** to bring greater commonality to the dialogue around rural water provision; this term is associated with 10 key institutional and operational characteristics and is defined below.[27]

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[24] A number of other groups and initiatives are working on maintenance issues as part of their programming including the Uptime consortia (https://www.uptimewater.org/) and RWSN, which is a global network for rural water supply professionals, with 10,000 members in more than 150 countries https://www.rural-water-supply.net/en/about/strategy.
[25] World Bank. 2017.
[26] Brikké, F. and Davis, J. 1995. "Making Your Water Supply Work: Operation and Maintenance of Small Water Supply Systems." Occasional Paper Series 29. The Hague, the Netherlands: IRC International Water and Sanitation Centre.
[27] Lockwood. 2021.

Professionalized maintenance involves trained personnel working within clear legal, policy, contractual, and accountability frameworks, which are monitored against performance indicators and with agreed financing arrangements and transparent, regulated pricing structures to carry out repair and support services of different types, on rural water infrastructure.

Although no formal global threshold exists in terms of performance, individual countries set targets for functionality rates and downtime as part of national policy or in regulatory frameworks where these exist. Data extracted from the WPDx repository for 31 sub-Saharan countries for water points over a 10-year period, show on average 76 percent functionality.[28] The research team consider functionality rates of 90 percent or more as a key indicator of an effective model of professionalized maintenance. This level of performance is aligned with national targets,[29] and rates in this range compare favorably to most experiences with CBM. This approach has in many cases been applied without the full support and guidance needed and has struggled to achieve these dimensions of service delivery (Moriarty et al., 2013; Carter R., 2021).[30,31,32]

Document Structure

The remainder of this report is divided into five sections as follows:

- Section 2 provides a historic overview of maintenance approaches for rural water.
- Section 3 outlines the methodologies adopted for the study and how maintenance systems across the different partner interventions were assessed.
- Section 4 provides a brief overview of the four SWS maintenance approaches investigated and the characteristics of the sector contexts in which they operate.
- Section 5 presents the main findings and a roadmap that illustrates how system strengthening for maintenance provision can best be achieved.
- Section 6 addresses where and how different stakeholders interested in supporting maintenance provision can start this process.

Historical Approaches to Maintenance of Rural Water Supply

Understanding how maintenance of rural water supply has been addressed in the past requires looking back over the evolution of approaches to management more broadly and the interplay between the state, community users, and market stakeholders, including NGOs and community-based organizations (CBOs) and the private sector.

Up until the turn of the century, most rural water supply approaches stemmed from the International Decade for Drinking Water and Sanitation in the 1980s, when community management emerged as the main model, largely as a reaction to the previous failure of centralized government delivery. Under this approach, external agencies made capital investments under the assumption that

[28] Water Point Data Exchange. 2021. https://data.waterpointdata.org/
[29] For example, the Government of Ethiopia has a target of 93% functionality and above as set out in its Growth and Transformation Plan II. In Uganda, the national policy aims for between 80% and 90% functionality with an ambitious repair downtime of no more than 24 hours.
[30] Moriarty, P., Smits, S., Butterworth, J., and Franceys, R. 2013. "Trends in Rural Water Supply: Towards a Service Delivery Approach". *Water Alternatives* 6 (3): 329-349.
[31] Carter, R. 2021. "Rural Community Water Supply: Sustainable Services for All" Rugby, UK: Practical Action Publishing; https://practicalactionpublishing.com/book/2556/rural-community-water-supply
[32] OECD. 2015. "The Governance of Water Regulators", OECD Studies on Water. Paris: OECD Publishing, http://www.oecd.org/gov/the-governance-of-water-regulators-9789264231092-en.htm

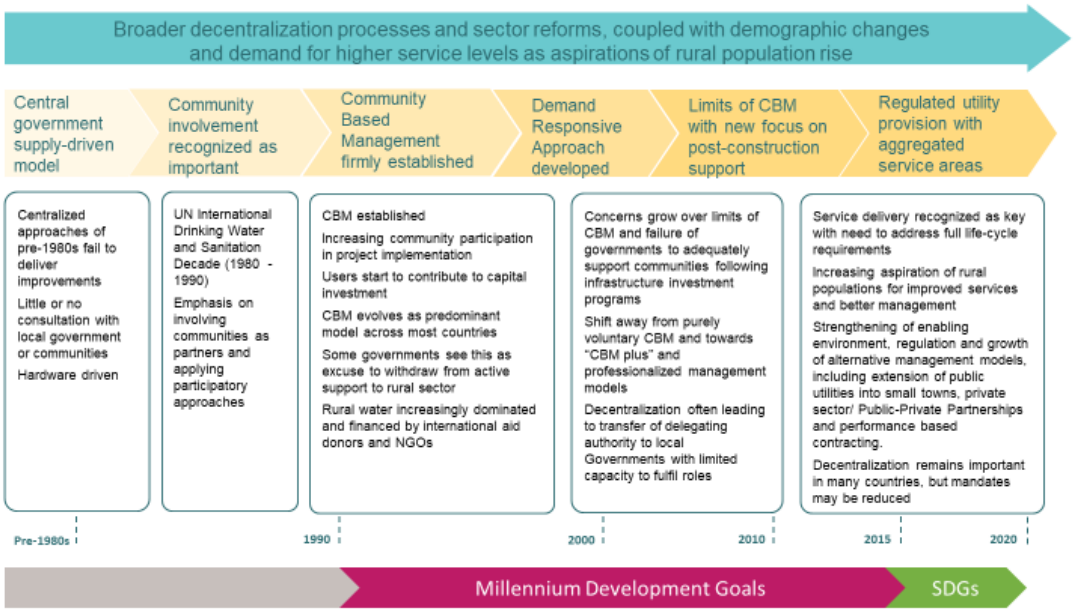
operations and maintenance (**O&M**) — and shifting risk for service continuity — would subsequently be taken up by communities following infrastructure "hand over" at the end of an installation project.[33]

By the early 2000s, ongoing challenges with the sustainability of service provision led to the questioning of this one size fits all approach and recognition of the limitations of such voluntary community management arrangements.[34] This questioning of CBM as the predominant paradigm also came about against the backdrop of increasing economic growth, demographic changes, urbanization, and increasing demand for more professionalized services. Several critical factors have undermined the ability of CBM to ensure adequate preventive maintenance and carry out major repairs when needed. These include the ability and willingness of governments to provide and finance long-term support to communities, limits to the capacity and accountability of community committees, willingness to pay for services that are perceived as unreliable or sub-standard, and the often-limited availability of reliable maintenance resources, including skills and spare parts.[35]

Addressing poor sustainability of rural water drove implementers to question CBM,[36] (Harvey and Reed, 2004) and a paradigm shift occurred in the late 2000s from the provision of infrastructure to a service delivery approach.[37]

[33] Moriarty et al. 2013.
[34] Schouten and Moriarty. 2003.
[35] SWS. 2020.
[36] Harvey, P. and Reed, B. 2004. "Rural Water Supply in Africa: Building Blocks for Hand Pump Sustainability." Loughborough University: WEDC.
[37] Lockwood and Smits. 2011.

Figure 2. Historical trends in rural water supply from the 1980s to 2020



The increasing **decentralization** of mandates for rural water service provision from central ministries to sub-national and local governments provided a further impetus to revisit the way in which management and O&M could be best achieved.[38] Finally, the move in many national sector policies toward a vision of piped supply on premises, reinforced by the SDG targets, set the bar high for improved service levels, requiring both professionalized management and maintenance.

Although the history of the rural water sector highlights the need for a transition to more professionalized management approaches, it should be emphasized that communities — and the community management entities that represent them — will continue to play an important role as key system actors. Firstly, the CBM model will always have a place in the range of approaches, particularly for highly dispersed rural populations and indeed is still employed as a viable solution in a number of Organization for Economic Cooperation and Development (OECD) countries.[39] Secondly, it is unrealistic to expect that services in rural areas of the global south will transition to a fully professionalized and regulated utility model in the near-term future. Therefore, as both management and maintenance services are progressively professionalized, community engagement will still be needed to collect bulk **tariffs** or report technical problems. Community management in some guise will, therefore, need to be better supported and improved as part of this transition.[40]

Evolving Approaches to Maintenance of Rural Water Service Delivery

As a response to these dynamics, increasing emphasis has been placed on providing ongoing support to community providers, as well as moving away from voluntary-based arrangements toward a diversification of management models, including various forms of private sector involvement. Specific entry points for strengthening CBM arrangements include more professionalized and service-

[38] Smits, S., Verhoeven, J., Moriarty, P.B., Fonseca, C., Lockwood, H. 2011. Arrangements and Cost of Providing Support to Rural Water Service Providers. WASHCost global working paper. The Netherlands: IRC. https://www.ircwash.org/sites/default/files/Smits-2011-Arrangements.pdf
[39] World Bank. 2017.
[40] Carter. 2021.

oriented management (for piped networks) and improved financial management and user participation in design of water points.[41]his trend has witnessed the growth and piloting of more innovative maintenance contracting, including clustering of water points under lease contracts, payment by results, and the emergence of public-private partnerships (PPPs), which seek to improve the management of piped water schemes in rural areas.[42] One end point of this transition is a vision of the "utilization"[43] of rural water service provision. Many OECD countries replicate this approach where the distinction between rural and urban consumers is blurred and cross-subsidies are used to support less commercially attractive populations. Ultimately, this is one of the principal pathways to achieving the SDGs, even though it will require careful management of more fragmented and heterogenous markets.[44,45]

The transition of institutional arrangements for rural water involves different stakeholders from across public, private, and community entities, assuming varying degrees of responsibility and risk for asset maintenance and (re)-investment. A wider range of approaches are now available to manage rural water services under which implementers can identify different management models. A management model is the combination of a service provider (e.g., the actor responsible for performing day-to-day operations of a water supply service, often including some element of maintenance), the **service authority** (i.e., the institution with the legal mandate to ensure water supply services are planned and delivered), and the associated enabling environment factors (e.g., regulation, monitoring, policy frameworks). Although not presented here, rural water services can also be provided through household self-supply, which faces similar challenges to unsupported CBM in terms of its professional support needs.[46] It is possible to cluster these into five main groups: [47,48,49,50]

1. **Unsupported CBM** where water committees operate with minimal or no post-construction financial or organizational support.
2. **Supported CBM**, which covers the wide range of improvements that have been made to CBM, including supported CBM, CBM with the **delegation** of predominantly technical functions to the private sector, and CBM with the formation of associations or federations.
3. **Local government** provision through the direct management of water supply facilities by a local government unit or department.
4. **Public or corporatized utility** provision encompassing the various different forms of utilities expanding to rural or small-town contexts or taking over the management of schemes in these contexts.

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[41] Marks, S.J., Kumpel E., Guo J., Bartram J., and Davis J. 2018. "Pathways to Sustainability: A Fuzzy-Set Qualitative Comparative Analysis of Rural Water Supply Program." *Journal of Cleaner Production* 205, 789e798.
[42] World Bank. 2017.
[43] The term utilization as a solution for the rural water sub-sector was first used by Manuel Alvarihno, the first Director of Mozambique's Water Regulatory Council circa 2009 and implies eventually moving toward a utility model for rural populations.
[44] Huston, A., Gaskin, S., Moriarty, P., and Martin, W. 2021. "More Sustainable Systems through Consolidation? The Changing Landscape of Rural Drinking Water Service Delivery in Uganda." *Water Alternatives* 14(1): 248-270.
[45] Franceys, R. 2019. Utilization', All Systems Go! WASH System Symposium, IRC, Den Haag, The Netherlands.
[46] Self-supply is an important and often highly complementary service delivery model and is recognized by the 2017 World Bank study. However, it is not included here because the emphasis is not on the management of individual household-level facilities.
[47] AGUASAN. 2008. Promising Management Models of Rural Water Supply Services Outcomes of the 24th AGUASAN Workshop Series, Gwatt, Switzerland.
[48] World Bank. 2017.
[49] WaterAid-Aguaconsult. 2018. "Management Models for Piped Water Supply Services: A Decision-Making Resource for Rural and Small-Town Contexts." WaterAid. https://washmatters.wateraid.org/publications/management-models-for-piped-water-supply
[50] USAID. 2020. "Rural Water Services". USAID Water and Development Technical Series, Technical Brief I. USAID. https://www.globalwaters.org/sites/default/files/usaid_rural_water_services_tech_brief_I.pdf

5. **Private operator** provision either through direct operation and management or through delegation of specific functions (which could include maintenance) by central or local government, a national asset holding entity, or purely private provision (i.e., invest, build, operate, and maintain).

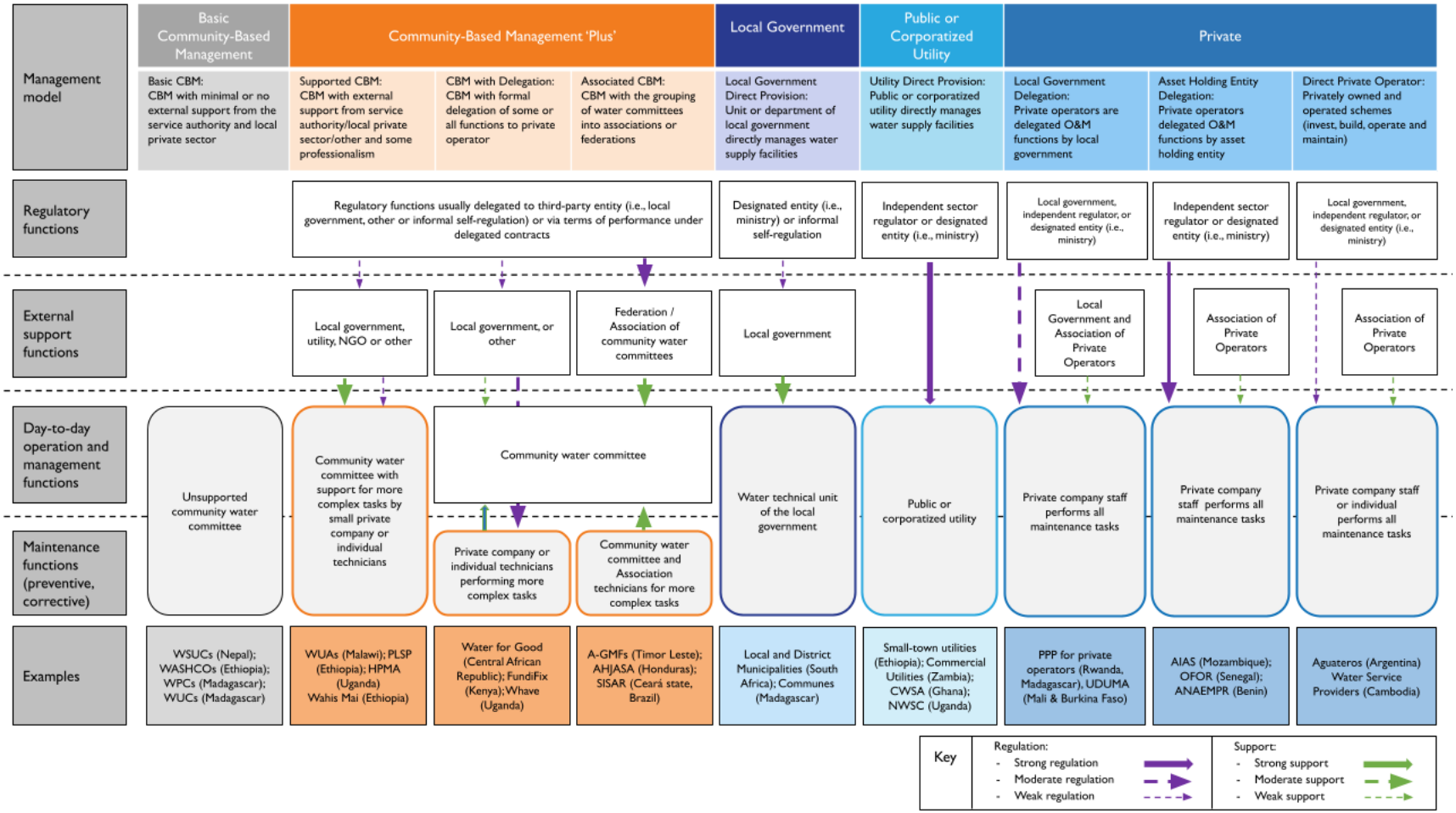
These five broad categories of management models include various permutations. Figure 3 below is based on the author's previous research, incorporates evidence from SWS, and provides a schematic highlighting nine main variants for rural water supply globally, indicating how maintenance functions are addressed in each one. These management models apply to low- and middle-income countries, as well as to more advanced OECD economies.

It is not possible for such a schematic to capture all nuances and hybrid arrangements are not reflected here. However, this framework does provide an overview of the main actors for each management model across four key sets of functions: regulatory, external support, day-to-day O&M, and maintenance (including both preventive and corrective). The arrows indicate the extent of regulation and support between actors with examples provided under each management model.

The schematic encompasses the three main overarching approaches for delivering maintenance services that SWS research identified: **ad-hoc reactive**, **structured proactive**, or **guaranteed service approach**.[51] However, these three overarching approaches do not fall neatly into the management models. Each variant contains examples of different overarching approaches to maintenance. For example, in the supported CBM category, CBM with delegation contains the structured proactive approach (i.e., Water for Good's Circuit Rider program in the Central African Republic), as well as examples of the guaranteed service approach (i.e., Whave in Uganda, FundiFix in Kenya). More broadly, within each of the examples identified, there are facilities where maintenance is performed on an ad-hoc, reactive basis when breakdowns occur, as well as examples of more structured proactive approaches where preventive maintenance is performed on a regular basis.

[51] Lockwood, H. 2019. Sustaining Rural Water: A Comparative Study of Maintenance Models for Community-Managed Schemes. SWS, UCB Technical Brief; USAID. Sustaining Rural Water: A Comparative Study of Maintenance Models for Community-Managed Schemes | Globalwaters.org

Figure 3. Generic institutional arrangements for management of rural water services, including maintenance tasks



Methodology for Capturing Learning on Maintenance

Assessing Maintenance Provision Through a Systems-Based Analysis

As set out previously, the persistent challenge of poor sustainability is considered a systems failure. This represents a failure of institutions, policies, and regulation, and their application in practice, which together undermine the effectiveness of rural water services. Maintenance forms a critical component of such a service once initial capital investments are made. However, this is not necessarily a failure or lack of capacity to carry out high quality maintenance; competent technicians and managers are available in most low- and middle-income countries to fulfil such functions.

SWS, therefore, seeks to understand and strengthen local systems, with the end goal of improving outcomes in terms of the sustainability and quality of services delivered to those who experience sub-standard water supply and sanitation. By definition, these are often the poorest and most marginalized in society. Systems thinking and systems-based approaches are based on the principal tenet of complexity: seemingly straightforward outcomes rely on a complex interaction of elements and interdependent actions that are non-linear and often unpredictable. One of the more popular definitions of a systems approach is: "An interconnected set of elements that is coherently organized in a way that achieves something (function or purpose)."[52]

Systems thinking in the water sector is increasingly recognized as a key approach to understanding and resolving the challenge of service delivery, especially in resource-poor contexts.[53] As a result, water supply is seen as a complex and constantly adaptive system, comprising different agents or actors and interacting and combining with a range of resources or factors.[54] For water supply, the system is taken to encompass the actors and factors that work together to deliver, manage, and regulate services.[55] The boundary for achieving this outcome can be described either geographically or administratively, usually at the national or district level.

It is necessary to consider **maintenance as a subsystem** of this larger water supply system, which itself is nested in broader local and national political economies. It is, therefore, subject to systemic process and influences, such as development planning priorities, decentralization, public administrative reforms, political influence, the impact of aid programs, as well as external economic shocks. Although it is possible to draw a boundary around any given maintenance subsystem, we must recognize that linkages — formal and informal processes, flows of information and resources, incentives and influences — will span between this subsystem, the wider local water system, and other national systems within which it operates.

The purpose of SWS is to understand these maintenance systems and identify gaps, weaknesses, and opportunities for improvement, leading to more sustainable and robust services in the long term. To gain these insights, SWS applied a range of systems-based tools and approaches to understand and measure changes in the strength of systems over time. These tools and approaches have not been limited to the topic of maintenance,[56] but many of the insights gained across SWS have value in understanding the system components and dynamics relating to maintaining rural water services. The systems-based approaches that SWS applied can be divided into three categories:

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[52] Meadows, D. 2008. "Thinking in Systems: A Primer"

[53] As a reflection of this growing acceptance of systems-based approaches, the "All Systems Go!" international symposium was held in 2019 focusing on WASH systems. More information available at: https://www.ircwash.org/symposium.

[54] Huston, A. and Moriarty, P. 2018. Understanding the WASH System and its Building Blocks." Building Strong WASH Systems for the SDGs; IRC Working Paper. https://www.ircwash.org/resources/understanding-wash-system-and-its-building-blocks

[55] Valcourt, N., Walters, J., Javernick-Will, A., Linden, K., and Hailegiorgis, B. 2020. "Understanding Rural Water Services as a Complex System: An Assessment of Key Factors as Potential Leverage Points for Improved Service Sustainability". *Sustainability 2020* 12 (3) Special Issue "Global Engineering and Sustainable Development" https://www.mdpi.com/2071-1050/12/3/1243

[56] There are three additional areas of cross-context learning being applied under SWS: (1) system stakeholder understanding, (2) collective action, and (3) network analysis. For more see: https://www.globalwaters.org/sws.

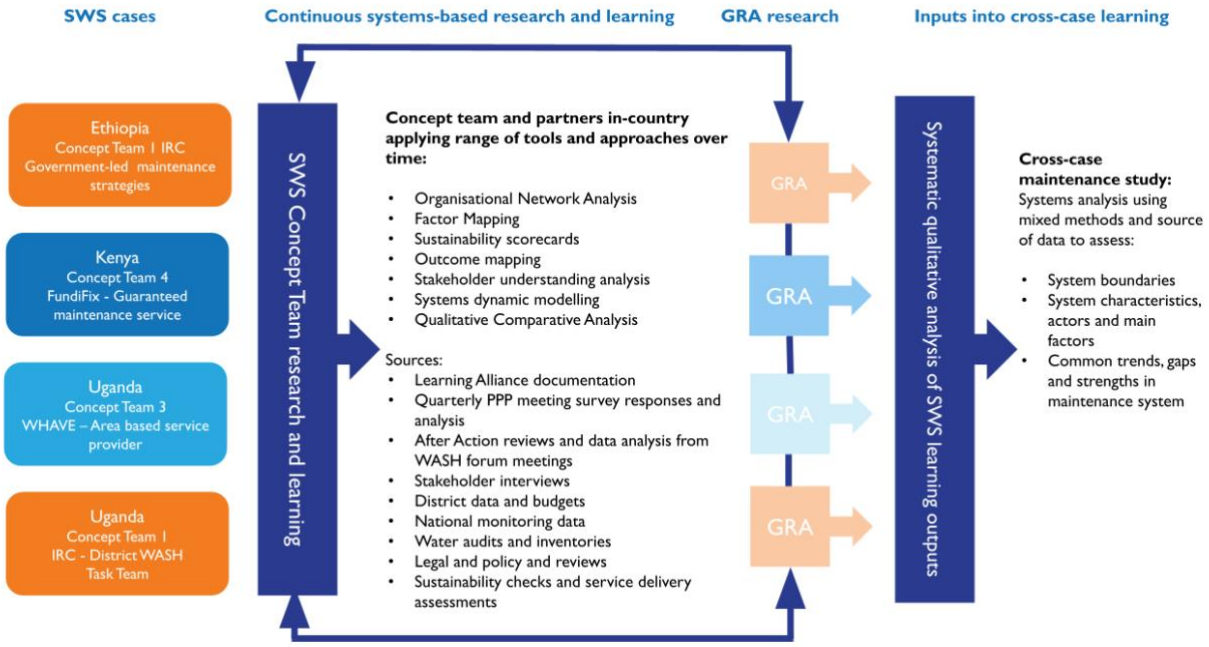
1. **Understanding system components:** generating insights about the key contextual factors and boundaries of a local water system including existing service levels, laws and regulations, financial flows, infrastructure assets, and local capacity. Examples of tools and approaches include: asset inventories, context and financial analysis, shit flow diagrams, and life-cycle cost analysis.
2. **Analyzing system interconnections:** analysis of the combinations of or interconnections among factors, conditions, or elements within a system, including the dynamic flow of information or resources through a system and changes in the system over time. Examples of tools and approaches include: factor mapping, sensor analysis, qualitative comparative analysis, network analysis, and system dynamics modeling.
3. **Measuring systems change:** assessing and measuring change in system factors, actors, and interconnections to evaluate the impact and sustainability of systems change. Examples of tools and approaches include: building block assessments, outcome mapping, service level assessments, sustainability assessments, and sustainability scorecards.

SWS is unique in applying such a range of tools across local contexts in four countries and presents the largest exercise of its kind in the rural water sector that the researchers are aware of to date. This study uses evidence taken from both quantitative and qualitative sources. First, and most importantly, is the learning generated by project partners over time at country level in the form of primary data collected through interviews, network analyses, operational reports, and published works. Second, the project also benefits from the graduate research assistants' investigations, each looking at a different aspect of systems analysis and applying a range of research methodologies, including system dynamic modeling, qualitative comparative analysis, and financial analysis. In total this meta-analysis involved a review and coding of 98 SWS project documents and other SWS case learning outputs (both internal gray documents and externally published reports) against 14 different themes with an analysis of common trends, gaps, and lessons (see Annex 1 for further details on the method used).

Figure 4 illustrates how these various streams of learning, using systems-based methods, are combined to inform this study and to derive overall lessons about the nature and characteristics of subsystems that underpin maintenance models in different contexts.

In spite of the large number and variety of evidence for learning around maintenance subsystems, the researchers recognize that this study is based on an aggregation of different systems-tools applied over a range of cases and with differing levels of detail and intensity. As such, it is a limitation to not be able to apply any one systematic approach across all four maintenance case studies and with the same level of rigor. Therefore, the final treatment of maintenance subsystems — and in answer to the SWS project's core learning question — will inevitably be based on a more fragmented method of analysis and differing levels of objectivity.

Figure 4. Systems-based methods and sources of learning and evidence for maintenance study



Context of SWS Project and Partners

National Governance Contexts and Rural Water Sector Overviews

SWS partners work on maintenance of rural water supply in three countries across eastern Africa:

- IRC works in two regions of Ethiopia (Southern Nations, Nationalities, and Peoples, or SNNPR, and Afar) and one district in Uganda (Kabarole)
- Whave works in 10 districts across all four regions in Uganda
- FundiFix operates in four rural sub-counties of Kenya: one in Kitui County and three in Kwale County

The World Bank classifies Ethiopia and Uganda as low-income countries, whereas Kenya is in the lower-middle-income bracket. Governance functions in all three countries have been decentralized, with Kenya having taken the deepest strides to devolve autonomy over many policy spheres to county-level government. Uganda has a long history of decentralization, including an element of fiscal transfer earmarked for water supply via conditional grants, however, the central government retains a strong degree of control and (political) oversight. In Ethiopia the regions wield a high degree of autonomy, but with a more limited level of decentralization to lower tiers of zones and woredas (see Annex 2).

Against the backdrop of increasingly decentralized power, rapidly growing populations, demographic shifts, and urbanizations, the rural water sectors in Kenya, Uganda, and Ethiopia are in a period of dynamic change. In all three countries, a conscious policy shift is happening away from community-managed hand pumps and point sources to piped water supplies at more convenient locations, including to the household, in line with the SDGs. The achievement of this vision will take time, requiring improved management, financing, and maintenance arrangements, and progress is taking place at a different speed in each country.[57] Annex 3 provides an overview of the rural water sector in each country, including institutional responsibilities for regulation and oversight as well as the officially sanctioned service delivery models and arrangements for maintenance.

In all three cases, sector funding for rural water supply is heavily reliant on aid funding in the form of both direct grants and concessionary loans, which largely focus on investment in new infrastructure. In Kenya, external financing is channeled via the central government, in part through repayable lending. For example, from 2016 to 2018, on average, the central government provided 39 percent of financing directly, with the remainder made up of external funding, but with a much higher proportion of repayable loans than grant funding (80 to 20 percent ratio in fiscal year 2015/2016).[58] Public resources (**taxes** and repayable loans) also tend to be directed at initial capital infrastructure investment, rather than on ongoing recurrent costs, including financing of core government functions relating to monitoring, maintenance provision, and direct support to CBM.

SWS Approaches to Maintenance Provision

This section provides a snapshot of the main components of the different maintenance approaches being applied across the four SWS interventions, as well as an indication of scale. Given the focus on understanding the systems that underpin these models, it is not the intention of this report to go into detailed descriptions, particularly as these have been documented elsewhere,[59] and each case has its own set of knowledge products and learning outputs.[60]

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[57] For example, the Government of Ethiopia's Growth and Transformation Plan II aims to reach 20% of the rural population with piped supplies by 2020, and in Uganda the Vision 2040 plan is much more ambitious with an 80% target for piped supply.
[58] KIPPRA. 2019. "Water and Sanitation Budget Brief." The Kenya Institute for Public Policy Research and Analysis Policy Brief series; No. 66/2018-2019.
[59] Lockwood. 2019.
[60] Further detail on SWS partner approaches and models can be found at https://globalwaters.org/SWS.

IRC: Government-Led Maintenance Approaches, SNNPR and Afar Regions, Ethiopia

Under guidance set out in the Ethiopian government's One WASH National Program, community-based Water Supply, Sanitation, and Hygiene Committees (WASHCOs) or formalized Water User Associations (WUAs), including community-appointed caretakers, are responsible for preventive and minor maintenance of water schemes. When the required maintenance is beyond their capacity, WASHCOs and WUAs can call in support from the woreda water office. The woreda may then escalate requests to either zonal departments, where these exist, or the Regional Water Bureau, if the repairs are complex and additional support is needed. The escalation process follows the different institutional levels established in the OneWASH National Program framework[61]

The primary responsibility for day-to-day operation and minor maintenance remains with communities who are also responsible to collect revenue from users and maintain funds in a bank account. For many years WASHCos had no legal recognition, but more recently the government has been promoting the legalization of committees across the country with a drive for registration with local authorities.

IRC Ethiopia is working in two different woredas, South Ari in SNNPR and Mille in Afar region, and promotes local innovation to strengthen systems through multi-stakeholder partnerships referred to as "learning alliances."[62,63] Through learning alliances, IRC supports local stakeholders to develop a better understanding of their local system and execute a shared action agenda. Because of differences in (ground) water availability and technologies, marked differences remain in maintenance requirements between regions. For example, the routine maintenance and repair of shallow wells and protected springs in South Ari are manageable for the CBM entities and woreda water office staff. By contrast, in Mille, services are mainly provided through deep wells with diesel powered pumps and some are equipped with solar panels or national grid electricity power. These schemes do not tend to break down with the same frequency as the point sources in South Ari, but when they do, repairs are often beyond the capacity of local stakeholders, and the Regional Water Bureau plays a greater role in maintenance and repairs. Additionally, in Mille the physical conditions are incredibly harsh for generators and equipment. Functionality rates in South Ari across three selected kebeles have reportedly risen from an average of 67.7 percent in 2017 to 81 percent in 2019.[64]

FundiFix: Guaranteed Maintenance Service, Kenya

FundiFix is a social enterprise that supports maintenance services in two rural Kenyan counties with two distinct physical environments.[65] Kitui County is semi-arid with high rainfall variability and two distinct rainy seasons (March–May and October–December). The second operational area is Kwale County, which is located in a coastal area with rainfall variability and seawater intrusion in the coastal strip, as well as a higher density of hand pumps. In total across the two counties, FundiFix serves approximately 79,000 beneficiaries using 108 hand pumps and 24 piped schemes as of December 2020. The enterprise started from a collaboration between the University of Oxford and the Kenyan engineering firm Rural Focus Ltd., which is based in Nairobi, in 2014. FundiFix operates a franchise model with two county-based companies that are locally staffed and equipped, and currently provide repair and maintenance services to communities and schools. The two privately registered Kenyan maintenance companies set up as franchisees of the FundiFix model are Miambani Ltd. and Kwale Hand Pump Services Ltd.

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[61] The different institutional levels are established in the federal government's ONE WASH Phase II program document, 2018.

[62] Darteh, B., Moriarty, P.B., Huston, A. 2019. How to Use Learning Alliances to Achieve Systems Change at Scale. Working Paper, IRC Netherlands. https://www.ircwash.org/sites/default/files/084-201909la_how_to_paperdef_web.pdf

[63] For further details on IRC Ethiopia, see https://www.ircwash.org/ethiopia.

[64] Pearce, J., Mekonta, L., McSpadden, B., Adank, M., Butterworth, J., Hailegiorgis, B., Ebrahim, M., Libey, A. 2020. "Second Interim Research Report on Strengthening Monitoring and Infrastructure Management In Pilot Woredas." SWS Concept 1, IRC Ethiopia, unpublished

[65] For further details of FundiFix, see https://fundifix.co.ke/.

The FundiFix model offers a performance-based approach and differs from the basic CBM model in Kenya, with maintenance tasks being formally contracted among communities, schools, clinics, the respective county government office, and the two FundiFix franchises. Annual renewable contracts with FundiFix's service providers stipulate key terms, including monthly service charges, breakdown response times for repair (within 3 to 5 days depending on water supply complexity), replacement of broken parts, and use of professional mechanics. The county government is a party to the contract, responsible for performance oversight, asset replacement, and extension of piped networks.

A key principle of FundiFix's approach is pooled risk, whereby scale reduces risk and associated costs, and pooling a larger number of water points under one maintenance framework leads to economies of scale. In terms of performance outcomes, FundiFix has proven to be highly effective, with average functionality rates of 98 percent, an average downtime of 1.62 days (for both hand pumps and piped schemes combined), and 96 percent of reported breakdowns fixed within the 3-day threshold (2020 data, based on 539 repairs).

In 2020, the two maintenance companies received more than $11,800 in revenue from user tariffs. Pumps are installed with meters, and communities are charged a per volume fee (~ 50 KES or around US $0.45 cents per m^3) based on water use. Fees are collected on a monthly basis; however, subsidies are required to make up the shortfall in operating costs. As part of the financing arrangements, two Water Service Maintenance Trust Funds (WSMTFs) were established, one in each county to channel financing from donor organizations, county government and public financiers, and other investors (e.g., philanthropists and private companies) to support maintenance provision. Each FundiFix enterprise applies for O&M gap financing to the respective county WSMTF in annual cycles; the trust funds review progress at the end of each cycle. The WSMTFs release funds to service providers based on the achievement of pre-identified performance targets. One of the aims of establishing the WSMTFs is to demonstrate that financing, including subsidies, can be channeled in a transparent and accountable way, and can be linked to performance-based outcomes that are carefully monitored and verified, including by county government.

Whave: Area Based Service Provider, Uganda

Whave is a social enterprise, registered in Uganda in 2012, operating as a maintenance company known as an Area Service Provider (ASP) or rural water utility, working on the basis of "guaranteed functionality." As of mid-2021, Whave operates in 10 districts across each of Uganda's four regions, with over 600 community service agreements supporting more than 160,000 individual service recipients.[66] Whave contracts local hand pump mechanics and trains them to follow preventive maintenance schedules and conduct immediate repairs with performance-related payment incentives. This approach has led to consistently high functionality levels, with Whave reporting functionality at over 98 percent on average since at least 2018, with few breakdowns occurring and repair times of less than 1 day in most cases, less than 2 days in more than 80 percent of cases, and less than 5 days in 100 percent of cases, with 91 percent customer satisfaction levels.

Whave builds PPPs with district local governments, signing a performance-based contract with each local government Water Authority that formally designates it as a maintenance service provider. Whave also signs service agreements with each community it serves, setting out respective roles and responsibilities, with community responsibility for welfare of vulnerable persons in terms of reliable access to safe water, security of the water assets, and collection of maintenance fees. Whave takes responsibility for preventive maintenance to minimize the number of breakdowns, and for immediate repairs. A key component of the PPP institutional design is that tariff price plans are agreed upon with communities and local and central government, ensuring that costs are affordable and balanced by revenue at regulated and government-approved levels. The government recognizes the model as an example of how maintenance services can be professionalized and is part of the transition to a rural utility approach. This approach is reflected in the Ministry of Water and Environment (MWE) National

[66] For further details on Whave, see: https://www.whave.org/.

O&M Framework released in late 2019, in which local governments are required to appoint maintenance ASPs and regulate them under performance contracts. Local governments are also encouraged to cluster together contracts so that a single ASP can grow to economic scale, enabling it to more feasibly balance cost and revenue and ensure stable water point reliability.[67]

Whave's service pledge to communities includes timely replacement of both major and minor components, with the target to eliminate the current scenario of communities waiting for hand pump repairs for months or even years. This service pledge incurs high costs, but Whave is committed to reaching full cost recovery, with all service costs being recovered from water user fees, although they are currently not at this point. Whave projects economically scaled service cost at $340 per hand pump per year, which implies household, institutional, and commercial maintenance fees at levels that are already socially accepted and affordable in rural communities. Tariffs comply with the recommended maximum of 3 percent of household income and are within the range of mandated household tariffs for rural water points outlined in sub-county bylaws and district resolutions.[68] Whave has developed and trialed three fee-payment modalities; annual bulk subscription by communities, with rebate incentives for early payment and mobile money payment integrated, has emerged as the most popular.[69]

IRC: District WASH Task Team, Kabarole District, Uganda

Over the past 10 years, IRC Uganda has worked with the local government authority in Kabarole District to test and improve maintenance services.[70] Hand Pump Mechanics Associations (HPMA) is a national government program that also receives significant external support from international NGOs to professionalize maintenance. The HPMA model is active in most districts; however, without external support, many remain as loose groupings of individual mechanics and struggle to provide any type of well-organized or routine preventive maintenance. This is compounded by the fact that over the years many water user committees have dissolved or become dysfunctional, which can limit the market for HMPAs.

Initially, much of IRC's work focused on strengthening district HPMAs with member mechanics represented in each sub-county. In Kabarole 18 hand pump mechanics served 1,077 water points and approximately 300,000 people in rural areas across the district. Individual hand pump mechanics at sub-county level may undertake small repairs with the water user committees and receive payment directly. In turn the mechanics are expected to contribute an annual membership fee to the HPMA, which is set by the association, but is normally around 20,000 Ugandan shillings (UGX) ($6.00). Any repair valued above UGX 400,000 ($107.50) is defined as a major repair. Above this threshold, maintenance tasks can be contracted to HPMAs by sub-county boards or by the District Water Office (DWO). In spite of these efforts, reported functionality rates from 2019 for rural water supply infrastructure in Kabarole remain low, at around 59 percent.

IRC Uganda is currently playing the role of a **hub** to an alliance of partners called the District WASH Task Team, which is led by the local government and focuses on operationalizing the new National O&M Framework. A key element of this framework, which has yet to be fully operationalized, is the role of sub-county government and the formation of Sub-County Water Supply and Sanitation Boards (SWSSBs). Under the O&M Framework such boards could potentially play several roles, including acting as direct service providers, or in an oversight and accountability role as service authorities. IRC supported the formation of six SWSSBs, documenting lessons to inform the development of an SWSSB operational manual as part of testing and operationalizing the National O&M Framework.

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[67] MWE. 2019.

[68] UNESCO. World Water Assessment Program webpage: http://www.unesco.org/new/en/natural-sciences/environment/water/wwap/facts-and-figures/all-facts-wwdr3/fact-55-charging-for-water/

[69] For further details of Whave's financing model, see "Investor's Guide to Rural Water Service Delivery" (forthcoming SWS report).

[70] For further details on IRC Uganda, see: https://www.ircwash.org/uganda.

Findings: Building Stronger Systems for Professionalized Maintenance Provision

A Roadmap for Professionalizing Maintenance Services

Based on the analysis of experiences and learning across the SWS partnership, the researchers developed a **roadmap** toward professionalization of maintenance provision. This roadmap represents the most important system factors, as well as desired behaviors and dynamics between actors that are considered essential to driving professionalization (a more detailed version of the roadmap is in Annex 4). Reading Figure 5 from left to right, this roadmap sets out the journey from an existing, but poorly performing or limited maintenance arrangement, to one that operates with economies of scale in well-defined service areas and with access to adequate financing and external oversight. The SWS learning suggests that a number of system elements need to be in place for a professionalized maintenance provider to operate at a financially viable scale:

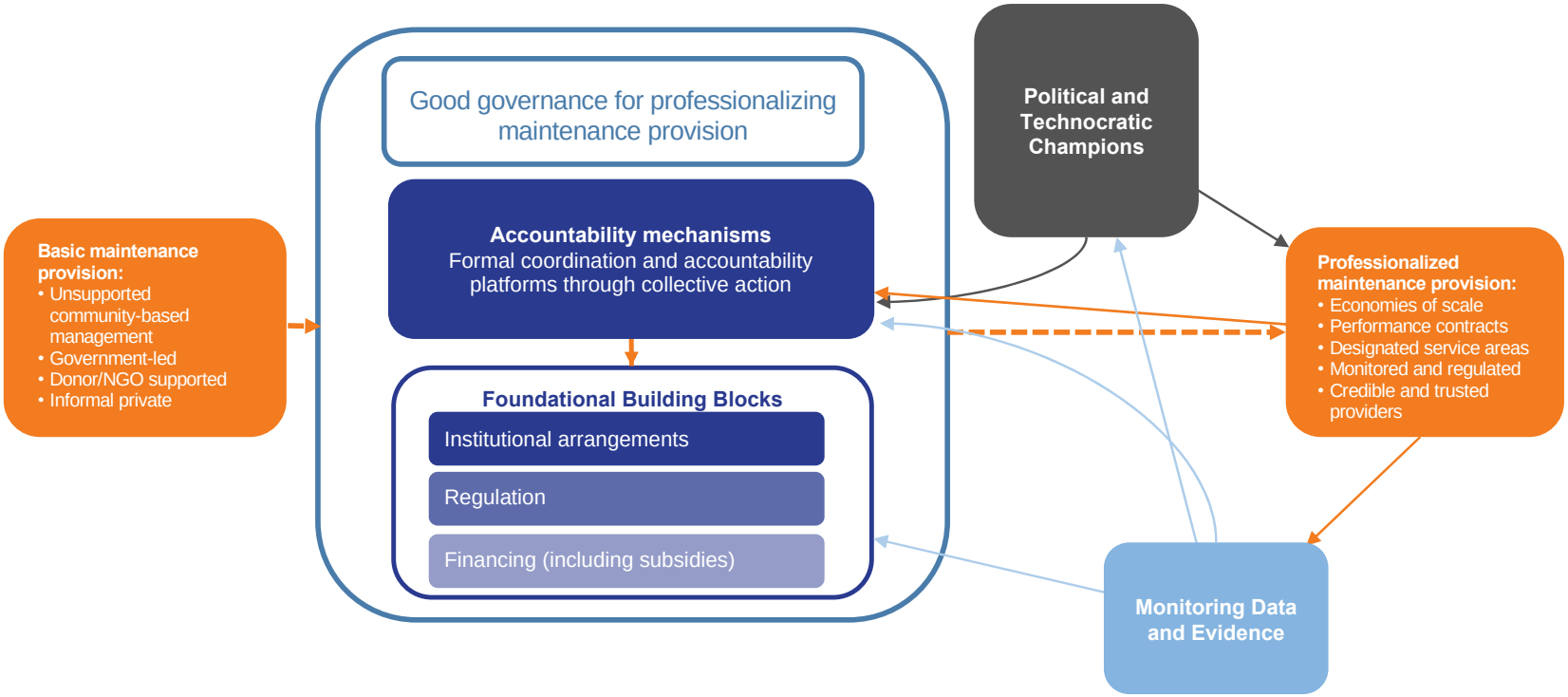
1. **Institutions, financing, and regulation**: A set of foundational factors that are essential to underpinning the operation of professionalized providers, including clear institutional arrangements and an adequate level of regulation, which can set and enforce the "rules of the game." Transparent financing mechanisms with the ability to deliver smart subsidies are also part of this grounding element and are essential to closing the gap between tariff revenue and operating costs.

2. **Accountability**: A set of formal and informal mechanisms and processes that can hold different actors accountable to one another and facilitate dialogue, sharing of information and the building of trust. Champions, both political and technocratic, can play an instrumental role in either enabling or undermining such accountability mechanisms. The importance of such elements of the system cannot be understated, as they influence the credibility and perceived value of (paying for) professionalized maintenance services for consumers. Local government plays a central role to establish and lead accountability efforts at the local system level.

Of course, other system factors, including having clear sector policies in place to establish unambiguous institutional arrangements, division of roles, and sharing of risk, should not be neglected. However, from the analysis of common lessons and trends across SWS cases, the most critical factors supporting professionalized maintenance are institutional structures, financing arrangements, and accountability processes and platforms. This roadmap also highlights feedback pathways that can become reinforcing over time. For example, providing political leaders and technocrats with monitoring data and evidence can provide credibility to the approach, which enhances the ability of the system to generate more data.

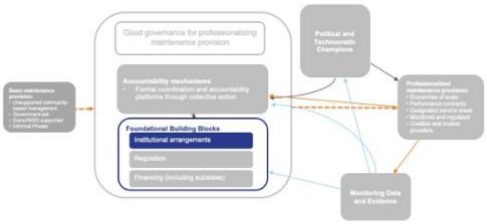
This section of the report unpacks this roadmap and presents evidence from SWS to illustrate how to strengthen a local system to support professionalization of maintenance services. The researchers recognize that there have been challenges with strengthening professionalized maintenance across all SWS cases and that they represent works in progress for a number of different reasons. The two enterprise-based models of FundiFix and Whave are not yet operating at full scale and rely on donor funding. In Ethiopia, the government-led model has had challenges with adopting the Asset Management System (AMS). IRC adopted a similar approach in support of the government in Kabarole, Uganda. In both cases public funding is highly constrained, and this has impacted the capacity of such government-led approaches to improve maintenance services. Nonetheless, the lessons from these cases point to what can be done to strengthen local water systems and improve the chances that a professionalized maintenance provision can be established.

Figure 5. Systems roadmap for professionalizing maintenance services



Getting the Fundamentals Right for Professionalizing Maintenance Services

Institutional Arrangements



Efforts to provide maintenance for rural water infrastructure will never occur in a vacuum. There will always be some form of maintenance provision, however inadequate or fragmented. Services may be provided by community volunteer technicians, through government- or donor-led programs, or indeed informal private providers. SWS learning illustrates that the successful establishment and scaling of professionalized maintenance provision is enabled when unambiguous institutional arrangements are in place. This applies at both the national and local levels. Without these system elements it is highly unlikely that any pilot will be able to succeed and grow; they include the establishment of clear roles and functions for different sector institutions, from service delivery to support functions, and establish which entity provides regulatory oversight. Clarity on the roles that different institutions play is critical to avoid duplication, or one arm of government undermining the efforts of another when delivering maintenance support services.

Institutional arrangements and regulatory frameworks are defined and established by sector policies and strategies that set out who is responsible for which functions and how responsibilities are shared, for example in terms of minor or major repairs. Critically, such policies also address responsibility for payment of O&M costs, including replacement of major asset components. Codification of policies and regulation is in turn often linked to the passage of legislation, either at national or local level, which provides legal backing, although enforcement is not always guaranteed in practice. Lastly, some aspects of professionalized maintenance provision, such as establishing PPPs, rely on government policy and legislation that goes beyond the confines of the water sector.

Importance of Scale, System Boundaries, and Actors

Over the past 10 years and more, understanding has been growing that the scale of intervention for effective delivery of rural water supply services must move beyond individual community interventions and to the level that can address systemic issues of capacity, financing, and oversight.[71,72] SWS's learnings have reinforced this lesson, concluding that the "district" (or decentralized level of government) represents a logical local system boundary for maintenance provision. This boundary contains a scalable set of actors and processes that, in combination, can support maintenance provision, but this level of scale also depends heavily on vertical linkages to function effectively, and is, therefore, subject to national level system dynamics. This is particularly true for core system factors and behaviors such as financing, enforcement of policy, and aid coordination, although much can be achieved at the local level.

SWS partners working in a variety of decentralized contexts are engaging with a range of different actors, including communities, national and international NGOs, political and cultural local leaders, and businesses and social enterprises. What emerges as a common feature in all cases is the **centrality of local government** as one of the most important system actors for maintenance provision. Arrangements for effective maintenance require some form of state authority, with access to adequate funding and the ability to pull on policy levers to engage with providers and to set and enforce the rules for service provision. Across the SWS cases, local government has shown to be somewhat effective in fulfilling this role and has been able to, with varying degrees of success, create a supportive environment for maintenance to take place. For example, responding to bottom-up accountability demands from sub-district actors in Uganda, enabled local government authorities to leverage public financing (albeit

[71] Lockwood and Smits. 2011.
[72] Huston and Moriarty. 2018.

to a limited extent) and put in place supportive measures such as removing barriers to consumer entry. However, in all cases local government suffers from limits to technical resources, financing, and policy awareness to provide support effectively, as well as institutional capacity challenges. These challenges flag the importance of adequate public financing if local governments are to fulfill their responsibilities and enable more consistent and sustainable maintenance models.

Across the SWS cases, the research team observed the importance of such policies as well as institutional arrangements. Even where some of these policies have only recently been introduced, the impact is marked and provides a "hook" onto which it is possible to both legitimize and promote new approaches. For example, clarity on sector policy for maintenance represents a major step forward in the case of Uganda's National O&M Framework, which transitions from CBM (see Box 1 for Whave's reaction to the new strategy).

Box 1: The Value of a National Strategy for O&M for Professional Maintenance Provision

The ministry's new rural water National O&M Framework is a huge step forward. It is important because it formalizes and legitimizes the PPP model advocated by Whave. Since this is now the official national model, we are able to scale our services and work with local governments and communities as before, but now with increased support… the structures and the guidance on key issues are clear, so scaling a professional maintenance PPP approach nationally is now ongoing. It provides a basis for collective work between Whave as a lead professional maintenance service provider and other stakeholders such as NGOs and politicians investing in infrastructure, the district governments, donors, the ministry, to accomplish the end goal of reliability assurance of all rural water points.

(Source: Whave, internal SWS learning meeting June 2020)

Likewise, in Kenya, the national Water Act, passed in 2016, laid important foundations for the recognition of the role of the private sector in water service provision, as well as protecting access in rural areas (ref. Article 94) that may be commercially non-viable. More recent guidelines further reinforce these policy positions and allow for new maintenance providers to emerge and for innovation in institutional arrangements to take place.[73] These national policy frameworks in turn can provide vital entry points for the development of local, devolved legislation and policy, as is the case for Kitui County, Kenya (see Box 2). One of the most important outcomes of having enabling policies and legislation in place is the ability to establish formal, long-term contracting frameworks and ring-fence concessionary service areas for maintenance. This in turn allows for pooling of risk, the aggregation of functions, and establishing common approaches to elements such as tariff setting and normalization of payment for service.

The inverse is also true — the absence of policies or legislation undermines the emergence of a strong maintenance system at the local level and can be a barrier to progress on public sector investment, enforcement of tariff collection, or movement to saturation scale. For example, in the case of Kumi and Kamuli districts in Uganda where Whave is operating, all sub-counties have passed lower-level bylaws in support of professionalized maintenance arrangements, but these are subject to district government confirmation. In both cases, the district governments are reluctant to legislate due to resistance to the removal of the discount pricing currently offered to communities, pressure from politicians, and benefits from the status quo.

[73] In late 2019 the Water Services Regulatory Board issued guidelines for provision of water and sanitation services in rural and underserved areas stipulating a number of different service delivery options, including delegation of operation and maintenance functions. From WASREB. 2019.b. "Guideline for Provision of Water and Sanitation Services in Rural and Underserved Areas." Water Services Regulatory Board, Kenya. https://wasreb.go.ke/downloads/Guideline%20on%20Provision%20of%20Water%20for%20Rural%20and%20Underserved%20Areas.pdf

Box 2: Local System Policy and Legislation in Kitui County, Kenya

The Kitui County Water Bill and Policy have been under development for the last 2 years, in part with support from SWS. These instruments were developed in tandem as part of the devolution process and build on national legislation and regulatory guidance. Together they set the foundation for the local system to support:

- Clarifying the role of the private sector in rural water service delivery and provide for formalized and long-term contracting frameworks.
- Granting private sector providers exclusive service concessions and enabling operation at scale.
- Acknowledging rural water services require subsidies and establishing transparent mechanisms for channeling of public subsidies to rural water services, including maintenance providers, which unlike the formal urban water services, have not been eligible for direct funding through county budgets.
- Strengthening county government's role in ensuring actors' investments, including NGOs, the private sector, and donors, align with its strategic direction.
- Establishing formal registration and reporting requirements ("regulation") for actors working in the WASH sector, coordinated by the office of the WASH forum.

The county cabinet is in the final stages of approving the bill and policy; the County Assembly legislative process will be next. Lessons include the importance of maintenance pilots and generating data/evidence on maintenance service provision in influencing policy responses, sequencing both instruments to legitimize actions and funding decisions, and integrating actor engagement and coalition-building that can reinforce subsequent implementation of both the bill and policy.

(Source: Information provided by FundiFix, July 2020)

From Policy to Practice: Bridging the Gap

SWS experience illustrates not only the importance of having good policies in place, with legislation to back them up where necessary, but the ability of the system to apply and enforce them in practice. This points to the importance of bridging the gap between policy and practice on the ground, particularly around capacity to deliver.

Challenges and barriers to professionalization are evident where policies or legislation exist but are poorly applied or not operationalized, or where capacity is severely constrained. As IRC flagged in its research findings from Ethiopia,[74] significant challenges exist in operationalizing policies, especially in terms of staff capacity and turnover, transportation, and the general working environment (i.e., lack of internet or working technology). For example, a clear institutional set-up for rural water service provision exists in South Ari, with defined roles and responsibilities for the WUAs and Gazer utility (the service providers) and the South Ari Woreda Water, Mines, and Energy Office (the service authority), with support from the zone and regional bureau. However, the South Ari woreda office is understaffed, with 61 percent of the required positions filled and only seven staff dedicated to rural water supply. In cases where the woreda governments struggle to fulfil their mandates due to such under-resourcing or lack of technical capacity, they are often bypassed, with higher level government structures stepping in to carry out repairs, which leads to confusion over mandates (e.g., among woreda, zonal, and regional teams). The conflation of responsibilities is also evident in Kenya, where FundiFix reports that confusion over maintenance roles and functions undermines coherence of service and responsibility to pay. Even with the CBM model, the county government and sub-county officers continue to directly intervene when major breakdowns occur or replacements are needed, and sometimes for minor issues.

Another important dimension in bridging the policy gap and applying a culture of maintenance is around the perceived value of investment in maintenance and the prioritization of service delivery — of which maintenance is a central component — over new construction or major rehabilitation. A lack of incentives or structures in place to monitor and support improvements in functionality reflects this

[74] Pearce et al. 2020.

reality when compared with the focus on construction of new water schemes that the government can immediately count as increased coverage. This is built-in, systemic bias must be addressed to shift the culture toward one of recognizing the value of "keeping the water flowing."

In Uganda, Whave is attempting to tackle this systemic weakness by instituting a pre-construction maintenance protocol, obliging new infrastructure investors to sign a maintenance agreement with an ASP prior to construction or rehabilitation.[75] The local governments are responsible for ensuring that NGOs and other new infrastructure investors are aware of and comply with this requirement. This provides a basis for the coordination among NGOs, the local governments, political representatives, and the ASP, embedding the concept of maintenance regimes from the start, thereby helping to sensitize communities as well as local government.

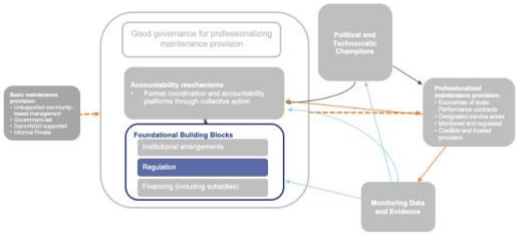
There is also the key question of how "good" policy is generated in the first place. In Uganda, good practice informed policy development. Over a 7-year period, Whave demonstrated the value of the PPP (or "Professional Management Approach," as that national government labeled it). This involved working closely with central and local government and many communities throughout the period and sharing in-depth results with all sector actors in annual workshops so that stakeholders could see practical results and methods.

Finally, compliance with national policies, and how these policies align with normative and cultural perspectives, can have a major impact on acceptance and trust that (potential) consumers will have with professionalized maintenance providers. For example, Uganda launched its National O&M Framework in August 2020, but many challenges and gaps remain in terms of translating the framework to district and sub-county levels and fully operationalizing its recommendations. This process depends upon the MWE officially communicating a directive to begin implementation to all districts, which may take many months if not years to fully achieve. The ministry is still reviewing the instrument at the time of this writing. A major part of ensuring that such a policy becomes fully operationalized with the associated instrument is the requirement to align with norms and beliefs of the main stakeholder groups involved. SWS interviewed 93 local government actors in Uganda and applied Organizational Institutional Theory to discuss their roles and responsibilities in water service delivery and determine what influences their actions and decisions. Most influences cited spanned norms and shared beliefs, including political dynamics, expectations within relationships between each other and with constituents, notions of identity as local leaders, and a general lack of self-efficacy for fulfilling allocated responsibilities. Conversely, policies and formal rules and structures were seldom referenced to influence actions and decisions related to service delivery. These results highlight the importance of ensuring that new policies and newly allocated roles and responsibilities align with the broader social contexts in which they are being implemented.[76]

[75] Harvey, A. 2021. "Ten Factors for Viable Rural Water Services." SWS, UCB Research Report; USAID. https://www.globalwaters.org/resources/assets/ten-factors-viable-rural-water-services

[76] Cord C., Javernick-Will A., Buhungiro, E., Harvey A., Linden K. 2021a. "Institutional Influences on Local Government Support for Professionalized Maintenance of Water Supply Infrastructure in Rural Uganda: A Qualitative Analysis," *Publication pending.*

Regulating Professionalized Maintenance Services



As professionalized maintenance services for rural water become established, more formalized regulatory frameworks are needed to protect consumer interests, particularly when private entities are providing the service. Across the SWS cases evidence of regulation emerged as a core system building block, particularly for enforcing agreed upon service operating areas and normalizing common tariff regimes. Currently, it is the general absence of effective regulation of the rural water sector that is a barrier to progress for professionalized maintenance providers working under SWS. As one SWS project stakeholder states simply: "*Without a good regulator, you can't get things done.*" These constraints involve many aspects of performance but are particularly critical in relation to tariff setting and compliance, the ring-fencing of service areas, and preventing actors such as NGOs or charities from under-cutting common approaches and tariff levels.

Among the three SWS countries, Kenya is the only case with an independent sector regulator. In Uganda and Ethiopia, regulatory functions are in theory channeled through government (via centralized and deconcentrated ministry representation and local government), which is a recognized model for regulation.[77] However, the extent and effectiveness of regulation at the local system level are considered weak. For example, even in Kenya, the focus of the Water Services Regulatory Board (WASREB) is largely on urban utilities due to a capacity constraint of engaging with thousands of rural service providers across the country, which are largely CBM entities. In the case of Whave and FundiFix, putting government-monitored performance contracts in place enhances regulatory capabilities.

No professional regulatory authority oversees provision of licensing of maintenance providers, which would be able to apply sanctions, withdraw licensing, and provide incentives to providers to improve performance.[78]

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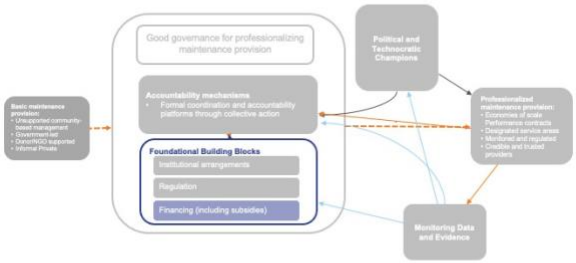
[77] OECD. 2015.

[78] This is the approach followed in Rwanda where district governments are empowered to contract private operators with existing licenses let by the Rwanda Utilities Regulatory Authority (RURA) after competitive bidding for the O&M of piped water schemes, which are segregated into "clusters," grouping all services in a given geographic area. District government retains ownership of the assets, and the private service provider takes on operation, maintenance, and administration functions under long-term affermage contracts, under which risk is transferred to the operators. The district also receives a fee, or royalty, for each cubic meter of water sold under delegated contracts, currently set by the regulator at 10 percent of revenue. From: MININFRA. 2018. "Water and Sanitation Sector Strategic Plan 2018–2024; Ministry of Infrastructure, Government of Rwanda.

Paying For Professionalized Maintenance

Experience from SWS cases reconfirms financing as a critical system factor, as well as the important lesson that higher service levels can help increase consumer revenue, but it still will not enable professionalized maintenance providers to cover the full costs. Financial data from FundiFix in Kitui County, Kenya, illustrates the extent of subsidy required (see Box 3). The need for subsidies is not a new phenomenon and indeed still applies to many rural consumers in OECD contexts.[79] The challenge is one of making subsidies transparent and progressive, in terms of targeting the poorest in society and avoiding distortionary impacts on service delivery.[80]



One commonly held belief is that rural households are simply too poor to afford the level of tariffs required for professional maintenance providers to cover their full operational costs. And while this is undoubtedly a significant factor, there are also many examples of poor households making contributions above the ratio for affordability commonly cited as 3 percent of overall household income or expenditure.[81,82,83,84]

SWS partners flagged low household incomes, particularly for some subsistence rural communities where a cash economy is lacking, as one barrier

Box 3. Increasing Tariff Revenues Is Not Enough to Meet the Full Costs of Maintenance Provision

FundiFix has demonstrated that through improving services — with functionality rates of 98 percent and repair times of under 2 days from reporting — professionalized maintenance approaches can stimulate greater levels of consumer payment. However, there is a limit to tariff revenue. Communities pay a monthly tariff for unlimited repairs (excluding capital expenditure), and under this system, revenues from rural water users in Kitui County were over $19,000 from 2019 to 2020. This supplied reliable drinking water services to around 58,000 people in rural communities. But this income has not been enough to pay for the costs of FundiFix's Kitui operations. For example, the average direct working ratios covered by user payments ranged from only 16 percent to a maximum of 21 percent in 2019. The shortfall in revenue has been made up with funding via the WSMTF and other external grants totaling around $132,000 over the same period.

(Source: FundiFix internal presentation 2021)

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[79] According to Franceys (2019), in the U.S. (with a GDP per capita of $59,500), federal grants and loan subsidies for water utilities infrastructure convert to an approximate $115 CapEx subsidies per rural person per year and $23 per rural person per year in OpEx support. Likewise, in low-population density rural France (GDP per capita $38,500) the government is investing EUR 6.5 billion over the next 5 years in grants (EUR 4.5 billion) and low-cost (concessional) loans (EUR 2 billion) to upgrade and update water supply and sanitation systems in rural areas. This indicates government subsidies of $108 per rural person per year (on the assumption that all funding goes to rural communities). Another study found even higher subsidies in the high-income small city of Boulder, Colorado, of $376 per person (56% of funding from federal, state, and local sources) as compared to subsidy levels of $0-1.36 per person in the SWS countries of Kenya, Cambodia, and Ethiopia. From: Libey, A., Adank, M., and Thomas, E. 2020. Who Pays for Water? Comparing Life Cycle Costs of Water Services Among Several Low, Medium and High-Income Utilities. World Development, 136, 105155. https://doi.org/10.1016/j.worlddev.2020.105155

[80] Andres, L., Thibert, M., Lombana Cordoba, C., Danilenko, A., Joseph, G., Borja-Vega, C. 2019. "Doing More with Less: Smarter Subsidies for Water Supply and Sanitation." Washington, DC. :World Bank, © World Bank. https://openknowledge.worldbank.org/handle/10986/32277

[81] World Bank. 2017.

[82] In an overwhelming majority of African countries, the combined capital and O&M costs of "basic" WASH services exceed 5% of a poor person's annual income in urban areas. Additionally, the same costs of basic WASH services are above 4% of a poor person's annual income in the rural areas of most African countries. From World Bank. 2016.

[83] This is also evident in higher income countries. In England, for example, 23% of households spend more than 3% of their income on services, while a further 8% spend more than 5% of their income on services.

[84] Carter. 2021.

for payment of tariffs for professionalized maintenance. However, the situation is nuanced, and several other important reasons explain why the revenue generated from user tariffs is inadequate; these include the following:

- Local hydrogeological conditions, reduction in demand due to seasonality of water supplies, and the availability of alternative "free" water sources such as surface ponds, shallow wells, or irrigation ditches has emerged as an important driver for payment behaviors. These conditions can cause a drop in consumer demand that undermines regular tariff payments[85,86]

- The question of who should pay for repairs is another common and strongly cited factor that can influence the willingness of communities and households to pay for maintenance services. Perceptions over responsibility for maintenance, which can stem from socio-cultural opinions about the value of water and obligations of the state as duty bearers, are strongly held across many rural populations, particularly when the provider is perceived to be "making a profit." For example, in Ethiopia, most consumers perceive that government or NGOs should pay for such services. Similar findings have been flagged in the other three SWS cases in Kenya and Uganda; for example, interviews with 93 local government staff in Uganda uncovered actors also believe that they should be providing free services to consumers, with aid partners providing supplementary funding to ensure communities receive free infrastructure repairs.[87]

- A major cause of inadequate revenue for professional maintenance providers is the inconsistency of tariff regimes across their operational areas. This may have a number of underlying causes, including lack of uniform tariff setting between national and local governments or the fact that different stakeholders — often externally funded aid projects or NGOs — set lower rates that disincentivize communities in the same service area. For example, Whave found that certain regulations produced a major disincentive for payment: those that stipulated government water departments or aid organizations take responsibility for repairs over a certain value, while communities are put in charge of smaller repairs. This caused communities to neglect small repairs to defer costs, with the result that the numbers and severity of breakdowns exceeded what the external parties could address.

- Another well-recognized disincentive for payment occurs through political influence and electioneering, where during political campaigns local politicians or members of parliament may offer the promise of "free water" or at least free repairs to communities, who then are less motivated to pay for maintenance services.

The lessons that SWS uncovered serve to demonstrate the complexity of the systems challenge in this critical area of financing of maintenance services and highlights that willingness to pay for a service goes beyond only the capacity to do so. Paying for a (maintenance) service is interwoven with a set of dynamics and norms around the value of water, trust, the role of the state, politics, and coherence among different stakeholders, including service providers, government, and aid projects. SWS project partner insights around financing are discussed in the following section.

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[85] Olaerts L., Walters, J., Linden, K., Javernick-Will, A., and Harvey , A. 2019. "Factors Influencing Revenue Collection for Preventative Maintenance of Community Water Systems: A Fuzzy-Set Qualitative Comparative Analysis" in *Sustainability* 2019 — Volume 11, Issue 13. https://www.globalwaters.org/sites/default/files/sustainability-sws-preventive-maintenance.pdf

[86] Hope R., Thomson, P., Koehler J. and Foster T. 2020. "Rethinking the Economics of Rural Water in Africa" in Oxford Review of Economic Policy, Volume 36, Number 1, 2020, pp. 171–190; https://academic.oup.com/oxrep/article/36/1/171/5696680

[87] Cord. 2021a.

Solutions to Meeting the Financing Gap at Scale Require Transparency and Good Governance, Not Just More Money

Having transparent and robust mechanisms (backed by formal policy or legislation, if necessary) to blend different sources of financing (tariff revenue, public subsidies, and private sector financing) is a critical factor in addressing the shortfall in financing for professionalized maintenance. Given that services cannot be fully financed via consumer tariff revenues alone, the ability to pool together finance from a range of sources is required at least for the immediate future to allow for subsidies to be directed efficiently. The scale of funding beyond tariff revenues required to support professionalized maintenance is not fully know, but recent research by the Uptime consortium[88] (of which both FundiFix and Whave are members along with three other providers in Africa) gives some insights. Uptime estimates the order of magnitude per capita cost for the provision of professionalized maintenance services is $0.91 cents per person per year.[89] Interestingly, this is in line with earlier research for "external support," which estimated a threshold of $1 per person per year to finance service provision.[90] One important emergent trend for maintenance services is linking subsidies to performance targets, which ensures transparency and an objective measure of output against which to make payments.[91]

Overcoming lack of clarity and trust in committing public financing on the part of (decentralized) government is especially important. This has been addressed in Kenya through the establishment of a trust fund mechanism that sits alongside the FundiFix franchise providers. The trust fund provides a means of pooling funding from different sources, including aid transfers and, in the case of Kwale County, private funding in the form of grants. This mechanism also provides the potential to use public funding to fill the gap between tariff income and cost recovery for private maintenance operators if county governments are able to support maintenance services in the future. The trust fund allows for a transparent mechanism for payments based on performance targets to bridge this gap.[92] The county government in Kitui is in the process of passing a water bill that will institutionalize this model via a similar county-owned Kitui Water Services Trust Fund. This will include a county government commitment to spend a proportion of its annual water sector development budget on the fund. To date the scale of funding has not been made clear.

Getting to Scale, Saturation, and the Benefit of Uniform Tariffs

Neither Whave nor FundiFix have yet reached saturation in terms of provision to an entire local water system boundary, such as a sub-county or district. By definition, the government-led cases in Kabarole, Uganda, and Ethiopia already operate at this scale, but in reality, they do not always reach all rural communities due to resource and logistics constraints. Despite this, partners such as Whave are learning that scaling and saturation to reach economies-of-scale and the social normalization of tariffs is an essential precondition to raising service fees to viable levels. To achieve such scale, it is also critical that all actors, and most notably local governments, fulfil their roles and responsibilities to enforce common rules, tariff regimes, and compliance with recognized service delivery models (i.e., not allow NGOs or charities to disrupt agreed-upon tariffs).

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[88] For further details on Uptime, see https://www.uptimewater.org/.

[89] McNicholl, D., Hope, R., Money, A., Lane, A., Armstrong, A., van der Wilk, N., Dupuis, M., Harvey, A., Nyaga, C., Womble, S., Favre, D., Allen, J., Katuva, J., Barbotte, T., Buhungiro, E., Thomson, P., and Koehler, J. 2019. Performance-Based Funding for Reliable Rural Water Services in Africa. Uptime Consortium, Working Paper 1. Available at: https://www.smithschool.ox.ac.uk/research/water/report-performance-based-funding.html

[90] Smits et al., 2011

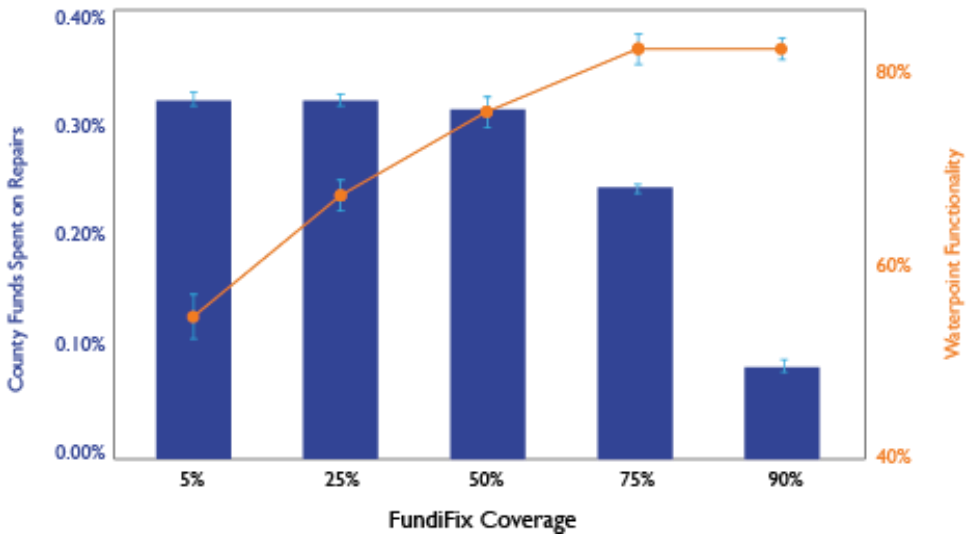
[91] McNicholl, D., Hope, R., Money, A., Lane, A., Armstrong, A., Dupuis, M., Harvey, A., Nyaga, C., Womble, S., Allen, J., Katuva., J., Barbotte, T., Lambert, L., Staub, M., Thomson, P., and Koehler, J. (2020). Results-Based Contracts for Rural Water Services. Uptime consortium, Working Paper 2. Available at: https://www.uptimewater.org/s/Results-Based-Contracts-for-Rural-WaterServices.pdf

[92] For more information on the FundiFix Trust Fund mechanism, see http://www.oxwater.uk/uploads/7/1/5/7/71579819/trust_fund_leaflet.pdf.

Contract retention for professionalized services is an important indication of customer satisfaction and potential for sustainable scaling of revenue income. SWS research into the retention of maintenance contracts over time among sub-counties in Uganda where Whave operates highlights the necessity of local government participation as a condition for success. All successful cases of contract renewal shared a high level of local government participation plus the important condition of social normalization of professionalized maintenance, indicated by continued growth of the ASP. All but one case achieved success with only one additional social condition, coordinated sector aid. In these instances all NGOs active in the water sector aligned their implementation with national and local mandates and with each other. The only case achieving high contract retention without aid coordination relied on larger communities that were easier to reach. Whave field staff and government partners held regular community meetings to discuss the benefits of professionalized maintenance to counteract expectations of free but unsustainable repairs.[93] Another success involved local leaders in this process to further legitimize Whave's maintenance services and increase trust.

UCB researchers produced modeling results from Kitui County, Kenya, that show financial benefits occur once professionalized maintenance service levels surpass a 50 percent coverage threshold.[94] Beyond this point, the modeling indicates that major breakdowns are reduced to a point where the intermittency of government funding availability becomes less of a constraint.[95] At lower coverage levels, a backlog of broken infrastructure accumulates in periods between national government allocations to the county level, leading to a depletion of repair funds when they become available. At higher maintenance coverage levels there is less demand for government repair funds, freeing up funds that could potentially offset maintenance costs (see Figure 6 below).

Figure 6. System Dynamics Modeling results showing impact of scaling up coverage of professionalized maintenance provision (Source: Chintalapati 2021)



[93] Cord C., Javernick-Will A., Buhungiro, E., Harvey A., Linden K. 2021b. "Enabling Professionalized Maintenance of Rural Water Infrastructure in East Africa: Pathways to Contract Retention Across Local Contexts." *Publication pending.*
[94] Chintalapati P., Nyaga C., Walters J., Koehler J., Javernick-Will A., Linden K. 2021. "Improving Sustainability of Water Service Delivery in Rural Kenya Through Professionalized Maintenance: A System Dynamics Perspective." *Publication pending*
[95] The reduction is the effect of scaled professionalized maintenance on county repair funds spent on major breakdowns. Beyond 50 percent coverage level, the model assumes FundiFix is providing responses to both minor and major breakdowns and therefore the effect is the result of a combination of preventive maintenance activities, which reduce the severity of major breakdowns (quantified in the model as downtime) and a shift in responsibility for the major breakdowns from county government to FundiFix, thereby reducing the amount of money the county has to spend on major repairs.

In Uganda, Whave is using a different approach through efforts to establish formalized and uniform tariffs or "price plans" that can be decreed under bylaws at the sub-county level and district ordinances. Once established, these price plans can be applied across a range of community sizes to allow a surplus to be derived from larger communities that have lower maintenance costs per consumer than in smaller ones, thereby contributing a subsidy (see Box 4 below). This approach also recognizes the reality of significant wealth disparities within communities that is accounted for in two ways. First, the water committee pays a bulk tariff to the maintenance provider and is left to determine individual household contributions according to wealth and consumption patterns. Second, Whave trains committees to assist vulnerable persons in several ways, for example finding their family members in town and helping to send mobile money contributions, calling in church donations generally from wealthier families (common in Muslim communities), and from wealthier members directly.[96]
This set-up requires a robust regulatory structure and accountability measures to be in place, involving local government. Ultimately, however, tariffs must be commonly applied and understood across an entire service area for the professionalized maintenance model to work.

Box 4: An Example of Tariff Setting from Mityana District, Uganda

Tariff pricing is set to be affordable to communities while still staying within a range to achieve cost-recovery at scale. To achieve a sustainable model, tariffs must be structured so that they can effectively cross-subsidize between large and small communities, with larger and wealthier trading centers paying a higher percentage of overall costs to ensure universal coverage in smaller, less affluent communities. Several factors determine affordability, including community norms and international consensus on percentage of income acceptable. In Whave's Mityana baseline survey, communities that did collect funds prior to a breakdown contributed on average 2,000 UGX per household per month, suggesting this is a socially acceptable amount. The UN recommends household expenditure on water not to exceed 3 percent of household income, in Uganda, rural income was reported to be 303,000 UGX per month, making a 2,000 UGX tariff 0.7 percent of income, an affordable rate by this measure.

(Source: communications with Whave 2019)

Whave cost and revenue projections indicate reducing marginal costs through scaling within a concentrated geography is possible if several savings are addressed. These include transport costs and communications and management costs that decline per water source serviced, as the number of service agreements in a concentrated area rises. For example, the salaries of a senior accountant, senior engineer, senior manager, and expenses associated with management from one office are the same whether they service a cluster of neighboring districts with more than a thousand sources or just 100 sources. Scaling is therefore vital for a rural utility to be economically viable and provide functionality assurance without dependence on uncertain subsidies. Whave's research indicates that a service area of approximately 1 mission people is a critical threshold for economies of scale.[97]

Keeping the Water Flowing: Placing Value on Continuity of Service Rather Than Repairing Breakdowns

All SWS cases highlighted a common challenge in the need to shift the narrative and incentive structures away from a focus on repairs and failure, to one of placing value on continued water supply services. This is a challenge as it goes against a well-established system of rewarding, through political influence, corrupt practices in initial construction and procurement processes and payment of technicians to repair schemes when they break down. All of these stakeholder groups will view change as a loss — in terms of funds, status, and/or influence — and yet, SWS partners have put into practice a number of interventions that are starting to overcome this systemic bias:

[96] Cord. 2021a.
[97] Harvey, A. 2019. Cost Model v1.2 for Rural Water in Uganda. Available at: www.whave.org

- In Uganda, Whave developed an incentive structure for its technicians that rewards them for keeping the water flowing, rather than based on the number of repairs they conduct (see Box 5 below). Whave has paid attention to technician earnings to ensure that these are well within financially sustainable levels, while still offering an attractive job and a good income by rural standards. Good performers are awarded larger concessions; bonuses are attached to attributes such as accurate and timely record keeping, while penalties are attached to late repair responses.[98]

Box 5: Realigning Incentives: A Potential Game Changer for Rural Water Point Maintenance

If one had to single out the most important systemic shift brought about within Whave's preventive maintenance service model, a strong case could be made for the incentive realignment carried out at the core of the preventive maintenance system. Under a traditional reactive maintenance model, hand pump mechanics are only paid when there is a water system breakdown. This model can create mistrust, as mechanics are sometimes suspected of less-than-ideal work in the hopes of a future payout from a subsequent breakdown. Under Whave's results-based preventive maintenance model, water service technicians are paid primarily based on their preventive maintenance service visits. They also receive bonuses (or avoid penalties) depending on whether they succeed in preventing any breakdowns each month and, in case of water system failure, how long it takes them to resolve a breakdown. Under this structure, water service technicians are incentivized to provide a continuity of water service through preventive maintenance and timely resolution of breakdowns. The technicians have higher job satisfaction under this arrangement (given consistent and predictable income), and communities experience a more reliable service with reduced breakdown times. With customer-provider trust improved, incentives better aligned across system actors, and service quality optimized, willingness to pay has been shown to increase, promising greater financial sustainability in the long run. As the volume of service agreements increases, so to does social consensus and normalization.

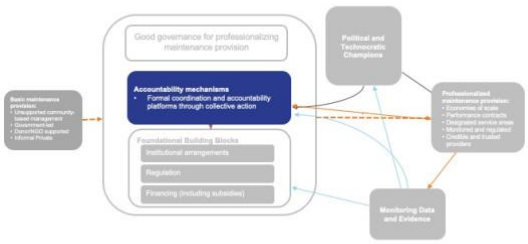
Source: Emerging Lessons on Sustaining Rural Water Services in Uganda: A Case Study of Whave's Preventive Maintenance Model

- In Kenya, as part of the FundiFix business model, communities and schools pay a monthly service charge (1,000 Kenyan shillings [KES]) for hand pumps, and for piped schemes 30 percent to 35 percent of the tariff applied to volumes used using low-cost, transparent, and convenient mobile payments regardless of the maintenance tasks performed in any given month. In addition, customers are guaranteed repairs within 3 to 5 days of any breakdown. If the service provider falls short on this promise, the customer is entitled to a free month of service, thereby creating a clear economic incentive for FundiFix service providers to maintain high service levels.

- An experimental system dynamics model of regional government maintenance provision in Afar, Ethiopia, and Turkana, Kenya, found that transferring funds from capital investments for new borehole installations toward repair and maintenance activities results in higher functionality rates (increasing from 54 percent to 75 percent in Afar and from 59 percent to 96 percent in Turkana). Additionally, researchers created an online interface for field staff to interact with model parameters, including budget levels and allocations for maintenance service provision, to observe how increased resources available for maintenance could improve both functionality and the number of working boreholes, and therefore coverage, in both regions.[99]

[98] Harvey. 2021.
[99] Libey, A., Chintalapati, P., Kathuni, S., Amadei, B., Thomas, E. 2021. "Turn Up The Dial: System Dynamics Modeling of Resource Allocations Toward Rural Water Supply Maintenance in East Africa." *Publication pending.*

Building Trust and Accountability Through Collective Action



The second critical element of any effective local system for supporting professionalized maintenance highlighted in the roadmap addresses the complex issues of trust and accountability. Accountability between stakeholders is a key foundational element; conversely, lack of trust, misplaced perceptions, disincentives, lack of information, and the inability to hold stakeholders to account can act as barriers to progress. From SWS–generated learning, there are common dimensions and positive examples of how to address these issues. First is the presence of formal, institutional coordination mechanisms together with platforms that enable different stakeholders to engage in open and safe dialogue. Another common factor is the role of politicians and other champions who can have a significant influence over the acceptance, credibility, and long-term success of efforts to establish professionalized maintenance providers; this is addressed below.

Coordinating Actors in the Local WASH System: Collective Action

Formal structures of reporting, flows of information, and decision-making are present in all national sectors in which SWS partners operate. The authority of sector line ministries to influence in a more "vertical" form of control is one dimension of such coordination, but across all three cases, coordination at the *local WASH system level* emerges as the most important. In all cases, partners have promoted collective action approaches as a core part of their system strengthening efforts, ranging from learning alliances adopted by IRC in Ethiopia and Uganda to the Kitui WASH forum in Kenya and quarterly PPP review meetings undertaken by Whave in Uganda.

Such processes have been instrumental to socializing and establishing a common vision around maintenance provision through open dialogue about challenges and joint discussions on potential solutions. Such mechanisms also allow the space to share data, establish common agreements, build consensus around terms and language used for maintenance, and work toward a desired outcome. They can provide a neutral platform to air grievances, even where there is an asymmetry in power relations between actors. In Uganda, for example, Whave recognizes the importance of these governance and accountability mechanisms between the service provider and consumers as one factor leading to contract renewals (see Box 6 below). These are not the only means to improve accountability; Whave also provides a toll-free number for regular consumer feedback and complaints, as well as a quarterly customer satisfaction survey. New contract sign-ups have occurred as a result of positive community feedback regarding Whave's services.

Box 6: The Critical Role of Collective Action to Build Accountability and Trust for Professionalized Maintenance Providers in Uganda

In Whave districts in Uganda, coordination platforms comprise mostly quarterly PPP review meetings, but other multi-stakeholder meetings have also provided important spaces for actor relationships to develop in support of professionalizing maintenance services. Several important actor relationships surfaced:

- Whave, district, and sub-county local government staff work with hand pump mechanics to ensure their efforts are coordinated with professionalized maintenance goals. Evidence suggests hand pump mechanics interfere with Whave's efforts by creating competition based on unsustainable price plans and service arrangements. There are several instances of both Whave and the government stepping in to combat this, for instance: "*The DWO convened a meeting with all hand pump mechanics in Kamuli District… the DWO instructed all hand pump mechanics to either work with Whave, or to align their work to preventive maintenance*."
- Technical government and higher level political actors hold politicians accountable to mitigate the harmful effects of politician-sponsored repairs, which creates unsustainable competition and reduces community willingness to pay and enroll in service contracts with Whave.
- Key actors, based on their relevant positions and responsibilities, help motivate consensus around appointing and procuring Whave as an ASP in the districts. For example, high-ranking actors at the district level used their authority to work with other actors, such as DWOs, to establish procurement and contracting processes.
- There are expectations within actor relationships regarding coordination. For example, sub-county local governments expect to be informed when development partners or service providers are operating within their areas, and communities expect all mechanics working within the area to be coordinated, although this isn't always the case (drawn from UCB research on institutional analysis). Evidence shows this led to communication gaps, particularly between Whave and the sub-county local governments, but these were resolved during the quarterly PPP review platform. The platform, along with other multi-stakeholder meetings, also served as a way to increase transparency between the service provider (Whave), the acting regulator (local government), and communities.

(Sources: SWS project outcome mapping form for Kamuli District, Q4 of FY 2019, multiple Quarterly PPP Review Meeting notes; graduate research on institutional analysis)

Sustaining Collective Action Mechanisms

Collective action has proven to be an effective tool for establishing professionalized maintenance provision across SWS cases and resulting in a greater tendency of different actor groups to collaborate and prioritize professionalization.[100,101] However, these approaches can be resource intensive and require specific skills, especially for facilitation of meetings and documentation. Although collective action should not necessarily be associated with any specific project, it is unclear whether local actors will be able to sustain these types of interventions after SWS and other aid-supported interventions end.

Nonetheless, in Kenya there has been significant progress in embedding a collective action platform within the county government. The newly proposed county water bill formally recognizes the WASH forum and provides permanent provision within the government budget to maintain them in the long term. The Kitui WASH forum provided the primary intersection among institutional arrangements, coordination, and collective action for SWS. Over the past few years, the forum evolved to become more standardized and has arrived at some important decisions via consensus of forum attendees.

- Actors at the December 2018 forum concluded that: (1) establishing a leadership structure for the forum is necessary for better coordination; (2) standardizing reporting for sub-county water offices would provide county-wide metrics and support comparative analysis and (3)

[100] McNicholl D., Nyaga C., and Pugel K. 2021. "Understanding Changes in Coordination in Kitui County's Water Sector 2018–2021." SWS, UCB Research Report. https://www.globalwaters.org/sites/default/files/kitui_ona_final_for_gw.pdf
[101] SWS. 2021. "Collective Action in WASH: Findings from SWS"; Webinar hosted by SWS, UCB. https://www.globalwaters.org/events/collective-action-wash-findings-sws

improved collaboration among consumers, providers, schools, other institutional actors, and the county water offices through joint planning of interventions remained a priority to eliminate duplication and inefficiencies.

More generally, the fora are cited to have improved coordination and collaboration within the sector over time and created an avenue for accountability where sub-county water officers have called out actors failing to coordinate with them on projects. For example, the Kitui endline Organizational Network Analysis (ONA) shows increasing relationships and interaction among actors across information and skill sharing. County government is progressively taking leadership, which is a position initially held by NGOs; however, government staff turnover and rotation is a risk to the Kitui collective action platform, along with the closeout of NGO programming.[102]

To date, UNICEF Kenya and SWS have both supported the forum, but recently the county government agreed to start financing the forum following the COVID-19 pandemic, although this is yet to happen. Supporting legislation (e.g., a new county water bill) is key for sustaining collective action around maintenance and ensuring that regular coordination and sharing will happen beyond the end of funded projects like SWS.

In Uganda, the most promising form of collective action is the PPP model because it is permanently embedded in the sector's institutional framework. This in-depth technical "collective talking" process was integrated with more formalized processes, so that district governments, NGOs, local HPMA members, communities, and service providers now work collectively. Their collective actions are guided by contracts with clear roles and responsibilities and tracked by nationally agreed performance indicators and targets embedded in those contracts, which are reviewed in the quarterly PPP meetings.

Donors and NGOs Must Play their Part and Align with Professionalized Maintenance for it to Succeed

Donor and NGO investments and programming can undermine efforts to promote new approaches to maintenance. If not well informed, such interventions can undo efforts to establish common agreements and approaches, particularly to tariff setting. The common lesson from SWS partners is that the investment in coordination, largely manifested through some form of collective action, pays dividends in terms of engaging and influencing external actors, such as NGOs and charities active in the local rural water system (see Box 7).

Box 7: Improving Government — NGO Coordination in Mille Woreda, Ethiopia

Room for improvement in the coordination between NGOs and woreda offices on post-construction support leads to duplication of efforts in some areas and leaves other areas behind. Stakeholders stressed that wells that have been dug by NGOs are often abandoned due to a lack of coordination with the woreda government. If studies are conducted at all, the information is not shared with the woreda government, often resulting in issues maintaining sufficient water quality and quantity after boreholes have been drilled. One potential beneficial structural change is improved information sharing and coordination from NGOs and regional government offices with woreda government offices. Qualitative input from other analyses in Mille suggests that this lack of coordination has led to duplication of efforts to develop and maintain water infrastructure in some areas while other areas remain underserved. In Mille, therefore, one way the learning alliance can improve water sustainability is by focusing specifically on information and problem-solving relationships between NGOs and woreda government offices.

(Source: IRC Ethiopia, Baseline Organizational Network Analysis, 2018; unpublished)

[102] McNicholl et al. 2021.

However, while collective action processes have proven to be effective, it is also the case that organizational policy and approaches are often determined beyond the boundary of the local system. Several SWS partners raised the importance of educating and influencing large donors, international financial institutions, and global NGOs that continue to work in ways that can undermine efforts to establish professional maintenance provision. Providing proof of concept and concrete evidence of what works is an important tool for changing mindsets as the experience of SWS partner FundiFix in Kenya illustrates (see Box 8). In Ethiopia, IRC reports a similar value of data, where the top-down government regional bureau structure requires leadership buy-in and explicit directions for responsibilities for monitoring at lower levels. Data have been found to improve communication and trust (e.g., photographs of breakdowns and maintenance issues) from the woreda to the regional level.

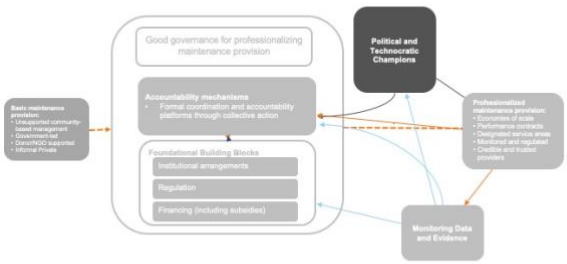
Box 8: The Value of "Seeing is Believing" for FundiFix in Kenya

Building credibility and sharing valuable data can influence other actors to focus on maintenance. There are indications that the role of FundiFix in Kitui County's rural water sector has reportedly contributed to influencing the way other actors, who have historically focused on new infrastructure projects, are prioritizing repair and maintenance activities. Although these examples are not directly attributable to the work of FundiFix, the organizations have all engaged in a dialogue on maintenance:

- The National Drought Management Authority, a national government institution with regional operations in Kitui, made a significant investment in rural water infrastructure repair and maintenance funded through a drought mitigation program.
- FundiFix granted the County Water Directorate access to the Kitui water audit (2017) dataset, which may have further influenced selection of community piped schemes for repair or maintenance.
- Regular reporting on performance of the FundiFix model in Mwingi North, including functionality status of piped schemes, may have further informed investment decisions and prioritization of piped schemes for repair or maintenance.
- JICA, one of the biggest bilateral donors of the water sector in Kenya, announced a new program of work at the March 18, 2021, WASH forum that aims to assess sustainability issues affecting its previous water in Kitui and the neighboring counties.

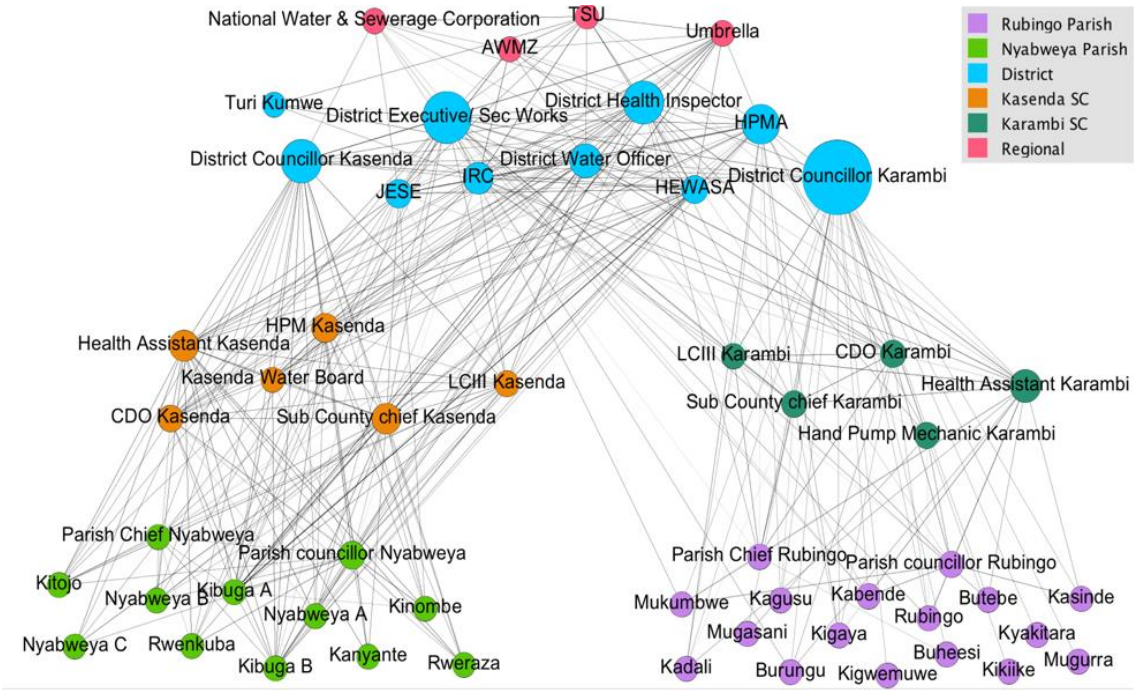
(Sources: SWS outcome mapping entries for Q2 of FY 2020 and Q2 of FY 2021)

The Importance of Political and Technocratic Champions



Politicians and other senior champions can play a critical role in influencing a local water system. Significant work has been done under the SWS project to map and understand such processes. For example, in 2018, IRC carried out network mapping in Kabarole District, Uganda, which highlighted the centrality of local politicians and influence along with chiefs as cultural leaders (see Figure 7). This figure and the accompanying analysis illustrate that local government district councilors are most central to the network studied. "Centrality" is measured by the likelihood that a stakeholder is on the shortest path between any two stakeholders in a network. District councilors emerge as central stakeholders because of their connections to both district and local levels. Other stakeholders central to the network include district government officers, such as the district executive and the district health inspector, and the HPMA. Sub-county chiefs become more central when considering higher frequencies of interaction. The implication is that the stakeholders most central to the network are ones that can bridge relationships between district level stakeholders and communities.[103]

Figure 7. Centrality of local politicians and chiefs as cultural leaders in the Kabarole Water System



When it comes to investment and procurement, anecdotal evidence from SWS and other organizations suggests that formally sanctioned government processes are not the only way decisions are made. In

[103] McNicholl, D. 2018. "Kabarole WASH Sustainability Actor and Factor Analysis," SWS, IRC/Aguaconsult. https://www.globalwaters.org/sites/default/files/kabarole_wash_sustainability_actor_and_factor_analysis.pdf

interviews with local government actors in Uganda, using an application of Organizational Institutional Theory, 35 percent of respondents cited political prioritization of rehabilitations and repairs for water points. In these instances current or aspiring politicians use personal finance to win favor among their electorate. This phenomenon is particularly acute around the time of elections where politicians attempt to curry favor with the promise of "free water" or tariff reductions.

A key challenge remains to recalibrate the political narrative to keeping the water flowing, rather than rewarding — and being rewarded politically for —repeated repairs after schemes suffer from breakdowns. In Uganda, research highlighted how political support for professionalized maintenance may also be motivated by the fact that professionalized arrangements sometimes reduce the burden on politicians, who often face internal and external pressures to repair water sources for their constituents at their own expense. A politician from Kamuli District summarized this in an interview, saying *"… (it was) before the service providers, where a certain borehole broke down and people were (connected to) the person with whom I contested… So, I had to put out 150,000 Ugandan shillings and repair the borehole. But when the (professionalized) approach came in, I was relieved. I've never gotten any other burden of repairing another water source"*).[104]

Finally, all SWS cases mentioned "bottom-up accountability" as a significant and powerful trend that can help nudge higher levels of government into action. Experience from Whave in Uganda cites community members holding their politicians and each other accountable and working through lower level local government structures (sub-county and parish) to help stop negative political interference from reducing service contract sign-ups and renewals, and tariff payment. The anecdote presented in Box 9 below reflects a broader trend identified across the work of SWS cases.

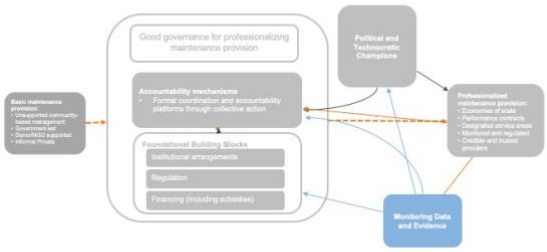
Box 9: The Power of Bottom-Up Accountability to Counteract Political Dynamics: Kumi District, Uganda

A parish chief challenged a potential member of parliament (national level) campaigning in Kumi, as recounted in an outcome mapping entry, when the candidate told a gathering of local village councils that they ought not to pay maintenance fees to the designated maintenance service provider, saying *"those are thieves."* He was confronted by the parish chief who then asked the councilors whose communities had benefited from preventive maintenance to put up their hands, which they all did, all agreeing when one councilor said, "*Community boreholes under preventive maintenance are no longer suffering erratic functionality*." These lower local government structures (parish chiefs, local council 1 members, etc.) are very important in the maintenance system for this reason, among others.

(Sources: SWS outcome mapping entries for Q2 of FY 2020)

[104] Cord. 2021a.

The Power of Data to Build Credibility



The importance of data and its role in professionalization of maintenance provision emerged as factor across all SWS cases. Monitoring data on performance, costs, and service standards have been used in different ways, including to generate evidence to enhance dialogue between local stakeholders. All partners cited the use of monitoring data as key to building credibility, leveraging financing, and convincing the government at decentralized levels to step in and pick up elements of the subsidies required to facilitate maintenance services. For example, in Ethiopia, IRC used SWS–generated monitoring data to determine actual water supply coverage, highlighting many areas with abandoned schemes and exposing the extent of the financing gap. This led IRC to successfully advocate for doubling of the capital budget in South Ari woreda in the Ethiopian FY 2012 (2020–2021), along with an increase in budget for performing monitoring, maintenance, and supervision activities from 163,000 Ethiopian birr (ETB) ($3,688) to ETB 253,000 ($5,724) in the same year.

Monitoring data, and the empirical evidence it generates, has also helped to attract government attention and influence their thinking by demonstrating proof of concept. For example, in Kitui and Kwale counties in Kenya, FundiFix provided data and insights from their maintenance model to convince local stakeholders of the value of this approach (see Table 1). Additionally, extensive FundiFix research into key local factors on rural water use, behaviors, and preferences — including affordability and willingness to pay as well as the influence of seasonality and water quality — enabled a better understanding of these context-specific issues and continues to inform the design of their maintenance approach and convince stakeholders to support this effort.

Table 1. FundiFix performance metrics average for Kitui County, per month for 2019

Hand Pumps	Average per Month	Piped Schemes	Average per Month
Total registered communities	22	Total registered communities	25
Average downtime (days)	0.9	Average downtime (days)	1.4
Longest downtime (days)	1.6	Longest downtime (days)	7.2
Percent of repairs completed within 3 days	99%	Percent of diagnostic visits within 48 hours after notification received	91%
Payment collection efficiency (%)	89%	Scheme payments collection efficiency (%)	49%

More Data Does Not Necessarily Lead to Better Decision-Making

In Ethiopia, SWS and the USAID Lowland WASH Activity put significant effort into supporting and learning from the establishment of a digital AMS for the Afar Regional Water, Irrigation, and Energy Bureau. This included an inventory of schemes, updated functionality (both manual and through sensors installed on half of the region's motorized boreholes), and a maintenance issue tracking function where prior to this, no formal data collection or record-keeping of maintenance activities existed. The IRC

team recognized the importance of designing the AMS so that it is easy to use and matches existing processes of its intended users, with "ownership" of data taking on significant importance. Higher levels of government at the regional level in Afar, in theory, were able to make greater use of the aggregated data to inform planning than the woreda WASH teams.

However, even after being established with significant inputs from an embedded SWS/USAID Lowland WASH facilitator, AMS uptake has been limited. The head of the maintenance team does not use the AMS tracking function to coordinate his team's work, and the engineers rarely use the mobile app to access AMS inventory data while in the field, as was intended. They are also not using key AMS functions such as adding schemes, updating information, checking recent sensor status reports, or using the maintenance issue tracking function. These challenges highlight the need for actionable "right-sized" data, but also the need to develop a culture and incentives that encourage the valuing and use of data. This is critical, given that no data had been collected on assets prior to this initiative.

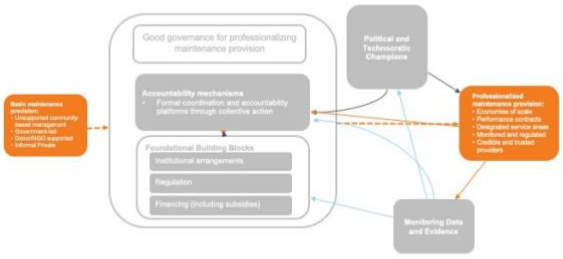
It is also important to note that any demand for improved monitoring to produce data requires additional resources and budget (e.g., for transport, staff time, phone credit, etc.), which in turn raises expectations of external financing support. Without greater financing for maintenance from a range of sources, including government, development partners, and communities themselves, and a greater policy emphasis on maintaining water services, use of monitoring data will likely remain low.

Experience from Kenya reinforces these insights. FundiFix reported varying capacities among government staff in terms of its ability to understand and use the AMS, and in some instances the need to revise job descriptions to support monitoring. There is a need to prioritize monitoring and key performance indicators based on local priorities or preferences (e.g., water quality does not feature among top performance indicators), and the AMS requires government to allocate resources for ongoing updating, including travel to collect or verify performance information.

Despite the challenges encountered, SWS lessons underline the importance and impact of data for more informed, evidence-based decision-making and building the credibility of professional maintenance providers with other stakeholders. In the absence of data, SWS case studies suggest that politicians and other interest groups can make and prioritize water-related investment decisions based on gaps in monitoring.

Supporting Professionalized Maintenance: Where to Begin?

This report presents SWS–generated lessons for policy makers, funders, and implementers, illustrating the need for both a solid grounding in institutional, regulatory, and financing arrangements, as well as the critical importance of the "softer" processes of accountability and trust building. What emerges is a complex challenge with many potential entry points to strengthen a local rural water system; the key question then is where to begin?



To answer this question, it is important to first consider the overall (national) context and the specifics of the local system in which professionalized maintenance provision is being introduced. Higher level considerations should also be taken into account, such as the societal and cultural theory of water risk and values and how these are expressed in policy terms, as well as how they are perceived "on the ground." Broadly speaking, different systems underpinning maintenance service provision follow a trajectory toward more comprehensive arrangements, increasing professionalization, and more pluralist policy environments that can balance the competing functions among communities, the state, and the market.[105] The more advanced and pluralist this framework, the more capacity there is to pool risk and professionalize service provision (see Figure 8).

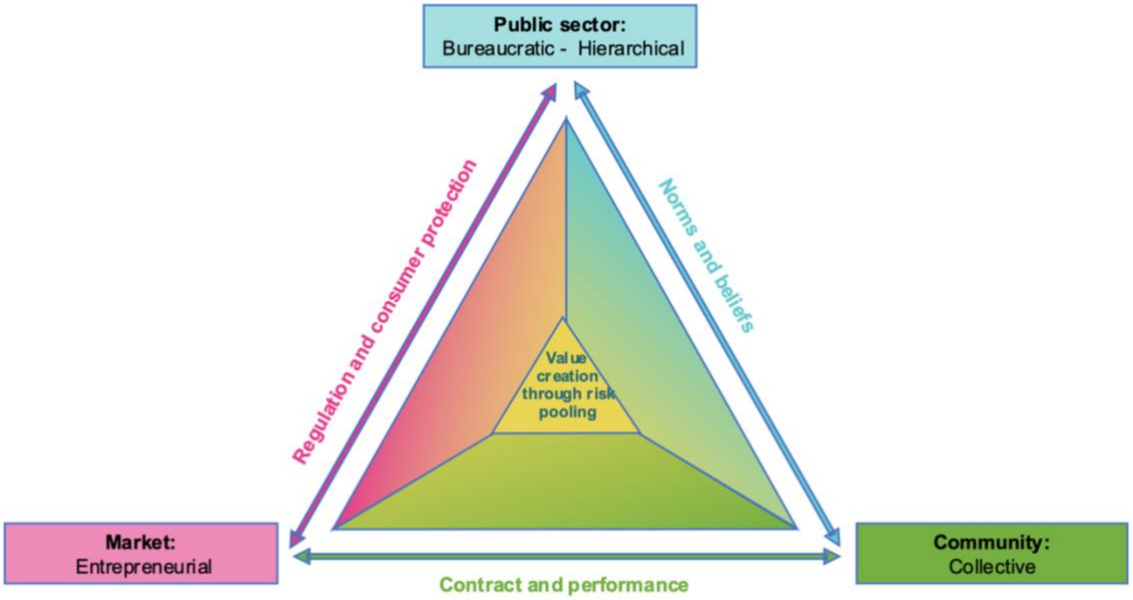
Applying figure 8 to SWS cases, the research team observes the following general trends across the different SWS case countries:

- Ethiopia: a more public sector–led model with limited market engagement, regulation, and consumer protection
- Kenya: the emergence of a more entrepreneurial model in the counties where FundiFix is working, with improved risk pooling and efforts to promote market involvement alongside improved contracting and regulation of services
- Uganda: a strong public sector–led model with growing opportunities for market engagement through the new National O&M Framework; the model retains community participation through contracting and local government plays the role of regulator

Although these examples draw on a diverse set of cases, each country has followed broadly similar steps. This starts with an acceptance that CBM has significant limitations and the fact that external support is required. The second important stage is a realization — and acceptance — that household tariffs will not be sufficient to pay for professionalized maintenance and that an element of subsidy will be required. The final step is the willingness to make public funding available as part of informed, rational, long-term decision-making that seeks to maximize performance i.e., through investing in good governance.

[105] Koehler, J., Rayner, S. Katuva, J., Thompson, P., and Hope, R. 2018. "A Cultural Theory of Drinking Water Risks, Values and Institutional Change". *Global Environmental Change* 50, 268-277. https://www.sciencedirect.com/science/article/pii/S095937801731258X?via%3Dihub

Figure 8. A pluralist framework for stakeholder engagement and pooling of risk (Source: Adapted from Koehler et al. 2018)



The trend toward more pluralist arrangements can also be seen to largely, but not exclusively, follow economic growth. As countries become wealthier, they have more capacity and resources to support ever-more comprehensive systems for maintenance provision. In turn, and with more advanced accountability and regulatory factors in place to provide good (enough) governance, overt political influence or corruption that undermine maintenance provision can be mitigated, at least partially.

Moving from a higher level understanding of the macro-level environment, what can be done at the local level to better support the conditions for professionalized maintenance? One dimension to this answer is the *time* it may take to achieve the shift from more existing maintenance arrangements to more professionalized solutions working at scale. Although no fixed blueprint exists, such an effort is likely to take at least a decade, which is in line with most system-strengthening interventions. This has implications for donor funding cycles that are generally much shorter but should take into account the need for sustained support to achieve changes of this nature. The researchers have identified a tailored set of recommendations for different stakeholder groups as set out below.

However, perhaps the most important starting point, regardless of role, is to take the time to *understand the local system* before making any decisions about intervening or investing in any way. Different methods can be used to carry out a mapping or assessment of the local system, ranging from desk reviews of policies and laws to the application of political economy tools, asset inventories, life-cycle cost analysis and Organizational Network Analysis. Ideally, such a mapping and understanding of the system should include collecting information and asking questions, such as:

Mapping and landscaping of the macro-level system:

- A thorough review and analysis of sector policies, legislation, and other, non-water specific government policies, for example around the establishment of PPPs and local perceptions on the involvement of the private sector.
- Mapping of institutional arrangements and roles and responsibilities — who is allowed to do what in the water sector? Who owns, manages, and operates the assets? Who is legally mandated and responsible for maintenance activities? Are professional maintenance providers — or others — already operating? To what extent are these roles adhered to? What is the capacity of actors at different levels of the system, particularly that of local government?
- How is financing arranged? What are the flows of different sources of financing, from public sources, revenue from tariffs, loans etc.? Are there mechanisms for subsidies in place for the rural

sector? At which point in the value chain are these delivered — on the supply side for maintenance providers, or the demand side to consumers? How are subsidies set and regulated?

- What oversight and regulatory mechanisms are in place to govern professionalized maintenance? Is there an independent regulator, are functions delegated, for example to local governments, or is regulation based on contracting arrangements?

Mapping and landscaping of local system characteristics:

- How is the local water system boundary defined? At what level are different functions performed, or where does the mandate lie (i.e., sub-district, district, sub-national or national)?
- What contextual factors are important to the provision of, and payment for, maintenance services? For example, local hydro-geological conditions, issues with seasonal availability of water, water quality, household consumption patterns, cultural practices, poverty levels, and household incomes.
- What type of data are being generated about the quality of service provision? Is data collected about the performance of service providers (operators or maintenance providers)? Who collects this and how is it used?

System stakeholder analysis:

- What maintenance arrangements are already in place at the local (intervention) level and who is responsible for what? Where are the key weaknesses and gaps?
- An assessment of how familiar and aware different levels of government are of existing policies regarding maintenance, both within government and NGOs, as well as civil society more broadly.
- What are the understanding and perceptions of households, CBM entities, and other local stakeholders about roles for maintenance and the responsibility of different actors? How are these perceptions likely to influence the introduction of more professionalized approaches?
- How is risk allocated and who is responsible for paying for what? And how frequently? Is this governed formally via contract, or loosely?
- What accountability mechanisms are in place already, both formal and informal? How do local government entities, providers, and communities engage with each other?

In most contexts, much of the above information may already exist and it will not be necessary to collect all these data from primary sources, but mapping the local system is a critical starting point to understand the context for maintenance provision.

Recommendations for Policy Support, Funders, and Implementers

Recommendations for Funders

The profile, scale, and modalities of funders varies widely, as does their ability to influence sector policy. Large funders, such as USAID and other bilateral donors mainly providing grant funding, can have a significant influence with partner governments or other implementing partners over sector policy. Other large-scale funders such as the World Bank or African Development Bank largely channel support via concessionary loans and so are more closely tied to government priorities. But these funders can also influence national policy. Smaller players such as NGOs and charities have a more limited scale of operation but can have a significant impact on local water systems; they are also able to play an important role in innovation and providing proof of concept as they tend to be more agile and can pilot new approaches quickly.

Regardless of the type of funder in question, the following recommendations may be useful to consider when looking to intervene in rural water provision:

Design of service delivery investment programs:

- Before committing to major investments in the rural water sector, make sure adequate arrangements are in place for professionalized maintenance. Look into both policy and regulation, as well as the presence of professional providers on the ground.
- Where efforts are underway to establish and scale professionalized maintenance, ensure that investments for new or major rehabilitation of water supply infrastructure do not disrupt existing arrangements, for example by undermining established tariffs. At the same time, innovation and testing can be useful for such ongoing efforts and should be supported.
- If it is unclear how water supply services will be maintained for the long term, or if community end users are left on their own to manage without support, include interventions in the design of funding to address these gaps.
- Consider local water system boundaries and potential for scaling in the design of your rural water programs.
- Consider supporting results-based subsidy mechanisms, both by potentially contributing to these through seed funding where they already exist (i.e., trust funds) or financing research into how they can be established within the legal and fiduciary frameworks of the country in question.

Support to policy and system-strengthening:

- Where there are obvious gaps in policy, institutional arrangements or regulatory frameworks, use funding and work with governments to support and strengthen these key elements.
- Influence and work with other donors to engage with national government stakeholders (e.g., lead ministries for water, local government, or finance) to push for greater public expenditure to support maintenance provision.
- Proactively engage with and seek to influence and guide grantees or contractors to consider the requirements for professionalizing maintenance provision, particularly for those who may still be working with voluntary approaches to long-term service delivery.
- Be informed of on-going good practices based on well-researched and proven solutions and seek to support them, including efforts to establish collective action processes in the rural water sector, both nationally and locally.

Recommendations for Implementing Organizations

As with funders, the size and experience of implementing organizations can vary widely, from large-scale engineering or consulting companies managing multi-million dollar procurement contracts to

international NGOs and much smaller, local charities and faith-based organizations. Some of these actors will be permanent to the local rural water system, while others will step in for defined periods only but may have a significant impact on the dynamics of rural water provision during this time. Recommendations for implementing organizations at the local level include:

- Fully engage and coordinate with local government authorities within the system boundary and inform them fully of planned interventions.
- Build the capacity of local government while respecting and aligning with official protocols, tools, and operating systems.
- Share data and information with local government and other actors in the local water system; avoid establishing parallel monitoring frameworks or data platforms that will not integrate with national frameworks.
- Respect existing institutional arrangements, regulations, and local bylaws that deal with rural water provision in general and maintenance provision specifically.
- Do not intervene in new construction or rehabilitation if major doubts exist about how water supply services will be maintained in the long term or if community end users are left on their own to manage without support.
- Where professional maintenance providers already exist, which is not likely the case, or where efforts are being made to support such providers, incorporate them into the design of interventions.
- Become familiar with the tariff regimes and subsidy mechanisms in place, and do not undercut established levels of payment for maintenance.
- Actively participate in coordination platforms and in any form of collective action processes.
- Document good practices and capture useful lessons on supporting professionalized maintenance to share with other stakeholders, both locally and nationally/globally.

Recommendations for Advocacy Organizations

In many countries, civil society groups or coalitions of NGOs can play an important role in holding governments to account and to lobby for improved services, particularly for the poorest and most marginalized groups. Research organizations can also contribute to the body of knowledge and good practice for maintenance provision. Recommendations for this group of stakeholders include:

- Engage with governments to reform policy, legislation, or regulatory frameworks that can support improved approaches to rural water service delivery, including establishing the conditions for professionalized maintenance.
- Use existing data, or commission new research, to generate evidence and knowledge products to advocate for a shift in culture from simply building infrastructure to supporting long-term service delivery.
- Lobby national — and local — government to allocate a greater share of public funding to be ear-marked for supporting long-term service delivery.
- Work with politicians, cultural, and business leaders at all levels to expose them to evidence about the importance of long-term professionalized maintenance and build alliances to push for change in policy and practice.
- Be aware of good practice in the sector, based on well-researched and tested approaches to sustaining rural water service delivery and help to disseminate documentation of such good practice widely.

Annex 1: Document Review and Coding Methodology

Priority documents outlined in Table 2 were gathered from the three cases and organized for qualitative coding. Excerpts from these documents were deductively coded into 14 pre-determined themes using Nvivo and Dedoose. The predetermined themes were created as nodes in the software and defined in detail, as shown in Table 3. The researchers discussed, iterated, and refined these definitions and the excerpts coded into each node throughout the coding process to ensure consistency. If an excerpt was described by multiple nodes, it was coded to all relevant themes.

To demonstrate intersections between the themes within the coded data, matrices were created in Nvivo and Dedoose; each theme was assigned both a row and a column in the matrix, resulting in a 14x14 matrix. Each cell in the matrix represented the number of excerpts coded under both themes, the theme representing the row and the theme representing the column. For example, the number 10 appearing in a cell under the row "Policy" and the column "Monitoring" would indicate 10 total excerpts that had been coded as both "Policy" and "Monitoring." Cells with relatively higher numbers indicated the theme intersections that the data was able to best describe. Because the set up and learning of each case varied over the course of the project, the type and total number of documents coded across them varied. The most meaningful insights were drawn by reading and interpreting the excerpts double coded under each theme intersection and comparing these insights across the coded data from each case. The emergent insights were validated by each respective case through written and oral feedback prior to their compilation in the report.

Table 2. Qualitative data analyzed across SWS cases

Document type	Number
Case 1 (IRC — Uganda, Ethiopia)	
Pause and learn meeting outputs	2
Interview transcripts/notes	1
Systems analyses	3
Baseline assessments and reports	2
ONA documentation	2
Iterative factor mapping and learning documentation	1
Other research reports	6
Written feedback and inputs	1
TOTAL	18
Case 2 (Whave — Uganda)	
Pause and learn meeting outputs	1
Outcome mapping reports	15
Quarterly PPP review meeting reports	23
Semiannual progress reports	8
After action reviews and other meeting reports	5
Other research reports	1

TOTAL	53
Case 3 (FundiFix — Kenya)	
Pause and learn meeting outputs	1
Outcome mapping reports	7
WASH forum meeting notes	10
ONA documentation	1
Semiannual progress reports	5
Other research reports	3
TOTAL	27
TOTAL CODED ACROSS ALL CONCEPTS	98

Table 3. Mapping existing learning outputs and project documentation against key maintenance topics

No.	Theme (Categorical)	Definition	Indicative Questions
1	**Policy**	Includes mentions of policy/content of actual sector policy documents and all its forms pertaining to rural water services (ministry policy and strategic guidance documents, national/decentralized laws and regulations, local bylaws and resolutions, and everything in between). Specifically, we're interested in two things: 1) the current policies that are in place or being passed — both their existence (or absence), coherence, any gaps, and specifically whether they address maintenance issues and if so how; 2) the effect these policies are having on supporting/strengthening maintenance systems.	Are there clear policy and or/strategies in place that address maintenance and provide clarity on who should do what and how this should be financed? Is it clear who owns — and is responsible for maintaining — water supply infrastructure assets? If such policies and/or strategies are in place, do you think they are comprehensive enough or are there gaps or will operationalizing such policies be difficult?
2	**Institutional arrangements**	Includes all mention of specific roles and responsibilities for rural water services, specifically for maintenance, or roles which ultimately encompass maintenance. May encompass both responsibility for direct maintenance provision, as well as indirect responsibility to ensure that maintenance is carried out (e.g., a service authority function). Institutional arrangements will also cover management arrangements (e.g., community, private, public). This theme should also investigate whether a distinction is made between different types of maintenance tasks (e.g., preventive vs.	Is there a clear role for maintenance — both everyday/week/month preventive maintenance and corrective maintenance for addressing more major failures? What are the models adopted to ensure maintenance happens effectively? Do the institutions (committees, boards, private providers, etc.) have the capacity and the means to carry out the different types of maintenance? Where are the gaps? What is preventing different actors from carrying out maintenance tasks effectively (e.g., lack of resources, knowledge, tools, spare parts, credibility, profit margin etc.)?

		corrective, as well as minor vs. major maintenance) and where relevant, responsibilities for more formal asset management. All roles and responsibilities should be coded, as well capacities and whether there is sufficient capacity within institutions at different levels to fulfil mandate and functions in support of maintenance.	
3	**Financing**	Includes evidence related to how all aspects of maintenance arrangements are paid for, by who, and plans for the future. Where possible this should include a differentiation between sources of financing or payment for direct operational costs; indirect costs; and capital investments/depreciation. Likely sources of financing to be captured may include: revenue from tariffs (paid under different mechanisms, e.g., pays as you fetch, flat fee guaranteed service/fee for repair, etc.); grant aid funding; public financing from central/local taxation; loans (commercial or concessionary); philanthropic funding. Should also capture where there is insufficient funding to enable maintenance services.	Is it clear which actor or entity is responsible to provide financing to carry out different maintenance tasks? Are the costs of maintenance generally known? What is the mix of different sources of financing used to pay for maintenance services (e.g., public funding, fees, aid support, gifts)? What is the gap in terms of the costs of providing a maintenance service and the income that can be derived? Are subsidies required and at which point in the provision chain are these applied (e.g., direct to provider, intra-community, inter-community/household)?
4	**Regulation**	Includes details about how maintenance services (and rural water services overall) are regulated within each context. To capture existence and role of formal/independent regulators, and/or delegated regulatory functions via local government or other entities. Absence of regulation and its impact on the ability of service providers and consumers to put in place maintenance services is also important to capture.	Who is responsible to regulate rural water? Do they have the capacity, skills, and resources to do this? Who is supposed to regulate or oversee maintenance services? Is this separate from general management of rural water or is it combined with day to day management?
5	**Monitoring**	Includes details about how actual service outcomes are monitored and reported on, including the actors and agencies responsible for this task, the type of data being collected, and how it is used. This theme should focus on monitoring of maintenance issues, which may include data collected by local government, deconcentrated ministry entities, implementing agencies, and maintenance service providers and/or communities themselves.	How well developed is monitoring of water supply services within the local system or district? Does this also include monitoring of the performance of maintenance and maintenance providers? Who uses the data produced by such monitoring and does it lead to changes in maintenance provision?

6	**Environment**	Includes details about the environmental context within with the maintenance provider is operating. For example, this would include mentions of local water resources, geography, and the physical layout of the area, specifically where this may support or undermine maintenance efforts, for example the use of alternative sources of drinking water during the wet season, which undermines payment for maintenance services.	Are there water resources shortages or issues of water quality that affect drinking water provision in the district? What impact does this have on maintenance provision? For example, if seasonal water sources become available for free, does this limit the amount households are willing to pay for services?
7	**Technology**	Includes any details about the infrastructure itself, and any additional technology used as part of the maintenance system (such as sensors or other equipment for monitoring, as well as the quality of materials used which may extend or shorten the working life of hand pumps or piped schemes)	How has the design and construction of water supply schemes affected maintenance issues (e.g., use of poor quality parts or poor workmanship)? Has the availability and affordability of spare parts affected the ability to provide maintenance services?
8	**Boundary and key actors**	Description of the maintenance system boundary (district, sub-district, ward, region, county etc.) Includes all main stakeholders involved in maintenance provision — directly or indirectly, including political leaders, local government, central government agencies, cultural leaders, private sector actors, faith-based groups, donors, NGOs, and any others.	What is the unit, or boundary for maintenance provision — is this at the district level or lower (or higher)? Who are the key players in maintenance of rural water services?
9	**Actor relationships**	Includes all information regarding relationships between actors in the maintenance system — including information regarding power dynamics, accountability, alignment, and priorities. Evidence of one or one group of actors having more power and influence for example? This also can include evidence of flow of information and communications and which groups appear to be most central to the local system and which most distant.	What do you think influences the behaviors of different actors relating to maintenance provision (e.g., public service, financial reward, health outcomes)? Is any one organization or group more important for maintenance provision than others? Why is this the case? Are there groups in the maintenance system boundary that are disadvantaged or marginalized because they lack resources/authority/connectivity to key decision-makers?
10	**Coordination / Collective action**	Includes all accounts of collective efforts and collaboration or coordination to achieve a common goal: strengthen and sustain systems for maintenance. Includes mention of and details about any platforms or "hubs" that seek to accomplish this goal. It may also include experiences where coordination and	Is there a local (district level) coordination mechanism for maintenance? — either to coordinate demand and supply or services or to coordinate more effective support from different actors and funders?

		collective action is undermined by influential individuals/organizations failing to — or resisting — working in more harmonized ways.	What do you think pushes — or pulls people away — individuals or organizations to work in a more coordinated way with a shared idea of how to improve maintenance? Does everyone operating in the local level agree on the model(s) for providing maintenance services? If not, what challenges does this create?
11	**Politics**	Includes any evidence of the impact of politics on maintenance systems. Politics is defined as any activities or actions associated with governing a given area, especially regarding conflicts related to power. This also includes information about the distribution of power and authority within local systems (such as within ONA results and other similar reports about actor interactions). Political influence can be exerted by formal elected politicians (e.g., members of parliament or local councilors/locally elected officials) and also in more nuanced forms, by powerful individuals within local government (e.g., district chiefs, chairs of budget allocation committees, etc.) who can influence support provided for maintenance service provision or make decisions that will undermine such services.	How does local level — or national — politics affect maintenance service provision in the district? What is the impact of this influence? What has been/can be done to mitigate this influence?
12	**Governance and accountability for maintenance services**	Existence of adequate governance mechanisms to ensure oversight of maintenance providers, such as a board or advisory group. Existence and robustness of accountability mechanisms for consumers to lodge feedback and/or complaints regarding maintenance service providers: direct vs indirect routes for accountability. In particular the accessibility to such accountability mechanisms for different stakeholder groups.	What mechanisms are in place to oversee and guarantee the services provided by maintenance providers? Do their clients (communities or households) have a means of seeking redress? Or complaining to a third party who can help settle disputes? What do you think drives behaviors to make people complain or file reports?
13	**Maintenance champions**	Includes any mentions of actors who appear to play a role in support of maintenance above and beyond what is expected of them in their current role. For example, this may come in the form of exceptional leadership, allocation of financial or other resources, or any other actions taken directly in support of strengthening the maintenance system. Such champions could also play the role of facilitator or "broker" within the WASH system boundary to encourage more collaborative behaviors. Whenever it is included, this should also capture any reasons given for the supportive behavior.	Who — individuals or organizations — in the district that have actively supported the improvement of maintenance services for rural water? How has this been expressed or carried out? What are the incentives of these maintenance "champions" to act in this way?

14	**Maintenance opponents**	Includes any mentions of actors taking actions and displaying behavior that is unsupportive of or undermines the maintenance system. For example, this may come in the form of blocking the passage of local resolutions, using broken hand pumps as a source of votes, offering "free water," refusing to attend key meetings or engage in coordination platforms. This group may include donor organizations or smaller NGOs/charities that undermine efforts to support maintenance providers through programs of new infrastructure or free rehabilitation without coordinating/thinking through tariff regimes, etc.	Who — individuals or organizations — in the district that have actively undermined the improvement of maintenance services for rural water? How has this been expressed or carried out? What are the incentives of these maintenance "villains" to act in this way? What do they seek to gain (money, political support)?

Annex 2: Summary of National Contexts and Governance Arrangements

Country	Administrative Organization	Decentralization Status	National GDP per Capita, PPP (USD)*	Human Development Index (Rank)**	Population and Density (person per km²)
Ethiopia	Ethno-federalist parliamentary, constitutional republic. Nine regional states (and 2 urban regions) based on ethnic territoriality, subdivided into 68 zones and 670 rural and 100 urban woredas (districts) with kebeles being the lowest level of government.	Devolution to regions and delegation to local government at woreda level then subdivided to kebele level (municipalities).	$2,154.4	0.470 (173rd)	Population: 109.2 million Density: 109
Kenya	Parliamentary democracy with two tiers of governance at national and county. Nairobi (county) plus 46 other counties further divided into sub-counties (with elected representation) and wards.	Devolution to county level government.	$4,294.9	0.579 (147th)	Population: 51.39 million Density: 90
Uganda	Presidential republic, parliamentary democracy. Four administrative regions, 15 sub-regions, 121 districts, further sub-divided into 146 counties, 1 city council (Kampala), and 13 municipalities. Alongside state administration 5 traditional Bantu kingdoms retain some level of cultural autonomy.	Delegation to local government at district level. All subdivisions managed by Ugandan Local Government Association.	$1,837.2	0.528 (159th)	Population: 42.72 million Density: 213

*World Bank, 2018; ** UNDP, 2019; *** World Bank, 2018.

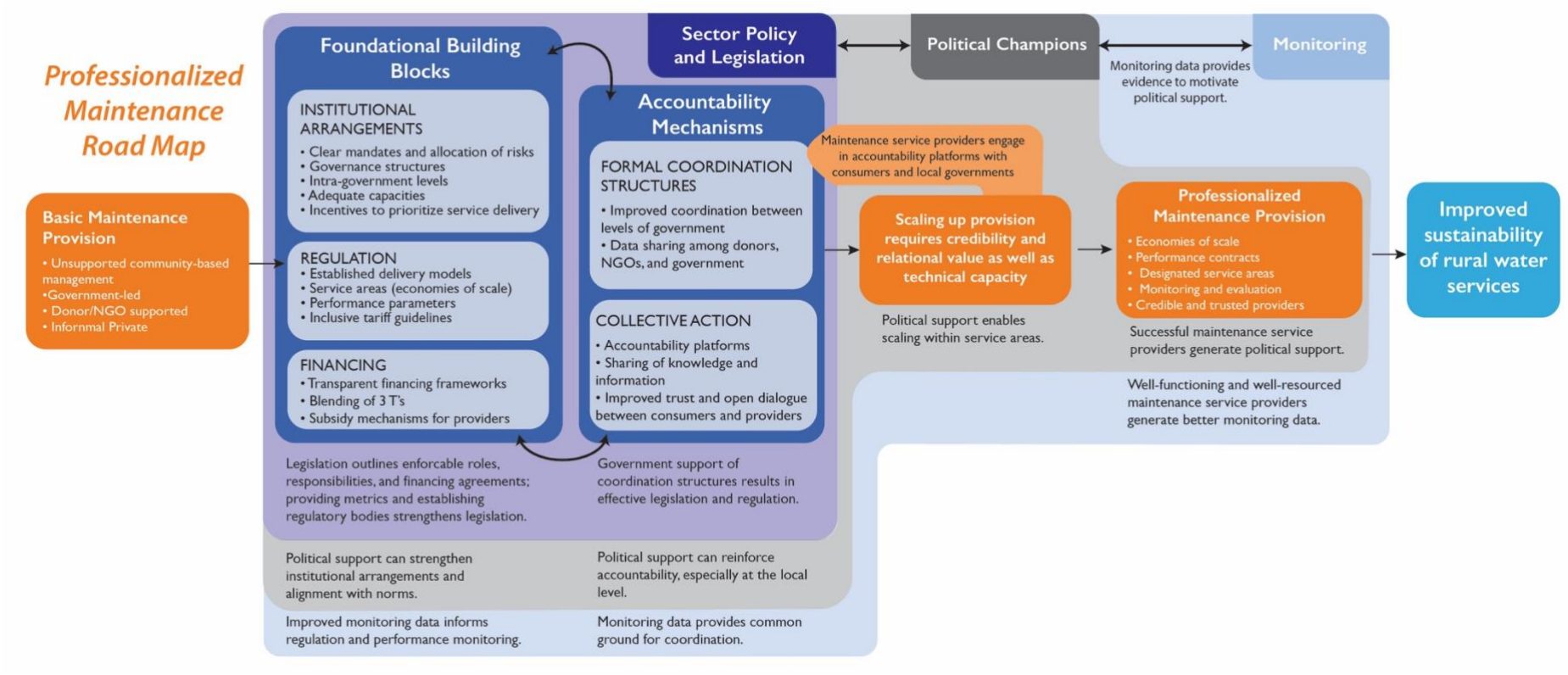
Annex 3: Overview of Institutional and Policy Arrangements in Support of Rural Water Supply Maintenance Services

Country	Legislative Basis	Lead Sector Ministry or Agency	Regulation	Mandate and Functions of Decentralized Government	Recognized Service Delivery Models for Rural Water	Maintenance Provision in Policy
Ethiopia	Constitution of the Federal Democratic Republic (Article 90) states that to the extent possible, all Ethiopians should have access to public health, clean water, and other social services.	At federal level the Ministry of Water, Irrigation and Energy is the lead among four ministries comprising the One WASH National Program (OWNP), responsible for water policy, coordination, and monitoring. Each region and zone has relative autonomy from central government in setting policy and strategies for WASH within overall framework	There is currently no regulator of water and sanitation services, including for urban areas. Regional bureaus and woreda WASH Teams expected to provide some level of oversight and be a conduit for user complaints/grievances.	At regional level ministry representation is through Regional Bureaus of Water, Health, Education and Finance and Economic Cooperation, all of which are part of a WASH Steering Committee supported by Technical Teams and have responsibility to manage and implement the OWNP. As at federal level, there are regional WASH Coordination Offices. At district or woreda level, woreda WASH teams are led by the woreda administrator and mandated with all WASH activities, including both	Regulations vary from region to region, but generally speaking rural water is managed by community-based entities, either in the form of WASHCos or WUAs, which have legal status. More recently, a Rural Public Utility management approach has been introduced by the Ministry of Water, Irrigation and Energy with guidelines to professionalize management and technical staff, along with a board to represent community	Nationwide policy under the OWNP is for WASHCos or WUAs to carry out day to day maintenance with support and guidance from woreda and kebele water teams. The Ministry of Water, Irrigation and Energy also has established a spare parts fund and supply chain via local government (woredas) that sell fast moving parts at set prices. Some regions have introduced different models to address maintenance, largely through setting up Private Local Service Providers as small businesses that provide repair services, but this varies across

		of OWNP.		decision-making and planning on new investments and supporting on-going operations in rural water supply through the woreda water office.	interests.	the country.
Kenya	Constitution of Kenya 2010 (Article 43 1 d) establishes right to clean and safe water in adequate quantities to all citizens. National Water Act 2016 provides policy framework and regulation, management and development of water resources and water and sewerage services, including Article 94 for professionalizing of services to rural areas. County governments have mandate to implement under this Act.	Ministry of Water and Irrigation, national level. County government ministries and Water Works Development Boards in all 47 counties.	WASREB with renewed mandate from Water Act 2016 and regulatory functions focused on urban and main county towns with formal service provision areas, with limited reach into rural areas. The Water Appeal Board created under the Water Act 2020 as an independent body to arbitrate in disputes and conflicts related to water use and access.	County government Act 2012 (Section 5) and Water Act (2016) provide county governments with authority to govern and create legislation for functional areas, including for water supply, and to establish Water Service Providers to be licensed and regulated by WASREB. Most urban water supply at county level is publicly owned and managed by county government through a board.	Service provision, including maintenance, is mandated to two categories of Water Service Provider covering both urban and rural populations: ● Public utilities, including Water User Associations in rural areas ● Private utilities: including formal utilities and private persons	Under the public utility option, the users or Water Management Committees have, in theory, the responsibility for maintaining their water supply facility. A small number of facilities are managed and maintained by self-help groups or community-based organizations. As part of efforts to increase professionalization and regulation of smaller operators, WASREB guidelines of 2019 aim to professionalize maintenance and PPP arrangements, including for outsourcing maintenance services.
Uganda	Constitution of Uganda (995) and Water Statute of the same year and	Ministry of Water and Environment at national level. Responsibility for	No independent regulator as such; the MWE and its Directorate of Water Development acts as the executive arm of government and	Local Government Act of 1997 provides for the decentralization of services, including the	Up until 2020, there were two main approaches to service delivery in Uganda:	National framework for O&M of rural water infrastructure announced in late 2019 supports Professional

	National Water Act 1997 which includes promotion of the provision of a clean, safe, and sufficient domestic water supply to all people	O&M of rural water supply sits with the Infrastructure, Operation and Maintenance Division Rural Water Supply and Sanitation Department. District Local Government; Water Office Water Supply and Sanitation Boards at sub-county, district, and regional levels	provides support to local governments and other service providers. In absence of economic regulatory body, National Water and Sewerage Corporation (NWSC) proposes tariffs for piped water that are set on a case by case basis, but tariff setting for water points remains community-based, set by each community separately. Although the new National O&M Framework promises tariff setting for isolated water points in areas not gazetted to NWSC by MWE, local district governments, and professional maintenance service providers. Environmental regulation is carried out by the Directorate of Water Development and the National Environment Management Authority	O&M of water facilities for local governments in liaison with the ministries. Exceptions to this are in any areas officially gazetted by the MWE to a utility. In addition to the primary mandate for District LG in Uganda there are 10 deconcentrated arms of the MWE called Technical Support Units providing support to communities and all 134 districts, as well as to utilities. Since 2020 these units are referred to as Rural Water Supply Regional Centers.	• Community-based management system for rural areas • Utility approach for cities, now being spread out to district capitals and rural towns via NWSC and six rural utilities (umbrellas). In 2020 the MWE disseminated a National O&M framework of rural water points that abolished community-based management and replaced it with the Professional Management Approach that requires local governments to appoint maintenance service companies or organizations to be accountable for functionality. Self-supply is practiced as in many countries and although the Government of Uganda does not actively support this approach it has been designated as an acceptable option in the absence of other services.	Management Approach also called "CBMS Plus" by requiring local governments to appoint maintenance Area Service Providers to be accountable for functionality in geographic areas not gazetted to NWSC, which may be a cluster of districts or as defined by the Water and Sanitation Boards at district and sub-county levels. ASPs are expected to take on O&M of water facilities within their designated area of operation, with employees including technicians, hand pump mechanics, or caretakers.

Annex 4: Detailed Version of Roadmap



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