Guaranteeing safe drinking water services for public schools in Kenya: A costed professional service delivery model for Kitui County

Working paper | September 2024

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Acknowledgements

This paper is an output of the REACH programme funded by the Foreign, Commonwealth & Development Office (Project Code 201880). The study on which this analysis was based was made possible by the REACH Programme and by the generous support of the American people through USAID under the terms of the Cooperative Agreement AID-OAA-A-16-00075 (the Sustainable WASH Systems (SWS) Learning Partnership 2016-2021). FundiFix is now a grantee and key partner in the USAID Sustainable, Transformational and Accessible WASH Interventions (STAWI) Activity in Kenya (2023-2028), under Cooperative Agreement #72061523FA00005. However, the views expressed and information contained in it are not necessarily those of or endorsed by FCDO or USAID which can accept no responsibility for such views or information or for any reliance placed on them.

This report should be referenced as:

Nyaga, C., Hope, R., Charles, K.J., Nowicki, S., Katuva, J., Mugo, P., Hoque, S., Olago, D., Thomas, M.K., and Mumma, A. (2024). Guaranteeing safe drinking water services for public schools in Kenya: A costed professional service delivery model for Kitui County. REACH Working Paper 14. University of Oxford, UK.

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Summary

- Kenya's ambition of middle-income status by 2030 will require progress on education, health, and equality goals. Providing universal safe drinking water services in schools is a necessary and equitable step to give every child the means to achieve their individual potential.
- Risks from gender inequalities, droughts, floods, and health shocks mean schools struggle to cope, girls drop out of school early, qualifications are sub-standard, and the country's education goals are missed generation after generation.
- Based on empirical studies in Kitui County, we estimate the annualized cost for guaranteeing safe and reliable daily drinking water services is KES 565 (USD 4.3) per pupil per year. In addition, the one-off capital costs to build and rehabilitate water supply systems in all public primary and secondary schools would be KES 9,425 (USD 72) per pupil.
- At the national scale, this translates to an initial capital investment requirement of KES 155.5 billion (USD 1.2B) to provide new access for all 17 million pupils[1] in the 37,910 primary and 11,399 secondary schools across Kenya (as of 2020). A further annual budgetary allocation of KES 9.3 billion (USD 71.7M) is required towards professionalized operation and maintenance (O&M) of the service to guarantee safe and reliable services for every pupil, every day.
- Professionalized service delivery models have been demonstrated to be effective in dramatically improving and maintaining rural water quality and reliability when combined with results-based funding. If Kitui County introduced a professional service delivery model, it is estimated that it would reduce government spending on major repairs by 60%, increase functionality from 54% to 83%, and increase water production by 67%. The economic logic is compelling (Chintalapati et al., 2022).
- Since 2016, FundiFix has been supported by the Water Services Maintenance Trust Fund (WSMTF) designed explicitly to subsidize long-term maintenance services in rural areas. Through results-based contracts guaranteeing service levels, corporates have provided funds to progressively pay for most of the operational costs. Critically, funding is conditional on high-quality results. While this may not address the projected national costs of USD 72M, it provides lessons on how new funding can be attracted if professional services are required and programmed from the outset.
- We recognize funding alone is not a singular solution. Clarity is needed on allocating responsibilities between the National Government and County Governments on infrastructure development, and, most importantly, its long-term operation and maintenance. Further, policy reform for accountable service quality, coordination, regulation, and enforcement with County governments is also required to successfully introduce professional O&M service delivery models for schools to secure education outcomes for current and future generations.
- Not all County Governments will be motivated or capable of changing current practices. However, identifying a few counties to demonstrate results could guide the transition to chart the way for all.

1 In 2020, there were 2.83 million learners in pre-primary institutions, 10.08 at the primary school level, and 3.569 at the secondary education level.

1. Background

Since 2014, the University of Oxford has been working with Kitui County stakeholders to design and test a professional service delivery model to improve drinking water services. Close collaboration with the county government helped to establish FundiFix as a social enterprise in 2015. FundiFix is a professionalized operation and maintenance (O&M) model guaranteeing reliable drinking water at piped schemes and handpumps used by rural communities, healthcare facilities, and schools.

The Kenya Water Services Maintenance Trust Fund (WSMTF)[2] was established in 2016 to support results-based contracts, recognizing that a subsidy was required to guarantee services are maintained on a daily basis. Compared to community or public management, FundiFix, supported by the WSMTF, has improved reliability, guaranteeing repairs within two days on average compared to weeks or months under traditional approaches. In recent years, water quality monitoring and water safety plans have been introduced and have guided FundiFix's actions to chlorinate water, advise users, and report monitoring results to the government.

While FundiFix operates in three of the eight sub-counties, a modelling exercise[3] calibrated 21 months of observed operational and financial data to simulate impacts at the county level. The results indicated the county government would reduce spending on major infrastructure repairs by 60%, partly due to functionality increasing from 54% to 83%, which led to 67% higher water production.

This study revealed the economic case to support financial investment in shifting from a 'build – abandon – rebuild' mentality to one of greater accountability, sustainable services, and lower costs. The shift is political and therefore contested, requiring national and international actors to change institutional behaviours and investment strategies, which remains challenging despite the best intentions of many individuals. The impact for water users would be dramatic as highlighted by comparing traditional community-based management of piped and point rural water supplies with a professional service model managed by FundiFix[4] (Figure 1).

In 2019, an analysis of the status of water, sanitation, and hygiene (WASH) services in Kitui County drew upon a survey of 1,887 primary and secondary schools. The assessment provided evidence on WASH service levels in schools, informing policy recommendations to guide new thinking on the delivery of safely-managed water services for schools in Kenya.[5]

2 www.kituiwaterfund.org

3 Chintalapati et al., 2022. Improving the reliability of water service delivery in rural Kenya through professionalized maintenance: A Systems Dynamics Perspective. doi: 10.1021/acs.est.2c009390939

4 Foster et al., 2022. Investing in professionalized maintenance to increase social and economic returns from drinking water infrastructure in rural Kenya.

5 Hope et al., 2021. Delivering safely-managed water to schools in Kenya. REACH Working Paper 8.

With an estimated 30% of the national population in either primary or secondary school, access to a safe and reliable water service in schools is central to the achievement of Kenya's Vision 2030 and the Sustainable Development Goals (SDGs) agenda on both basic education and water services.

Therefore, building on this assessment, this briefing note aims to inform the annualized cost of achieving a safe and reliable water service for all schools in Kenya for better policy and planning.

Figure 1: Operational performance by maintenance model (Source: Foster et al., 2022)

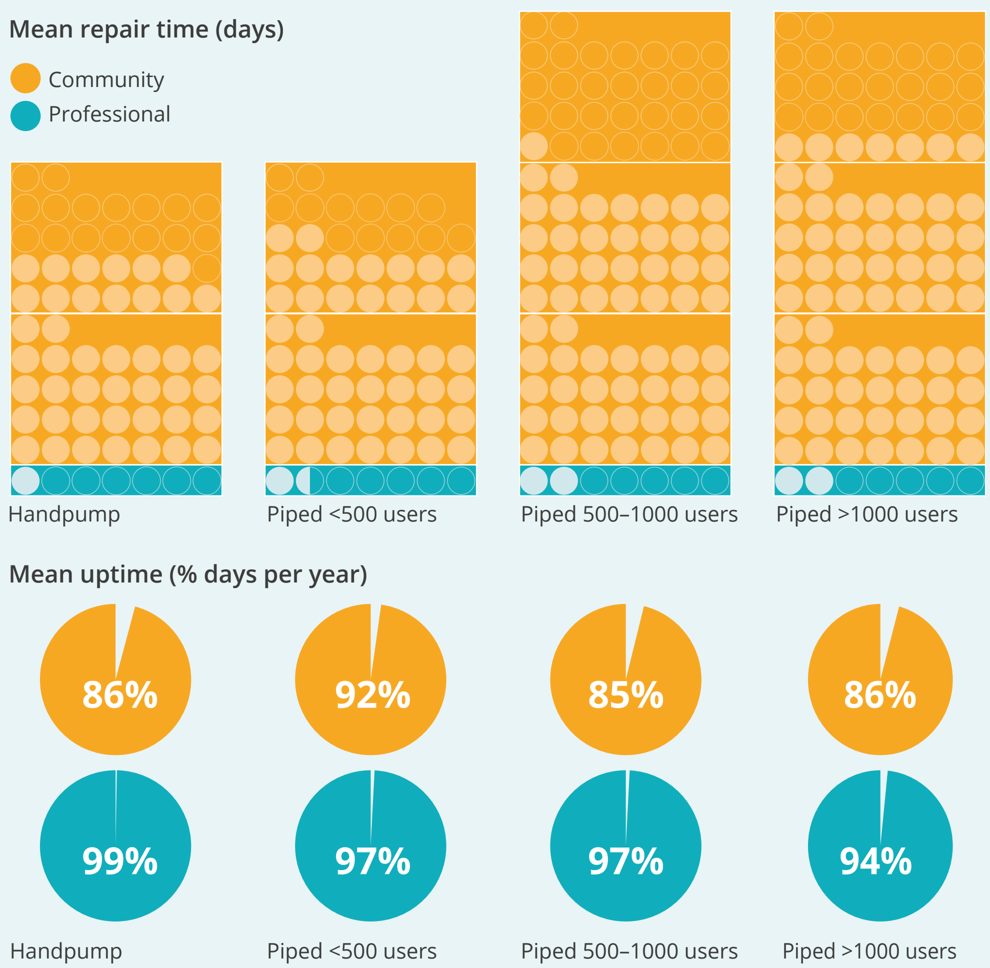
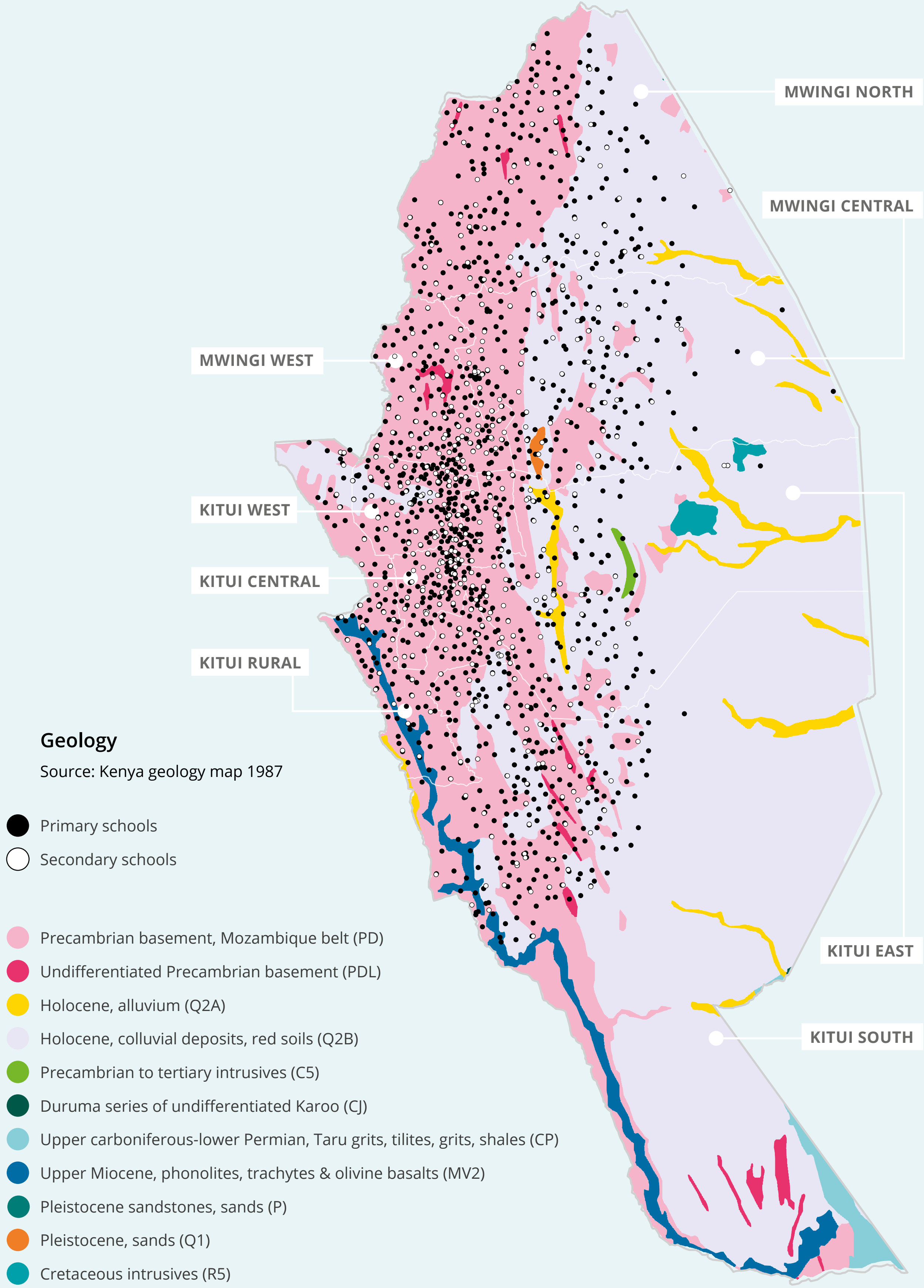


Figure 2: Spatial distribution of primary and secondary schools in Kitui County.



2. The mandates for water service delivery in Kenya schools

Access to basic education is a Constitutional right in Kenya. Schools without water cannot deliver high-quality education as health, sanitation, gender, food, and hygiene requirements cannot be met.

The Kenya Vision 2030 blueprint aims to make Kenya a newly industrializing middle-income country providing high-quality life for all its citizens by 2030. Vision 2030 aims to achieve the goal of ensuring: (1) universal access to basic water and sanitation by 2030, and (2) access to education and training, including basic infrastructure at all levels of basic and vocational education. To actualize these goals the Government of Kenya has also put in place additional sectoral policies, plans, and strategies to guide education service delivery nationally.[6] On water services, the Constitution of Kenya sets out the right to safe water in adequate quantities, and further, through the Water Act (2016) and the County Governments Act (2012) decentralizes this function to a sub-national level with each of the 47 County Governments in Kenya responsible for ensuring universal water service coverage within their administrative areas. The County Governments are, therefore, responsible for water service delivery to schools and other institutions in addition to households and public settings.

The education system in Kenya is structured across four levels: (1) Early Learning and Basic Education, which includes pre-primary, primary, secondary, and teacher education; (2) Vocational Education and Technical Training, (3) University Education; and (4) Post Training and Skills Development. At the Early Learning and Basic Education level, the National Government is responsible for the development of education policy, standards, curriculum, examinations, primary schools, secondary schools, and special education, while the County Governments retain the mandate for the pre-primary education and childcare facilities. Public day primary and day secondary education are 'free' to all, with parents contributing towards the cost of food and school uniforms, while public boarding primary and secondary schools often charge additional fees. To fund education and related services, the national government annually allocates a subsidy to each pupil attending public, day primary, and public secondary school (non-boarding). Besides teaching and learning materials, the annual subsidy caters for operational costs including WASH services; however, the budget for water is blended to include other items such as electricity, water, conservation, and general facilities renovations, maintenance, and improvement. Decisions on spending on water services are made at the school level and largely depend on the headteacher who prepares the school's annual budget and the school board of management that approves them.

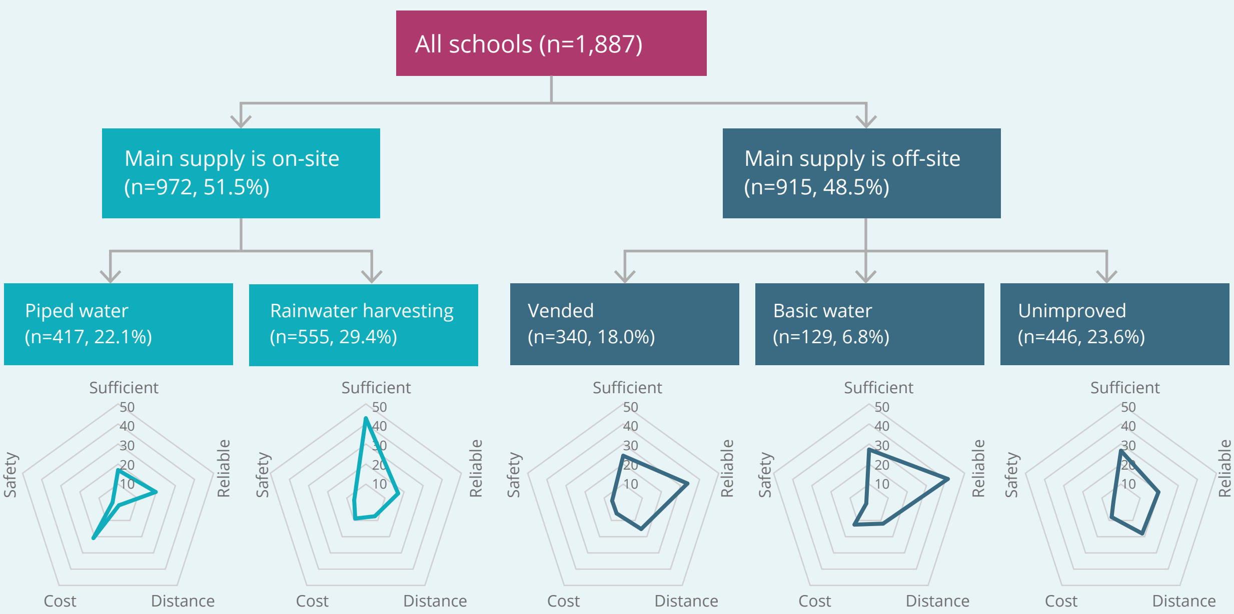
6 The main ones include the Kenya Environmental Sanitation and Hygiene Policy (KESHP) 2016 – 2030, the National School Health Policy and Guidelines 2009, Basic Education Act. 2013, Public Health Act Cap 242, and the Safety standards and Guidelines for Kenyan Schools (2008).

3. Kitui County Context

Kitui County is one of the 47 Counties of Kenya with a total population of slightly over 1.2 million people, most (86%) living in rural areas. The County has an arid and semi-arid climate with a bi-modal rainfall pattern of short (October-December) and long (March-May) rains and is representative of the fragile Arid and Semi-arid lands (ASALs) of Kenya that account for 80 percent of the land mass and that are characterized by higher poverty levels, agro-pastoral livelihoods, high vulnerability to climate shocks, underdeveloped social infrastructure, low access to social services, and in extreme cases conflict over natural resources, especially during droughts.

In 2019, Kitui County was home to 1,742 public primary and secondary schools, representing a student population of slightly over 400,000 pupils and 17,000 teachers (Figure 2). In addition, there were up to 145 private education institutions across the various education levels. The main sources of water for half of the schools are on-site rainwater harvesting (29%) and/or on-site piped water (22%). The remaining half of the schools rely on off-site supplies, with vended water (18%) and improved waterpoints (7%) from nearby handpumps or piped schemes constituting the main sources. One in four schools used an unimproved water source in 2019, ranging from unprotected wells, ponds, and dams, to 'dry riverbed scooping' (Figure 3). Most schools (75%) use two or more water sources over a year.

Figure 3: Typology of main water sources for schools in Kitui County and service quality concerns



When asked to state their top concerns concerning the school's drinking water supply, the leading issues reported by most schools include availability (35%), reliability (26%), cost (11%), and distance to water supplies (9%). While water quality is a primary concern for four percent (82 of the 1,887) of the schools, safety issues remain and from the survey two-thirds of the schools still perceive their drinking water source to be unsafe due to reported concerns related to fecal contamination (28%) and organoleptic properties of taste (15%) and smell (11%) especially. Reliability and distance are mainly a concern for off-site water sources while sufficiency of the supply is a concern for schools relying on rainwater.[7]

4. Framework for estimating the cost of safe and reliable water services for ALL schools in Kitui County

Figure 4: A costed framework for a schools' service delivery model.

	1 Infrastructure (RWH, new BHs, REHABS)	2 Professionalized O&M service delivery	3 Water quality	4 M&E MIS – performance management
One-off costs	New water supply infrastructure			
	Renovations & rehabilitations	HQ & field service hubs setup	HQ & Hub laboratories setup	Database setup & implementation
Annual costs	Operation & maintenance	Service hub operations (utilities, salaries, fuel)	Water quality monitoring & management	

In response to the observed water access and service quality status across all Kitui County schools, a prototype service design is simulated to estimate the cost of services. The proposed design benefits from operational data and experience implementing a professional maintenance model – FundiFix, working with community-managed sources in Kitui County over 2016-2024 to guarantee the safety and reliability of handpumps and piped schemes.[8] The maintenance service by FundiFix guarantees that breakdowns are fixed within a day or two on average, with sanitary inspections, sampling and testing, and treatment at waterpoints to manage water quality. Operations data relied upon include repair and maintenance costs by source typology, water quality data, volumes supplied, billing and revenues data, population coverage, resources (staff and equipment), and other administrative insights. These complement data from the 2019 Kitui schools study[9] to provide granularity on county-wide WASH status and a basis for costing service delivery at scale.

7 Hope et al., 2021. Delivering safely-managed water to schools in Kenya. REACH Working Paper 8.

8 fundifix.org/about-us

9 Hope et al., 2021. Delivering safely-managed water to schools in Kenya. REACH Working Paper 8.

From the insights, we identify the key elements for an enduring service, based on which we estimate the costs. The design combines infrastructural investments in both new and restoration of existing water facilities in schools to enable universal access to good quality water, a professional operation and maintenance service through local hubs to guarantee functionality and therefore reliable delivery of safely-managed water, and a monitoring and report system for accountability. To reflect the WASH sector practice of disconnected infrastructure construction from the operation phase, we split service delivery costs between the initial one-off investment costs and the recurrent costs required to keep the service running annually (Figure 4).

4.1 Infrastructure

Infrastructure investments aim to achieve three objectives: first, maximize the use of rainwater harvesting (RWH) systems beyond the current 538 schools to reach all 1,742 Schools in Kitui County. Second, put in capital investments in piped schemes and handpump sources to optimize and expand existing facilities while also developing new infrastructure in schools with no access. Third, ensure accompanying operation and maintenance (O&M) service for all facilities to maximize value. The cost of each is analysed at a county scale and reported here.

4.1.1 Rainwater Harvesting (RWH) Systems

As part of building climate resilience, investments to maximize rainwater harvesting in the ASALs of Kenya are key considering its importance in augmenting supply in the wet season. For Kitui, the total cost of RWH systems is estimated at KES 623,705,692 (USD 4,797,736) and constitutes rehabilitation cost for the existing RWH systems at KES 196,058,523 (USD 1,508,142) to ensure their peak performance and installation of new systems at schools with no RWH for KES 427,647,169 (USD3,289,594) to attain 100 percent coverage (Table 2, Annex).

For the existing systems, rehabilitation assumes that 20 percent of RWH systems installed at the 538 and 765 schools as their main drinking water source and alternative drinking water sources respectively would require restoration. Cost items here would include the replacement of up to 1,040 crumbling storage tanks with uPVC ones of 10,000 litres each and at KES 100,000 (USD 770) per tank, renewal of gutters and associated connectors at 261 schools with each requiring an estimated 100m[10] of retrofitting at KES 62,500 (USD 480) per school, associated tank stands, pipes, and taps at a round sum of KES 40,000 (USD 308) for each of the 261 schools, and an additional 30 percent and 20 percent allowance for labour and transportation respectively.

In addition to improved access, these investments would also see water quality improvements in schools from reduced contamination risks. Installation of new RWH systems targets all schools other than those already using rainwater as the main source for drinking in addition to expansion at those that already have existing but inadequate RWH systems. Here, the target is to reach a storage capacity of at least 138 litres/student/term in each school, reported to lead to a 'water always available' outcome throughout the standard three-month school term, during the 2019 study. An estimated 1,617 new storage tanks are therefore earmarked for 1,204 schools, in addition to associated infrastructure (gutters, connectors, tank stands, pipes, and taps) and at a unit cost profile similar to that for the rehabilitated RWH systems.

10 Assuming a standard-length Public-School Classroom of 8 meters and at least six equivalent Classrooms of appropriate roofing, both ways, are available.

The annual recurrent costs of keeping the RWH systems at all the 1,742 Schools fully operational is KES 27,872,000 (USD 214,400), comprising of cleaning costs twice a year to rid them of debris and sediments as part of water quality risks mitigation (KES 3,484,000), replacement of the various taps and valves at the schools each term (i.e., three months long) when broken (KES 20,904,000), and the repair of pipes, gutters, and connector system twice a year (KES 3,484,000). Cleaning of all tanks and the repair of the gutters system is advised twice a year, just before the March-April-May (MAM) and October-November-December (OND) rains for KES 2,000 per school on every occasion, and the replacement of taps and valves is estimated to cost KES 4,000 per term taking into account the multiple taps proposed in each school and their countless usage.

4.1.2 Piped Water Schemes and Handpump Sources

To supplement rainwater use, infrastructural improvements would be required to; (i) restore existing but broken piped schemes estimated at 45 percent in Kitui,[11] (ii) optimize and expand existing piped schemes and handpumps to shift delivery technology from handpumps to solar submersibles thus allowing the extension of pipe networks to serve at least two adjacent schools, considering the sparse population densities in ASAL counties, and (iii) for remote schools with no nearby improved source available, development of 385 new solar-pumped piped schemes within school compounds to provide a yard connection to the school. The setup also integrates a reticulation network to allow public taps in the fringes that provide a basic service for approximately 50 nearby households and excludes water chlorination infrastructure, whose costs are provided separately in Section 4.3. The one-off capital cost of this combination of interventions is estimated at KES 3,284,100,000 (USD 25,262,308) and includes a rehabilitation cost of KES 974,100,000 (USD 7,493,077) for existing facilities and a capital cost of KES 2,310,000,000 (USD 17,769,230) for new Piped Schemes.

Rehabilitation would target the 100 existing handpumps and schemes situated offsite, where 55 of these only require minor investments (KES 1,000,000) per facility to introduce yard connections to at least two nearby schools, and with the remainder 45 broken facilities requiring costlier investments of KES 4,000,000 (USD 30,770) each to restore functionality and expand the networks to also reach at least two nearby schools (Table 3, Annex).

The reference 2019 Kitui Schools Study observed that onsite sources, within schools' premises, comprised 356 Piped Schemes and 33 Handpumps. With up to 45% of these estimated to be either partly or completely broken, a cost allocation of KES 3,000,000 (USD 23,077) per scheme is provided to restore each of the 175 facilities and a further KES 1,000,000 on each fully functional onsite scheme to extend water supply to a second school. Altogether, these improvements on the 489 existing water facilities, both offsite and onsite, would reach up to 56 percent (978) of the schools in Kitui with a yard connection. A different approach is therefore proposed for the remainder 764 Schools, entailing the construction of 385 new piped schemes, for KES 6,000,000 (USD 46,154) each, in schools with no access. The capital cost estimate is conservative and assumes corresponding contributions from the County Government in staff time and equipment for core activities such as studies and engineering designs, drilling, and construction supervision.

11 Nyaga, C. 2019. Sustainable WASH Systems Learning Partnership: A water infrastructure audit of Kitui County.

Figure 5: Water containers used by primary school children in a Kitui school to bring water from home and meet their daily needs. Photo Credit: Jacob Katuva/FundiFix

The one-off cost of the 385 new facilities is KES 2,310,000,000 (USD 17,769,230), with much wider service impacts anticipated through increased community water access if peripheral public taps are built in. Assuming a conservative capacity to serve 50 households through these public taps for every rehabilitated or newly constructed piped scheme, the Kitui county-wide impact would be a 13 percent increase in basic access.

Excluding water quality management costs, the annual recurrent cost for O&M of these Piped Schemes and associated facilities totals KES 157,320,000 (USD 1,210,154) determined from the average observed maintenance (only) cost by FundiFix for a typical Piped Scheme in rural Kitui and also reflects gains from a professionalized maintenance service that integrates a responsive service with technological advancements in the sector, among other benefits.

4.2 Professionalised O&M Service Delivery Hubs

Experience implementing the FundiFix model in Kitui suggests that the local presence of a professional O&M service provider (PSP) is key for a rapid response to failure events and accountability for a guaranteed service. On this premise, we identify at least four intra-county service hubs required for Kitui County, with each responsible for roughly 450 Schools. Possible regional locations are the Mwingi North hub, Kitui East hub, and Kitui South hub, with each sufficiently equipped to cover two to three adjoining sub-counties. A central management office in Kitui Central/headquarters would double up as the fourth service hub.

The headquarters (HQ) hub hosts a central management office with a lead team comprising; a CEO/Managing Director, a Monitoring and Evaluation Manager, a Water Engineer, a Water Quality Manager, an Administration and Finance Manager, and an Operations Manager. Each regional hub is directed by a manager responsible for sub-county level service delivery activities, monitoring, and reporting to the HQ, supported by a Hub-level team that comprises; a Water Quality Officer, and eight Technician-level staff including a Water Quality Assistant, Electrician, Mechanic, and Plumbers.

The one-off set-up costs for the entire hub service delivery structure are estimated at KES 28,900,000 (USD 222,308) and each hub is furnished with; a set of one car and eight motorcycles, equipment, and tools including pipe wrenches, spanners, electrical meters, generators, gantry/winch, diagnostic kits, protective gear, and others; three laptop computers in addition to another six for the management office; desks, chairs and a printer, and other loose items. Given the poor road connectivity of many rural locations and strict sample handling requirements for *E.coli* testing, a decentralized network of field laboratories is proposed; one in each of the four O&M hubs. Field laboratories also ensure that the results are available for action by the PSP the next day. Hub-based field laboratories will have the capacity for roughly 200 *E.coli* tests every month,[12] in addition to several other parameters collectible in situ such as Electrical Conductivity (EC), pH, Total Dissolved Solids (TDS), free chlorine, and fluoride. A fully equipped management office laboratory provides a broad range of chemical analysis. Unreliable mains power supply in many rural areas means a backup solar power-based supply would be required at all four water quality laboratories.

The operating cost of the service hubs sums up to KES 43,440,000 (USD 334,154) every year comprising staff salaries (75%), transport (19%), rental space for the hubs and the head office, insurance and permits, utilities, and communication (Table 4, Annex). Operating costs for the water quality laboratories are assumed under the water quality service sub-section below.

4.3 Water quality service

A consistent water quality monitoring, reporting, and management service is required for the schools' service delivery model to manage water safety. In Kitui, for instance, routine sampling conducted at 22 water points across 17 schools, including 11 primary schools and 6 secondary schools in Mwingi North in 2019 indicated extensive contamination issues in school sources, including rainwater harvesting systems. Roughly 90 percent of the schools returned positive for *E.coli* results at least once, with 52 percent of all samples collected in schools indicating *E.coli* contamination, highlighting the need for consistent monitoring of risks and the addition of chlorination and other management actions to ensure the quality of water supplied.

Therefore, the proposed schools model integrates sanitary inspections and water quality sampling with treatment. Sanitary inspections (SIs) will assess whether the water infrastructure condition is appropriate to deliver safe water for all schools. Up to three *E.coli* tests at each of the 1,742 schools are proposed annually, aligned with seasonality (one each after MAM and OND rains) with an allowance for repeat sampling in case of identified risks from SIs.

12 A total of 6,270 samples for *E.coli* are required each year including duplicates and blanks. Therefore, when distributed across the four hub/field laboratories this suggests 1,568 samples per hub per year or 174 samples per hub per term assuming a 9-month school calendar.

Except for free residual chlorine, EC, pH, and TDS that would be done in the field, at minimum, a five-yearly broad-range chemical analysis of samples from each of the 874 water sources serving the 1,742 schools is to be conducted at the fully equipped central management office laboratory unless changes are made to the school water supply system and/or there are water quality related concerns reported by users requiring ad hoc tests. To address contamination risks and based on observed water demand and other design parameters, tablet-based chlorination of all water supplied is introduced for all schools as a standard, with monthly chlorine demand and free chlorine levels monitoring. Nine free chlorine tests are budgeted in a year to track efficacy during school terms, and chlorine demand estimates are based on the use of Trichloroisocyanuric Acid (TCCA) tables, with one kilogram assumed to treat up to 900 m^3 of water at 1 mg/l concentration. The approach however acknowledges that actual chlorine demand could be higher depending on local environmental conditions e.g. temperatures, and other water quality parameters such as Iron, pH, turbidity levels, etc., which can affect chlorination, so further adjustments to design might be needed during implementation. For every 100 samples collected, an additional 10 duplicate samples and 10 blank samples are tested as part of quality control measures to ensure the accuracy of results. This is applied to samples for both *E.coli* and chemical analysis.

Cost estimates assume a standard piped scheme design and do not consider nuances in infrastructure and components layout and further, exclude any remedial actions required whenever a high SI score is observed. In addition, treatment of groundwater mineralization issues such as fluoride and salinity common in the ASALs of Kenya is excluded, and instead assume that blending with RWH to dilute levels would provide a pragmatic low-cost solution. Also excluded is the cost of water quality service to communities in the case of shared piped schemes.

Set-up costs for the water quality laboratory infrastructure are provided under the service hubs. The annual operating costs for the monitoring, reporting, and management service are estimated at KES 7,632,630 (USD 58,713), consisting of costs for the site level chemical analysis every five years (KES 419,520), *E.coli* tests, monthly free chlorine tests and consumables including those for quality assurance (KES 6,084,294), and water chlorination (KES 1,128,816) (Table 5, Annex).

4.4 Monitoring and MIS-based reporting costs

Regular reporting by the appointed service provider to the county government and the area water utility, in the case of Kenya, would be a core function of the management office aided by information management systems set up at the hubs. Kitui and many other Counties of Kenya are taking a lead role in establishing water sector monitoring platforms mainly through donor-funded governance support programmes. The mWater[13] platform, for instance, is already in use in a handful of the counties across Kenya including Kitui, with the latter supported through a USAID-funded Programme.[14] The platform provides a structured modality for efficient reporting and potential regulation of service provision to schools. A provision of KES 1,000,000 (USD 7,690) is therefore made towards the adaption of this platform to monitor outcomes and the impact of the schools' service delivery model. In this model, verification costs are not included but assumed under the County Government’s budget and/or any other funders supporting implementation.

13 www.mwater.co/about

14 www.globalwaters.org/sws

Independent verification of service quality and results is a key part of a credible and transparent results-based funding model. A leading global initiative, Uptime,[15] is designing and delivering results-based funding securing reliable drinking water services for more than five million rural water users and offers insights into how verification of results could be efficiently done. For data integrity, Uptime's protocol comprises a three-dimensional triangulated process of screening, validating, and verifying the data systems of service providers. An initial screening phase entails visits to confirm that services are credible and approve data systems and processes. This is followed by periodic standardized data reporting to minimize errors, with validation of reported metrics against historical data. Annual spot checks of sampled waterpoints from the service provider's portfolio are then completed to verify reported performance. The Uptime work therefore provides a sound methodology that could be adapted and scaled to schools' services.

5. Limitations and assumptions

In providing the cost estimates for a universal, safe, and reliable water service for schools various assumptions have been made. First, the observed demand of 2.3 litres per student a day is assumed to be sufficient for all needs and students across the County despite that the nationally recommended basic minimum water requirement for non-residential schools is five litres per pupil/day.[16]

Water usage is also expected to be highly variable from one school to another due to dissimilar social-economic welfare of the nearby communities, variable climate risks over space and time, level of the school's infrastructural development and maintenance, and hygiene practices, among many other factors. Consistently, extrapolation of costs to national-wide estimates also assumes all other 46 Counties in Kenya mirror the water supply, demand, and socioeconomic profile of Kitui County, yet this will not be the case. Second, groundwater quality is assumed to meet drinking water standards and that any intrinsic chemical quality issues would be sufficiently addressed by blending groundwater with rainwater.

The cost estimates provided here therefore exclude removal costs for salinity, fluoride, or any other harmful minerals. Third, the analysis assumes sufficient density of schools in a rural context to allow at least two yard connections to each existing or newly constructed scheme, and likewise convenient proximity to households. Fourth, in deriving the cost estimates an efficient procurement and implementation process that assures integrity and value for money is assumed, with in-kind Government contribution during roll-out of the model. Fifth, estimates exclude about 150 private schools and all tertiary institutions in Kitui, as well as costs related to inflation, depreciation, asset replacement, and compliance fees and licenses payable to various state agencies in the water service delivery value chain. Sixth, while there exist several hundreds of community-managed schemes in Kitui that could potentially service hundreds of schools and reduce the initial investment requirement, these are deliberately excluded from this analysis due to complex legacy and asset ownership issues that would distract or impede a smooth and cost-effective rollout of a schools service model.

15 www.uptimewater.org/publications

16 WHO guideline on Water, Sanitation and Hygiene Standards for Schools in low-cost settings (2009).

Finally, Schools WASH data relied upon in this analysis were collected five years ago and before the Covid-19 pandemic, and it is probable that WASH service levels in the schools and communities have since plummeted. This is based on generally observed poor post-pandemic O&M of WASH investments, such as handwashing facilities in schools.

6. Next steps

The realization of water services for all children in public schools in Kenya by the SDG 2030 timeline requires joint action by all relevant actors. This brief estimates the initial capital investment required and thereafter, the recurrent cost for the operation of services to ensure safety and reliability (Figure 6). The one-off cost of KES 9,425 (USD 72) per student, and a recurrent budget of KES 565 (USD 4.3) per student per year, can further be extrapolated to provide indicative national estimates for the 16.5 million school-going children in Kenya as of 2020.

Figure 6: One-off and recurrent costs breakdown for a universal service delivery model for Kitui schools

Capex cost per student	KES 9,425 (USD 72)
Recurrent cost per student / year	KES 565 (USD 4.3)

	1 Infrastructure (RWH, new BHs, REHABS)	2 Professionalized O&M service delivery	3 Water quality	4 M&E MIS – performance management
One-off costs	New: KES 2.7 billion Rehabs: KES 1.2 billion	KES 19.9 million	KES 9 million	KES 1 million
Annual costs	KES 185.2 million	KES 43.4 million	KES 7.6 million	

Estimates suggest an initial investment of KES 155.5 billion (USD 1.2B) to provide new access for all the 16.5 million pupils in the 37,910 primary and 11,399 secondary schools as of 2020, followed by a further annual budgetary allocation of KES 9.3 billion (USD 71.7M) towards professionalized operation and maintenance of water facilities to guarantee every child in Kenyan schools today a safe and reliable water service. The estimates also enable meaningful dialogue on the allocation of sufficient funding for WASH in schools to expedite progress toward the SDG targets more systematically.

A national estimate of over USD 1 billion for new and upgraded infrastructure must only be considered in tandem with long-term provision of USD 72 million for regular operation and maintenance. Over 20 years, this figure will be around USD 2.5 billion. Building infrastructure access without maintaining services has been shown to be financially inept and socially ineffective. The rehabilitation costs are a measure of the failure of existing approaches. Government and donors must plan for the long term to escape the traditional cycle of building systems and walking away.

Since 2016, FundiFix has been supported by a Water Services Maintenance Trust Fund (WSMTF) through results-based contracts to subsidize drinking water services in rural areas. The WSMTF has been successful in attracting corporates to fund results-based contracts. Two Kenyan-based companies played a key early role with small but strategic funding; this led to a German social enterprise providing longer term support. Critically, this 'new' money is conditional on results. By FundiFix providing high quality and verified services corporates can make a social case to invest with non-repayable capital. There are many lessons and opportunities for how the long-term operational costs might be shared outside government and donor circles which struggle to fund service sustainability. Kenya now has a playbook and evidence of how to do this if government and donors wish to consider new approaches to both finance (loans) and fund (grants) safe drinking water in rural areas.

To achieve progress, the comprehensive schools report[17] identifies further enablers for long-lasting services. Key among them is first, to provide certainty on the allocation of responsibilities between the National and County Governments on infrastructure development and most importantly its long-term operation and maintenance. Second, to roll out and institutionalize results-based funding arrangements for WASH in schools, linking funding to service provider performance and reporting, to ensure accountability and a virtuous cycle of data informing planning, investments, and policy reform. Third, to invest in the expansion of professionalized service delivery models that are accountable for service quality. Since 2016, Kitui County has pioneered the testing of a professional service delivery model with community supplies. Breakdowns at rural water sources are resolved within a day or two, while also integrating a water quality monitoring and treatment service. Performance-based service contracts are maintained between FundiFix and each of its community or institutional clients, and the Kitui County Government. Further upstream funding contracts are maintained with the Water Services Maintenance Trust Fund[18] and Uptime Global[19] providing match funding against metrics for volumes supplied, revenue collected, and waterpoints repaired promptly. The FundiFix model is replicable in other counties of Kenya, with adaptations if required.

17 Hope et al., 2021. Delivering safely-managed water to schools in Kenya. REACH Working Paper 8.

18 www.kituiwaterfund.org

19 www.uptimewater.org/solution-index

Table 1: Main sources of drinking water in public primary and secondary schools in Kitui

Main sources of water						
Facility level	Piped water	Rainwater harvesting	Vended water (push carts, tuk tuks, trucks	Basic water (onsite handpumps and offsite scheme and handpump)	Unimproved / no service	Totals
Primary schools	185	452	230	87	359	1,313
Secondary schools	165	85	84	27	60	421
Tertiary / colleges	6	1	0	1	0	8
Total number	356	538	314	115	419	1,742
Proportion	20%	31%	18%	7%	24%	100%

Table 2: Required investments in rainwater harvesting systems for all schools, both new and rehabilitation.

One-off investment costs – infrastructure; rainwater harvesting systems required for full coverage in Kitui						
Existing RWH Systems requiring rehabilitation-only						
	% School sources	No of tanks, 10m³	Schools needing gutters	Schools needing – stand, taps, pipes	Labour, 30%	Transport, 20%
Rainwater harvesting	20%	1,040	261	261		20%
Totals	**0**	**1,040**	**26,060**	**261**	**30%**	**20%**
Unit cost, KES		100,000	625	40,000		
Total cost, KES		*103,994,182*	*16,287,500*	*10,424,000*	*39,211,705*	*26,141,136*
Grand total, KES						**196,058,523**

New RWH for schools with NO storage, and those with storage deficit					
	New plastic tanks	Gutters, schools	Tank stand, taps, and pipes	Labour, 30%	Transport, 20%
Piped water	394	356	356		
Rainwater harvesting	230	0	0		
Unimproved (earth dams etc.)	652	419	419		
Vended	190	314	314		
Basic water	151	115	115		
Totals	**1,617**	**120,400**	**1,204**		
Unit cost, KES	100,000	625	40,000		
Total cost, KES	*161,688,113*	*75,250,000*	*48,160,000*	*85,529,434*	*57,019,623*
Grand total, KES					**427,647,169**

Annual recurrent costs – Maintenance of rainwater harvesting systems					
Activity	Quantity	Units	Rate, KES	Cost / School, KES	Total Cost (1,742 Schools), KES
Regular cleaning – tank and gutters	2	times/year	1,000	2,000	3,484,000
Replacement of valves taps	3	times/year	4,000	12,000	20,904,000
Pipe and gutter maintenance	2	times/year	1,000	2,000	3,484,000
Grand total, KES				**16,000**	**27,872,000**

Table 3: Infrastructural investments in Piped Water schemes for all schools, both new and rehabilitations.

One-off investment costs – Infrastructure; rehabilitations, upgrading, and new construction of piped schemes			
Shift to piped systems	Offsite sources – schemes and handpumps	Onsite sources – piped schemes and handpumps	Totals
Existing number of systems	100	389	489
No. of non-functional systems, 30%	30	117	147
No. needing rehabilitation, 15%	15	58	73
Rehabilitation of Broken Schemes – observed ranges of KES 3-5M	4,000,000	3,000,000	7,000,000
Extension of pipe network to Connect the nearest school; for functional schemes (KES 1m)	55,000,000	213,950,000	268,950,000
Total CAPEX for rehabilitation, KES	**235,000,000**	**739,100,000**	**974,100,000**
Total no. of piped systems (new and old)	100	774	874
No. of NEW piped schemes needed		385	385
Total number of schools connected (Assuming 2 schools per piped scheme)	200	1548	1748
Total number of households served (New)	2,250	28,003	30,253
CAPEX for new piped systems, KES (at KES 6m each)		**2,310,000,000**	**2,310,000,000**
Total CAPEX (KES)	**235,000,000**	**3,049,100,000**	**3,284,100,000**
Total OPEX per year (KES)	**18,000,000**	**139,320,000**	**157,320,000**
Total CAPEX (USD)	***1,807,692***	***23,454,615***	***25,262,308***
Total OPEX per year (USD)	***138,462***	***1,071,692***	***1,210,154***

Table 4: One-off setup and recurrent cost items for the Service Hubs

One-off investment costs – O&M Service Hubs				
Item	**Unit cost, KES**	**Unit**	**Total, KES**	**Comments**
Motorcycles	150,000	28	4,200,000	8 motorcycles per Hub – 6 for mechanics, 1 for WQ sampling; 1no backup
Vehicles – HQ and at Hubs	1,300,000	5	6,500,000	Vehicles are safer, allow greater coverage workforce, and extra vehicle for WQ/Management office.
Equipment and Tools	1,000,000	4	4,000,000	Lumpsum cost – Pipe wrenches, spanners, Gantry, overalls, helmets, etc.
Laptops, including #6 for HQ	80,000	15	1,200,000	3 laptops/hub, for Hub manager, WQ officer, and Operations supervisors
Other equipment or furniture	200,000	4	800,000	4 Desks, 4 Chairs, 1 Printer, for each hub
Laboratory set-up – Hubs	2,000,000	3	6,000,000	Hub labs for bacteriological, pH, EC, etc. Need capacity for 100 *E.coli* tests/month
Laboratory set-up – HQ	3,000,000	1	3,000,000	HQ Lab with the capacity to conduct full chemical analysis
Office fabrication/setup costs – solar power	800,000	4	3,200,000	Grid unreliable to run a WQ lab, partitioning, etc.
Total set-up cost, KES			**28,900,000**	

Annual recurrent costs – O&M Service Hubs					
Item	**Unit cost**	**Unit**	**Months**	**Total, KES**	**Comments**
CEO/Managing Director	200,000	1	12	2,400,000	Based at the Management Office
MEAL Manager	150,000	1	12	1,800,000	Based at the Management Office
Water Engineer	150,000	1	12	1,800,000	Based at the Management Office, Technical design, rehabs, etc.
Water quality manager	150,000	1	12	1,800,000	Based at the Management Office
Admin/ finance manager	150,000	1	12	1,800,000	Based at the Management Office
O&M Operations Manager	150,000	1	12	1,800,000	Based at the Management Office, Repair service delivery
Hub Managers	80,000	4	12	3,840,000	Hub-based, responsible for operations management and reporting
Technicians, 8 per hub	40,000	32	12	15,360,000	Include 1 WQ assistant, Electrician, mechanic, and plumbers
WQ Officer/Lab technician, 1 per hub	40,000	4	12	1,920,000	Supported by a Water Quality Assistant on sampling
Fuel, insurance, repair, and maintenance – motorcycles	12,000	28	12	4,032,000	Cost per motorbike per month of KES 12,000 based on observed unit costs
Fuel, insurance, repair, and maintenance – motor vehicle	70,000	5	12	4,200,000	Cost per vehicle per month of KES 70,000 based on observed unit costs
Office rent for Hub, including annual permit, power, garbage fees	35,000	3	12	1,260,000	Includes power, water, garbage
Office rent for Kitui HQ, Business Permit	50,000	1	12	600,000	Includes power, water, garbage
Other office costs (printing, mobile credit, internet)	1,500	46	12	828,000	1k per technician/month, internet 5k per hub/month
Total recurrent cost per year, KES				**43,440,000**	

Table 5: One-off setup and recurrent cost items for water quality management

Annual recurrent costs – Water quality service operation and maintenance						
Water quality item	Cost per sample	Samples per school or scheme	Tests per school / year	Cost / school or scheme per year, KES	No of piped schemes or schools	Total cost per year, KES
Full chemical analysis in Year 1 – new lab, equipment	2,000	1	0.2	2,000	874	349,600
Full chemical analysis in Year 1 – (10% duplicates)	2,000	0.1	0.2	200	874	34,960
Full chemical analysis in Year 1 – (10% blank samples)	2,000	0.1	0.2	200	874	34,960
Field office or hub labs (*E.coli*)	833	1	3	2,498	1742	4,351,115
Field office lab (10% duplicates)	833	0.1	3	250	1742	435,112
Field office lab (10% blank samples)	833	0.1	3	250	1742	435,112
Free chlorine monitoring	35	1	9	415	1742	542,820
Calibrations and other consumables	613	0.1	3	184	1742	320,136
Total, KES				**5,997**		**6,503,814**

Annual recurrent costs – Remediation and chlorination					
Water quality item	Unit cost per m^3, KES	Water demand per school/ year, m^3	Number of schools	Cost/school or scheme, KES	Total cost per year per school, KES
Disinfection – TCCA tablet-based chlorination.	5.00	130	1,742	648.00	1,128,816
Post-remediation *E.coli* test (20% of Schools)					
Total, KES					**1,128,816**

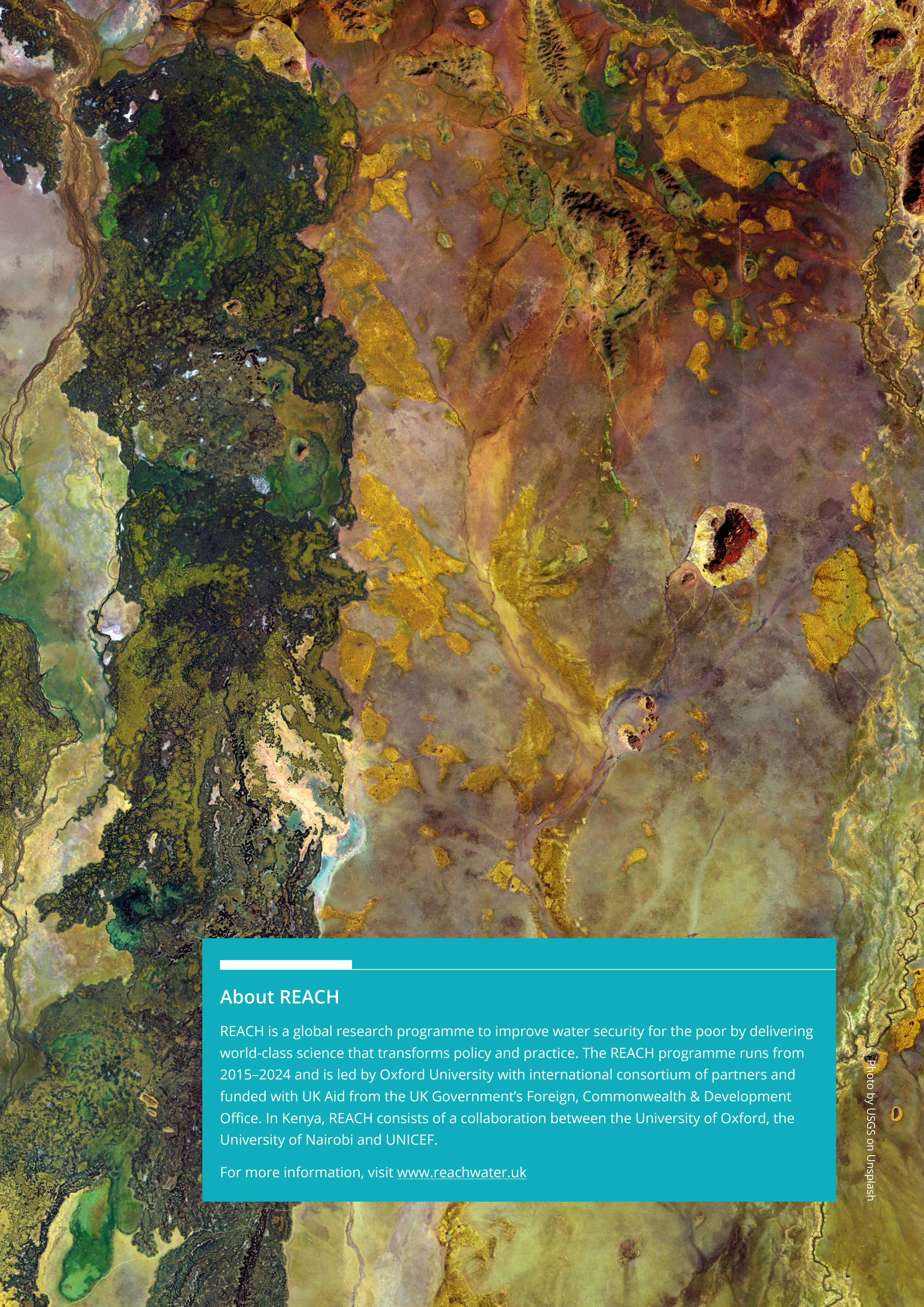


Photo by USGS on Unsplash

About REACH

REACH is a global research programme to improve water security for the poor by delivering world-class science that transforms policy and practice. The REACH programme runs from 2015–2024 and is led by Oxford University with international consortium of partners and funded with UK Aid from the UK Government's Foreign, Commonwealth & Development Office. In Kenya, REACH consists of a collaboration between the University of Oxford, the University of Nairobi and UNICEF.

For more information, visit www.reachwater.uk