



MARKET-BASED OPERATION AND MAINTENANCE FOR RURAL WATER PROJECTS

Bundled Water Schemes in Turkana County, Kenya



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The provision of water in Kenya is mandated to county governments, which tend to play a more prominent role in urban centres, while donors and NGOs take the lead in harder-to-reach or less commercially viable rural settings. Mostly, donor-funded water projects cover only capital expenditure (capex) and not operations and maintenance (O&M), resulting in inadequate maintenance of water infrastructure. After the initial investment, projects are handed over to community volunteers, who often do not have the technical expertise or financial management skills needed to keep them running. In addition, the tariffs collected are not sufficient to cover the O&M costs.

1 INTRODUCTION

While Kenya has seen substantial capital investment in the water sector in the past 20 years, access to improved water supply has increased only slightly. The percentage of Kenyans with access to basic drinking water services increased by 7% between 2000 and 2015, from 46% to 53%.¹ Two-thirds of rural water systems in Kenya's arid and semi-arid lands (ASALs) are dysfunctional within 3–5 years of construction and about one-third are non-functional at any point in time.² The problem is particularly acute in remote rural communities, such as in Turkana County in the northwest of the country, where up to 50% of rural water systems fail within 1–3 years of construction. This leaves communities vulnerable, especially in the face of recurrent drought, and many are unable to access safe water for months at a time.

There is therefore an urgent need for new business models and financing mechanisms that can create financially viable, affordable and sustainable water supply schemes in remote rural areas.

In 2021, an innovative public–private partnership (PPP) O&M approach for rural water systems was co-developed by Oxfam and LeFil Consulting. This approach aimed to deliver effective and efficient O&M in five sub-counties of Turkana County, using three main levers: i) improving the lifespan of infrastructure at lower cost by channelling more resources into professional and cost-effective O&M services through private sector engagement; ii) improving tariff collection/avoiding tariff leakage; and iii) advocating for ringfencing of funds for O&M. To assess the economic feasibility of this approach, the first and second levers were piloted in 60 stand-alone rural water systems in the ASALs of Kenya for one year. If the pilot proved successful, this would trigger the implementation of the third lever and pave the way for wider adoption of this O&M model.

2 DESIGN OF THE PILOT PROJECT AND CHARACTERISTICS OF THE TARGETED WATER SCHEMES

The pilot targeted stand-alone water systems in remote rural areas serving very small, small and sometimes medium-sized villages which did not fall under the direct management of the local water utility. Once identified, schemes were randomly assigned to the treatment group (60 schemes) or to a control group (30 schemes).³ By ‘bundling’ together a large number of water schemes, the project aimed to ensure sufficient profitability to incentivize private companies to invest, rather than merely bidding for small-scale, short-term projects focused largely on construction, as is often the case. Equally, it aimed to ensure that O&M would be sustained, including for smaller and more remote schemes that might otherwise not be commercially viable.

On average, each of the water schemes participating in the pilot served 229 households and up to 15,000 head of livestock, depending on season and location. Most of the schemes were solar-powered (90%), with some being solar-diesel hybrids (8%) and some generator-based systems (2%). Most were fully functional at the beginning of the project (target group: 67% vs. control group: 50%). Others were partially functional (target group: 28% vs. control: 45%) or non-functional (target group: 5% vs. control 5%). In terms of water quality, 30% of the schemes had sodium levels above the WHO benchmark (i.e. 200 mg/litre); 40% had levels of fluoride above the benchmark (1.5 mg/litre); and in 26% *E. coli* bacteria were present.

A key component of the pilot was the contracting of a professional private operator to undertake O&M services; Epicenter Africa Ltd was chosen following a competitive procurement process. Under the terms of the contract, the company was required to make at least two preventative visits⁴ to each water scheme and to test water quality once, with curative works⁵ carried out as required. A portion of the overhead costs (including Turkana office, salaries of relevant administrative staff, licences, water analysis, equipment and materials for preventative works and field staff costs) were paid upfront, regardless of the works performed, while variable costs were paid depending on the nature of the work needed, with Epicenter submitting quotes to LeFil and Oxfam for approval. Performance was tracked through key performance indicators (KPIs): these included response times to curative calls and resolution times for curative works. The company was penalized financially if the targets were not met.

Another crucial component was the collection of tariffs through cashless payment mechanisms. For each village, the local Water User Committees

(WUCs) were enrolled into the scheme – notably the chairman responsible for overseeing the scheme and the treasurer in charge of collecting water tariffs from users. The latter were trained in transferring payments via a Paybill account on Safaricom’s M-PESA mobile money service. AQ-taps were installed by Grundfos but were not tested during the pilot phase.

Lastly, to avoid depending on unpaid volunteers, the WUCs also designated local field staff to manage day-to-day operations, who were to be paid from the tariffs collected. Depending on the scheme, the local team would include a pump operator, a kiosk attendant to manage water distribution points and/or a guard to look after solar panel infrastructure, when located remotely from the village.



Water point in Turkana County, Kenya. Photo by Blandina Bobson/Oxfam.

3 FINDINGS

To assess the achievements and the cost of the pilot, financial, operational and performance data was collected from both groups before and after the programme was implemented. An external consultant was hired to conduct the baseline data collection, while the endline was performed by Oxfam and LeFil. An external consultant was engaged to conduct a final impact evaluation. Despite the challenging context,⁶ the project improved access to water supply for 75,240 people,⁷ as well as their livestock, and cushioned them from some of the harsh effects of the drought. It also reduced the number of unscheduled repairs by 89% and significantly reduced the costs of spares for maintenance by 46%.

INFRASTRUCTURE

In terms of functionality, the pilot managed to keep a larger proportion of schemes fully functional than in the control group. By the end of the pilot, 19% of schemes in the target group had lost functionality, going from fully functional to partially functional. In contrast, 36% of schemes in the control group lost functionality, going from fully functional to partially or non-functional. In addition, after the pilot, 2% of schemes in the target group needed full reconstruction, while 9% of schemes in the control group fell into the same state. This proves that a lack of proper maintenance causes accelerated deterioration of schemes. Lastly, 15x more curative works were performed in schemes in the pilot than in control communities, in addition to other minor works to improve the overall reliability and quality of water.

WATER QUALITY

During the baseline assessment, 21% of the water schemes did not meet WHO's bacteriological standards, mostly as a result of infiltration of faecal coliforms into aquifers. Inline chlorine dozers were installed in 12 schemes, which are relatively easy to use and maintain, and these proved 100% effective in eliminating coliforms. By the end of the implementation period, *E. coli* was present in only 5% of schemes. There was a 57% reduction in water-related ailments in communities in intervention areas. TCG is looking at other technologies, such as reverse osmosis systems, to reduce quantities of fluoride, calcium, magnesium and sodium in the water supply.

SERVICE PROVIDER'S PERFORMANCE

Epicenter set up a shop in Turkana County, staffed a toll-free line for communities to report issues and dispatched staff and equipment for the duration of the pilot.

As per the contract, two rounds of preventative maintenance for each water scheme were performed. In addressing curative maintenance, 52 calls were received, 90% of which were assessed and resolved within 48 hours, as set out in the KPIs. However, while it was anticipated that only 30 curative visits would be required, i.e. for 50% of the schemes, it turned out that most of them at some point required curative measures. Even among the better functioning schemes that were selected, 65% already required repairs by the time the team was deployed on the ground. This created an unexpected backlog at the very start of the pilot, which drove a higher spend than anticipated, and increased pressure on delivery. On top of this, drought conditions and the incremental inflow of pastoralists into communities with functioning schemes increased demand for water, putting an even greater strain on infrastructure.

Epicenter required more time than anticipated to respond: 38% of works that did not require pre-approval (i.e. smaller repairs) were delayed beyond the target of five days envisaged in the contract, with the company taking an average of 11 days to complete them. Meanwhile, 93% of works that required pre-approval were delayed beyond the target of 20 days envisaged in the contract, with an average of 92 days taken to complete them. That said, these response times were still better than in the control groups where it reportedly took 1.19 days more⁸ to resolve an issue. Furthermore, the intensity of curative repairs reduced considerably between the first and the second half of the pilot (a 61% reduction), partly due to better management of O&M.

COMMUNITY ENGAGEMENT

The pilot worked with local staff nominated by the communities for local operations: pump operators and guards (all of whom were men) and kiosk attendants (54% women across the schemes.) Only 7% of local staff were actually paid, given the availability of funds.⁹ It was recommended that the service provider should train pump operators on basic repairs and better diagnosis of problems. In addition, LeFil deployed a local resource person to facilitate liaison between the WUCs and the other stakeholders.

The evaluation found that 60% of WUC leaders in the target group felt that their ability to respond to water issues for their communities had improved, while only 13% of leaders in the control group felt the same. Furthermore, 55% of pump operators in the targeted schemes reported being able to perform O&M services on their own, compared with 9% in the control group. However, the number of local staff trained was limited due to high staff turnover, as some migrated to urban areas in search of jobs during the drought and some were still uncomfortable with new technology, especially solar or hybrid water pumping systems.

Although the pilot managed to improve the proportion of households paying in 40% of the target schemes, the payment rate decreased in 51% of target

schemes and remained the same in the remaining 9%. More specifically, payment rates decreased systematically among the best-performing schemes, and in 50% of cases among the second-best performing schemes.

At the beginning of the pilot, only 35% of households had a mobile phone and only 51% of schemes had an M-PESA agent nearby. Thanks to the pilot, 89% of schemes used M-PESA at least once to pay tariffs.

Contrary to initial expectations, by the end of the pilot 72% of communities in the target group were 'little satisfied' or 'not satisfied at all' with the performance of their water schemes, compared with 34% in the control group. This may be because expectations were set differently from the beginning, with the target group being promised fully functional water schemes whereas the control group was not expecting any improvement in their water infrastructure. However, focus groups and interviews indicated that the pilot had helped to improve a sense of communal ownership of water schemes.

OTHER COMMUNITY BENEFITS

The rehabilitation of infrastructure contributed to reducing the time spent by women and children in fetching water, which freed up time for economic activities and reduced their exposure to risks of harassment and gender-based violence. Improved infrastructure also helped to reduce water-related conflicts, which were reported in 21% of locations across the five sub-counties. Lastly, better management of the schemes resulted in more secure infrastructure, with the target group reporting fewer hazardous incidents (5%) than the control group (18%).

ECONOMIC FEASIBILITY

A major objective of the pilot was to assess the economic feasibility¹⁰ and cost-benefits of this approach compared with the status quo, i.e. leaving the WUCs to handle the repairs, until TCG or donors could pick up the bill for larger repairs. The pilot was effective in providing information about how much such a model would cost in similar settings, how much could be collected in tariffs (in a transparent and reliable way) and what would be generated in savings (in avoided repairs and/or avoided reconstruction of schemes).

The cost-benefit analysis showed that 60 bundled O&M schemes would cost KES 37.9m¹¹ (US\$307,000) in the first year of implementation, with O&M service provision accounting for 80% of the total, field staff salaries for 13% and scheme reconstruction for 7%. On the other hand, 60 schemes without the equivalent provision of O&M services would cost KES 34.8m (\$282,000)

annually, including 52% for large breakdown repairs, 36% for scheme reconstruction and 12% for field staff salaries.¹²

Tariff payments recorded through the M-PESA platform in the target group amounted to KES 645,725 (\$5,230) (i.e. equivalent to 6% of targeted households paying a monthly average of KES 100 in water tariffs). This source of revenue was dedicated exclusively to cover salaries for local staff and other local expenditures (e.g. oil, fuel, etc.). This figure would have had to reach KES 4,501,651 (\$36,463) (i.e. 40% of households paying a monthly average of KES 100) for the tariff to cover 100% of local expenditures. In comparison, WUCs in the control group reportedly managed to collect KES 2,641,984¹³ (\$21,400), or 64% of what was required to pay for local field staff salaries.

By adopting this O&M model, 7% of infrastructure in the target group was preserved from falling into total disrepair. The pilot realized savings of up to KES 10,166,667 (\$82,350) (or 30% of the total amount invested in the project by donors and TCG), which could have been spent on reconstruction of infrastructure due to rapid deterioration. This was all the more significant during the drought, when systems failed at a time of heightened need.

In conclusion, interventions such as this pilot require subsidies. A subsidy of KES 22.6m¹⁴ (\$183,000) would be needed to replicate this pilot to 60 other schemes of similar nature in the first year of implementation, assuming that tariffs could be brought to a level where all local salaries and expenditures could be covered from that source of funds. This cost is expected to reduce in subsequent years. However, if both monetary and non-monetary benefits are considered, this approach appears worthwhile, especially as an alternative to more reactive and possibly less efficient emergency response models.

One of the possible funding mechanisms to pay for the financial gap (i.e. the funding requirement for O&M) recommended to TCG was to institute an O&M levy on water sector actors investing in new water infrastructure to cover the future O&M costs that arise over its lifespan. Based on the results of the pilot, the recommended O&M levy would be 18% of total capex invested.¹⁵

One key achievement of ongoing engagement with the county government is that TCG has ringfenced 10% of its annual water budget for O&M and, under the Turkana County Water Act (2019), has established a new water fund to pay for capital projects. This has since been gazetted, and operationalization is ongoing.

KEY LESSONS AND RECOMMENDATIONS

- **Database management:** The partnership identified the importance of a comprehensive and effectively managed database of water schemes. Identifying schemes took longer than expected and at times inaccurate diagnostics were made because information on the specifications of infrastructure components and boreholes was not available. To address

this issue, local government (in this case the Ministry of Water) should map and geo-reference water schemes to ensure traceability. In addition, the information collected thanks to the pilot on the location and functionality of schemes can be used to guide TCG's own investments and intervention decisions in the future.

- **Operation and maintenance in a complex environment:** The challenges faced over the course of this project demonstrated the need to better factor in environmental pressures on water systems, as this had a big impact on the investment needed. The state of some systems at the start of the programme was worse than anticipated even after the completion of a water systems audit. This was due to overuse (in large part due to the drought) along with the limited management that the schemes had in place, and was complicated by limited investment by TCG. Sound investment in capex is recommended to ensure quality construction from the outset. This will subsequently reduce ongoing opex costs.
- **Mapping of migratory routes:** In the ASAL areas, demands by people and livestock cause tension and potential conflict. Infrastructure in these areas needs to be constructed and managed within the context of migration, increasing water scarcity and climate change as driving factors in the design and management of water schemes. Systems and processes need to be able to contract and expand within these contexts to ensure that people and livelihoods are protected, which calls for clear migratory routes for nomadic communities.
- **Private sector engagement:** It was expected that the business model envisaged in the pilot (i.e. provision of a long-term performance-based service contract, and contributing to the overhead investment involved in setting up operations in a new zone) would incentivize private sector interest. However, the number of private sector actors operating or wanting to operate in Turkana was very limited at the time of bidding. Hence, mapping out the weaknesses of the business environment and finding creative business mechanisms to incentivize investment should be a crucial component of any future intervention. It is recommended that TCG works collaboratively with other stakeholders to engage more private sector actors and invest in creating a better enabling environment for private sector actors to operate in Turkana County.
- **Operational and financial management and oversight:** Sufficient resources and appropriate tools and processes need to be developed to ensure the smooth operation of an intervention of this complexity. Areas that required (much) more handholding than expected included: review and processing of quotes, financial reporting and payment processing, verification of works, and tracking and reporting tools to capture progress and operations and check that work was being done reliably, transparently and with sufficient quality controls. An alternative to output monitoring, which was found to be too mechanical and time-consuming, would-be outcome monitoring and automation through the adoption of remote sensing technologies.
- **Digital infrastructure for tariff collection:** The requirements of Safaricom for the opening, management and auditing of accounts, and access to them, was found to be cumbersome for the rural communities. It is

recommended that resources are invested in capacity-building in communities on the use of cashless tariff collection methods, such as mobile money, and in establishing clear systems of operation between service providers and communities. Even though the idea of cashless tariff collection was initially embraced by the communities and was found to improve accountability, continuous community engagement is recommended to sustain the momentum and to keep up to date with technological changes.

- **Political engagement:** Turkana is a context of high need and a high dependency on aid. While Oxfam and TCG built a good working relationship, the demands of the drought and subsequent need for reactive funding and decision-making deflected focus from the agreed investment in the O&M of water systems. Contingency funding and clarity about the critical points of engagement by TCG would need to be included in the design of the pilot.
- **Community engagement:** Community engagement at each site is a key element for sustainability, particularly in complex contexts. In Turkana, community groups had already been managing water systems for over a decade and the pilot disrupted the status quo. Community engagement therefore took longer than planned because of attempts to change management processes, especially in the middle of a drought. Significant time and resources need to be dedicated to continuous community dialogues to enhance social accountability and transparency, especially in the collection of water tariffs.
- **Tariff collection:** Contrarily to our initial expectation, the proportion of households paying tariffs in the target group decreased over time. This unintended result could be due to reduced purchasing power in the community due to the protracted drought, or increased dependency on donor aid. Another explanation could be that users paid less over time because they were dissatisfied with the support given to the pilot. Yet another explanation could be that users paid less due to the (perceived) difficulties involved in the introduction of the M-PESA-based payment system. Setting realistic expectations from the start and being consistent on the requirement to deliver O&M should be a crucial component of any future intervention.
- **Public health promotion:** The focus of the pilot was on water access through the provision of timely O&M services, but the quality of the water provided is also crucial. An emphasis on behaviour change in public health (adopting appropriate sanitation and hygiene behaviours) by the community could be key in ensuring that there is no primary or secondary contamination of water.

CONCLUSION

The pilot demonstrated that proactively maintaining water infrastructure over time yields significant savings and benefits compared with the status quo. Notably, it yielded more reliable water infrastructure, since it prevented schemes from falling into total disrepair, saving costs and providing better outcomes for communities by serving water more reliably to 12,366 remote rural households during a severe drought.

These investments of course came at a cost, but given the scale and reactivity of the pilot they are deemed worthwhile, particularly considering the protracted drought experienced during the time of implementation. The pilot provided a better coordination mechanism for collecting information on exactly which schemes were most affected and in what way, and it had an implementation arm ready to be deployed quickly where needed.

Despite the bundling of projects to improve the commercial viability of water schemes in poor rural areas, the resources mobilized from the collection of tariffs were not sufficient to cover O&M costs. It is important for government to realize the need to subsidize O&M in such communities in its mandate to provide sustainable access to water, especially in times of drought.

That said, many challenges remain, notably in terms of community engagement, operational/financial management and the quality and quantity of supply of private O&M services, as well as digital payment systems. These challenges should certainly be addressed before replicating or scaling up, given the rate of deterioration of infrastructure and the ever-increasing pressure on water systems due to repeated droughts. Once addressed, this model can be used as a preferred alternative to letting communities deal with these problems on their own, except for ad hoc interventions coming from emergency response.

Going forward, the lessons learned from the pilot project will be used to promote the approach with other actors in the water sector, and to further Oxfam's efforts to set up a funding initiative in Turkana that encourages social investors and donors to align funding with outcome-based mechanisms that include the provision of O&M services for sustainable water access.

NOTES

- ¹ UNICEF and World Health Organization. (2017). Progress on drinking water, sanitation, and hygiene: 2017 update and SGD baselines. UNICEF/WHO Joint Monitoring Programme (JMP). <https://data.unicef.org/resources/progress-drinking-water-sanitation-hygiene-2017-update-sdg-baselines/>
- ² C. Tiwari. (2013). Water services delivery as a business: an approach to sustaining water services in rural areas. In: R.J. Shaw (ed). Delivering water, sanitation and hygiene services in an uncertain environment: Proceedings of the 36th WEDC International Conference, Nakuru, Kenya, 1–5 July 2013. <https://wedc-knowledge.lboro.ac.uk/resources/conference/36/Tiwari-1682.pdf>
- ³ Control group schemes would be included in any subsequent roll-out of the pilot. During the first year, however, data was collected to provide a comparison with the target schemes, in terms of the evolution of the condition of the infrastructure, repairs needed and performed, and tariff collection.
- ⁴ Preventative visits included cleaning, lubrication, oil changes, adjustments, small repairs, inspection of parts, testing and alignment.
- ⁵ Curative works entailed the repair and replacement of parts and the repair of equipment but did not include full replacement of equipment (with a few exceptions) or the installation of new equipment.
- ⁶ Due to a severe drought in the region, by December 2022 over 56,000 head of livestock had died in Turkana and 146,315 households, including 20,050 children aged five and under, had insufficient access to water for drinking, cooking and cleaning. More than 4.4 million people in the ASALs required humanitarian assistance. The situation deteriorated further with the outbreak of cholera in October 2022. Other challenges included regional insecurity, which limited movement of staff for extensive periods of time.
- ⁷ This has been computed assuming that fully and partially functional schemes have reasonable access to stable and clean water supply, with an average of 229 households per scheme and six people per household.
- ⁸ Of note, interviewees in the control group only reported major breakdowns and repairs (as asking for more minor repairs would have likely generated unreliable answers).
- ⁹ Cross-subsidizing would have allowed the pilot to cover 14% of field staff salaries. However, it was decided not to do this, given the wide variations in tariff payment rates and the overall low levels of commitment of communities (i.e. this might have encouraged ‘free-riding’ behaviour in low-paying communities, at the expense of more committed communities).
- ¹⁰ For comparison purposes, all costs mentioned in this section have been extrapolated to 60 schemes.
- ¹¹ Of note, this total does not take into account the management, coordination and oversight activities performed by Oxfam and LeFil for this pilot.
- ¹² Data on tariff collection and payment of field staff salaries in the control group was self-reported, so it cannot be guaranteed that this proportion is accurate.
- ¹³ This data was also self-reported, and its accuracy cannot be guaranteed.
- ¹⁴ This compares with KES 30,557,110 (\$247,513) spent on the pilot by various donors and TCG.
- ¹⁵ Assuming that 60 schemes are (re)constructed every year in Turkana at an average cost of KES 2,541,667 (\$20,588).



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This is a summary paper of the endline and impact evaluation reports on a market-based approach piloted in Turkana County to manage the operations and maintenance of rural water schemes in the ASALs of Kenya, co-developed by Oxfam and LeFil Consulting.

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Cover photo: Water tap, Kenya. Photo by Mark Wahwai.



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