Research Brief

Sustainable WASH Systems Learning Partnership

ENABLING PROFESSIONALIZED MAINTENANCE OF RURAL WATER INFRASTRUCTURE: PATHWAYS TO SUSTAINABILITY

January 2022

Summary of Key Findings

Currently, one-third of hand pumps in sub-Saharan Africa are estimated to be non-functional within the first few years after construction. Professionalized maintenance arrangements demonstrate the potential to solve this issue, but only if local governments support them and if communities demand and are willing to pay for improvements. This research identified the combined influence of operational, political, social, natural, and physical conditions on contract retention among consumers over a period of 3 years, indicating sustained consumer demand and willingness to pay for professionalized maintenance services over time (see Figure 2). Evidence suggests that operational, social, and political conditions may be sufficient to enable high contract retention, irrespective of the natural and physical conditions of an implementation context. Given the importance of local government participation for sustainability, this research further examined the constraints on and determinants of local government follow-through on key supportive actions, finding that policy changes alone are unlikely to motivate support.

Introduction

Systems to ensure the maintenance of existing water supply infrastructure, typically hand pumps in the context of rural sub-Saharan Africa, must be strengthened to ensure global safe water access and the achievement of Sustainable Development Goal (SDG) 6.1.[1] Ad hoc and poorly supported arrangements, often in the context of community-based management, have failed to realize improvements to safe water access despite decades of investment.[2,3] Currently,

[1] Truslove, J., Miller, A.V.M., Mannix, N., Nhlema, M., Rivett, M., Coulson, A., Mleta, P., and Kalin, R. 2019. Understanding the Functionality and Burden on Decentralised Rural Water Supply: Influence of Millennium Development Goal 7c Coverage Targets. Water, 11(3), 494. Available at: https://doi.org/10.3390/w11030494

[2] van den Broek, M., and Brown, J. 2015. Blueprint for breakdown? Community Based Management of rural groundwater in Uganda. Geoforum, 67, 51–63. Available at: https://doi.org/10.1016/j.geoforum.2015.10.009

[3] Whaley, L., and Cleaver, F. 2017. Can 'functionality' save the community management model of rural water supply? Water Resources and Rural Development, 9, 56–66. Available at: https://doi.org/10.1016/j.wrr.2017.04.001

nearly one-third of hand pumps constructed in sub-Saharan Africa are estimated to be nonfunctional within the first few years of installation.[4]

Professionalized maintenance arrangements hold the potential to strengthen systems for maintenance and are shown to provide high levels of infrastructure functionality.[5] Professionalized arrangements are continuously emerging and growing across sub-Saharan Africa and are even being formalized in national policies in countries such as Uganda.[6] The sustainability of these arrangements depends on consumer demand and willingness to pay for these services. This brief combines findings from two studies that used qualitative and quantitative evidence from 22 sub-counties (cases) in Uganda to better understand the conditions that enable the sustainability of services under a professionalized maintenance service provider, Whave Solutions.

Service providers such as Whave Solutions operate in diverse local contexts. Across these contexts, operational conditions (those under the control of the service provider) and contextual conditions (those describing the local social, political, natural, and physical environments that are difficult to change) may influence sustainability.[7,8] Using fuzzy-set qualitative comparative analysis (fsQCA), a rigorous cross-case comparison method, over a span of 3 years, this study identified combinations of conditions that led to high levels of contract retention, indicating consumer demand and consistent payment, across the 22 cases.

Because all successful cases feature high local government participation, a second study investigated the constraints and determinants of local government fulfillment of key support roles and responsibilities. Within the context of Uganda's new national framework that formalizes professionalized maintenance as the primary rural water service delivery approach, this study interviewed 93 local government actors, who often act as the rural service authorities in sub-Saharan Africa, and applied a lens of organizational institutional theory to identify opportunities and challenges they face to supporting long-term service delivery.

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[4] Bonsor, H.C., Oates, N., Chilton, P.J., Carter, R.C., Casey, V., MacDonald, A.M., Etti, B., Nekesa, J., Musinguzi, F., Okubal, P., Alupo, G., Calow, R., Wilson, P., Tumuntungire, M., and Bennie, M. 2015. A Hidden Crisis-strengthening the evidence base on the sustainability of rural groundwater supplies – results from a pilot study in Uganda. Water, Sanitation and Hygiene Services Beyond 2015: Improving Access and Sustainability. 38th WEDC International Conference, Loughborough University, UK.

[5] Sustainable WASH Systems Learning Partnership. 2021. Professionalized Maintenance for Rural Water Service Provision: Toward a Common Language and Vision. USAID, Sustainable WASH Systems Learning Partnership. Available at: https://www.globalwaters.org/resources/assets/sws/professionalized-maintenance-rural-water-service-provision-toward-common-language

[6] Directorate of Water Development. 2019. National Framework for Operation and Maintenance of Rural Water Infrastructure in Uganda. Ministry of Water and Environment, Republic of Uganda. Available at: https://www.mwe.go.ug/library/national-framework-operation-and-maintenance-rural-water-infrastructure-uganda

[7] Alexander, K.T., Tesfaye, Y., Dreibelbis, R., Abaire, B., and Freeman, M.C. 2015. Governance and functionality of community water schemes in rural Ethiopia. International Journal of Public Health, 60(8), 977–986. Available at: https://doi.org/10.1007/s00038-015-0675-x

[8] Jiménez, A., LeDeunff, H., Giné, R., Sjödin, J., Cronk, R., Murad, S., Takane, M., and Bartram, J. 2019. The Enabling Environment for Participation in Water and Sanitation: A Conceptual Framework. Water, 11(2), 308. Available at: https://doi.org/10.3390/w11020308

Methodology

Data collection: Qualitative data collection engaged 153 participants from all 22 cases. Five focus group discussions were held, including a total of 12 service provider field staff and 40 technicians who service hand pumps and interact with communities in each case. Key informant interviews were conducted with 93 local government actors and eight service provider management staff. Data from 65 research reports, reporting forms, and meeting notes supplemented these interviews and focus groups.

Identifying pathways to sustainability for professionalized maintenance in Uganda: First, case studies of 22 sub-counties (the cases) in Uganda were compiled, using qualitative and quantitative evidence to provide details about the outcome, contract retention, and important physical, natural, social, political, and operational causal conditions in each case. High contract retention was defined as maintaining over 50 percent of contracts that had been signed by communities over the 3-year data collection period, ending in 2020. Causal conditions were initially identified from the literature review and further refined, condensed, and contextualized to professionalized maintenance arrangements through the qualitative evidence from all cases, resulting in seven final conditions (see Table 1). FsQCA[9,10,11,12] was then used to identify condition combinations, or causal pathways, to high contract retention. This method allowed the determination of a consistent and reliable solution, containing two alternative pathways to high contract retention, that led to high contract retention in nine successful cases.

Table 1. Hypothesized Causal Conditions Influencing Contract Retention

Condition	Definition	Select Sources
Consistent expansion (operational)	Consistent expansion of services over time leads to social normalization of concepts such as tariff payment and reduces the availability of unpaid alternative sources.	Literature[13,14]; Emergent concepts from qualitative data

[9] Jordan, E., Gross, M.E., Javernick-Will, A.N., and Garvin, M.J. 2011. Use and misuse of qualitative comparative analysis. Construction Management and Economics, 29(11), 1159–1173. Available at: https://doi.org/10.1080/01446193.2011.640339

[10] Kaminsky, J., and Jordan, E. 2017. Qualitative comparative analysis for WASH research and practice. Journal of Water, Sanitation and Hygiene for Development, 7(2), 196–208. Available at: https://doi.org/10.2166/washdev.2017.240

[11] Ragin, C. 2006. Set Relations in Social Research: Evaluating Their Consistency and Coverage. Political Analysis, 14(3), 291–310. Available at: https://doi.org/10.1093/pan/mpj019

[12] Ragin, C. 2014. The Comparative Method: Moving Beyond Qualitative and Quantitative Strategies. University of California Press. Available at: https://doi.org/10.1525/9780520957350

[13] World Bank Group. 2017. Sustainability Assessment of Rural Water Service Delivery Models: Findings of a Multi-Country Review. World Bank. Available at: https://doi.org/10.1596/27988

[14] Lockwood, H. 2019. Sustaining Rural Water: A Comparative Study of Maintenance Models for Community-Managed Schemes [Research Report]. USAID, Sustainable WASH Systems Learning Partnership.

Coordinated sector aid (social)	NGOs and other aid actors coordinate with each other and with the government to ensure consistent implementation and respect for legal arrangements and policies, especially regarding tariffs.	Literature[15,16,17]; Emergent concepts from qualitative data
Widespread water user committee interventions (social)	Interventions increase water user committee capacity and accountability to improve consumers' experiences with professionalized maintenance.	Literature[18,19,20,21]; Emergent concepts from qualitative data
Local government participation (political)	Local government actors are involved in these arrangements as the service authorities and hold strong relationships with communities to increase trust, transparency, and accountability between service providers and consumers.	Literature[22,23,24,25,26]
Deep water sources (natural)	Communities with deep water sources likely have access to fewer available alternatives and may experience more breakdowns and prolonged downtimes, which may improve their perceptions of value from continuous, reliable services.	Literature[27,28,29]; Emergent concepts from qualitative data

[15] 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, 12(3), 1243. Available at: https://doi.org/10.3390/su12031243

[16] See footnote 1.

[17] UNICEF. 2016. Strengthening Enabling Environment for Water, Sanitation and Hygiene (WASH): Guidance Note (p. 58).

[18] See footnote 7.

[19] Fisher, M.B., Shields, K.F., Chan, T.U., Christenson, E., Cronk, R.D., Leker, H., Samani, D., Apoya, P., Lutz, A., and Bartram, J. 2015. Understanding handpump sustainability: Determinants of rural water source functionality in the Greater Afram Plains region of Ghana. Water Resources Research, 51(10), 8431–8449. Available at: https://doi.org/10.1002/2014WR016770

[20] Foster, T. 2013. Predictors of Sustainability for Community-Managed Handpumps in Sub-Saharan Africa: Evidence from Liberia, Sierra Leone, and Uganda. Environmental Science & Technology, 47(21), 12037–12046. Available at: https://doi.org/10.1021/es402086n

[21] 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. Sustainability, 11(13), 3726. Available at: https://doi.org/10.3390/su11133726

[22] See footnote 15.

[23] Pugel, K., Javernick-Will, A., Peabody, S., Nyaga, C., Mussa, M., Mekonta, L., Dimtse, D., Watsisi, M., Buhungiro, E., Mulatu, T., Annis, J., Jordan, E., Sandifer, E., and Linden, K. 2022. Pathways for collaboratively strengthening water and sanitation systems. Science of The Total Environment, 802, 149854. Available at: https://doi.org/10.1016/j.scitotenv.2021.149854

[24] See footnote 8.

[25] Soppe, G., Janson, N., and Piantini, S. 2018. Water Utility Turnaround Framework: A Guide for Improving Performance. World Bank. Available at: https://doi.org/10.1596/30863

[26] See footnote 19.

[27] See footnote 15.

[28] DuChanois, R.M., Liddle, E.S., Fenner, R.A., Jeuland, M., Evans, B., Cumming, O., Zaman, R.U., Mujica-Pereira, A.V., Ross, I., Gribble, M.O., and Brown, J. 2019. Factors Associated with Water Service Continuity for the Rural Populations of Bangladesh, Pakistan, Ethiopia, and Mozambique. Environmental Science & Technology, 53(8), 4355–4363. Available at: https://doi.org/10.1021/acs.est.8b07173

[29] See footnote 22.

Ease of access to communities (physical)	Communities close to the service provider's field offices are not only easier to access for trainings, repairs, and contract sign-ups or renewals, but are also better connected to urban centers and may have increased cash flows from markets.	Literature[30,31,32,33]
Size of user communities (physical)	Communities with more households may have more collective funds available to make annual service payments. They also may experience more frequent breakdowns due to high usage, which may improve their perceptions of value from continuous, reliable services.	Literature[34,35]; Emergent concepts from qualitative data

Identifying barriers and opportunities for one essential condition: local government participation: One contextual condition was present in all pathways to success: local government participation, which is contingent on local government actors following through on outlined responsibilities. Aside from the content used to construct case studies for the fsQCA, several interview questions focused on identifying constraints on and opportunities for follow-through on key actions expected of local government actors under professionalized maintenance arrangements. Organizational Institutional Theory[36,37] was applied to analyze the interview transcripts and determine the most widespread influences determining and constraining action, spanning regulative, normative, and cultural-cognitive influences (see Figure 1).

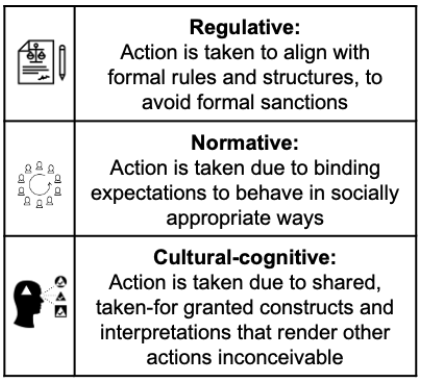

Figure 1 Constraints on and Determinants of Action, Based on Organizational Institutional Theory

[30] See footnote 15.

[31] Klug, T., Cronk, R., Shields, K.F., and Bartram, J. 2018. A categorization of water system breakdowns: Evidence from Liberia, Nigeria, Tanzania, and Uganda. *Science of The Total Environment*, 619–620, 1126–1132. Available at: https://doi.org/10.1016/j.scitotenv.2017.11.183

[32] Kulinkina, A.V., Kosinski, K.C., Liss, A., Adjei, M.N., Ayamgah, G.A., Webb, P., Gute, D.M., Plummer, J.D., and Naumova, E.N. 2016. Piped water consumption in Ghana: A case study of temporal and spatial patterns of clean water demand relative to alternative water sources in rural small towns. Science of The Total Environment, 559, 291–301. Available at: https://doi.org/10.1016/j.scitotenv.2016.03.148

[33] Koehler, J., Thomson, P., Goodall, S., Katuva, J., and Hope, R. 2021. Institutional pluralism and water user behavior in rural Africa. World Development, 140, 105231. Available at: https://doi.org/10.1016/j.worlddev.2020.105231

[34] See footnote 30.

[35] Cronk, R., and Bartram, J. 2017. Factors Influencing Water System Functionality in Nigeria and Tanzania: A Regression and Bayesian Network Analysis. Environmental Science & Technology, 51(19), 11336–11345. Available at: https://doi.org/10.1021/acs.est.7b03287

[36] Scott, W.R. 2003. Institutional carriers: Reviewing modes of transporting ideas over time and space and considering their consequences. Industrial and Corporate Change, 12(4), 879–894. Available at: https://doi.org/10.1093/icc/12.4.879

[37] Scott, W.R. 2008. Institutions and Organizations: Ideas and Interests (3rd ed.). Sage Publications.

Findings and Lessons Learned

Together, these studies produce important findings regarding the pathways to more sustainable service provision through professionalized maintenance arrangements:

Operational, social, and political conditions enabled high contract retention among user communities. The predominant pathway to success featured consistent expansion of services to normalize new concepts — such as tariff payment; local government participation to increase trust, transparency, and accountability between the service provider and communities; and sector aid coordination — ensuring that unregulated actors and the provision of free repairs did not undermine efforts of the service provider and local government partners.

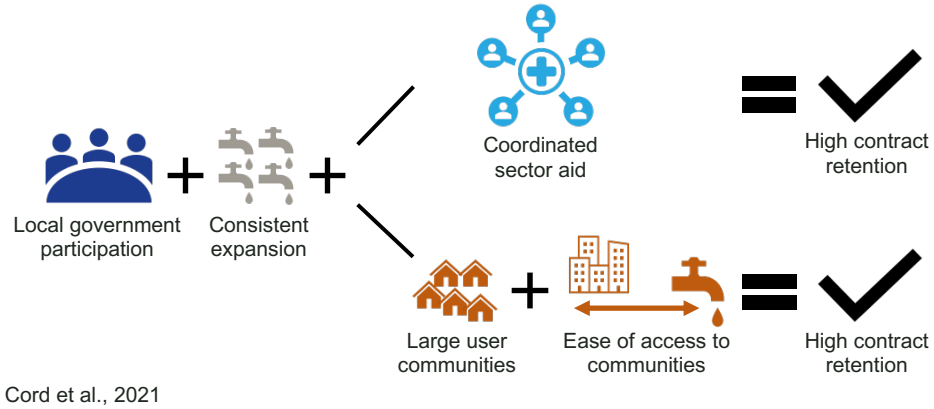

Figure 2. Findings from an Application of fsQCA to Identify Conditions Leading to High Contract Retention across 22 Service Contexts in Uganda

Natural conditions were relatively unimportant for determining contract retention when examined together with other domains of influence, and physical conditions only played a role in the absence of aid coordination. Only one case achieved high contract retention in the absence of aid coordination, because it was enabled by the large size of communities in the sub-county and proximity to the service provider's main office. When the right social and political conditions are in place, this study's results demonstrate that natural and physical environments, which are often more difficult or impossible to change, play a limited role.

Community-level interventions to strengthen water user committees may be limited in their ability to realize improvements in consumer demand and payment over time. Despite significant interventions in water user committee trainings and capacity building over the last 3 years, there was no clear relationship between cases with high contract retention and success with registering water user committees with the local government and opening bank accounts for them. These results expand on growing evidence calling for a departure from exclusively community-focused solutions such as community-based management for service delivery in

low-income contexts.[38,39] Though it may not lead to high contract retention, strengthening water user committees is still important for tariff collection.

Local government participation in and support for professionalized maintenance is vital, but new policies are unlikely to motivate fulfillment of key roles and responsibilities. Norms, expectations, relationships, beliefs, and notions of identity may determine courses of action among local government actors, especially political actors. Existing influences can be leveraged to motivate support; for example, politicians can contribute funds toward community service agreements and take credit for improvements during election campaigns, rather than campaigning against tariffs or personally providing repairs to gain electoral support. This study provides evidence that, for some local government actors, these motivational shifts are already taking place.

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[38] See footnote 17.
[39] See footnote 15.