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ENSURING AVAILABILITY AND SUSTAINABLE MANAGEMENT
OF WATER AND SANITATION FOR ALL

Operational, financial and institutional considerations for rural water services: insights from Kyuso, Kenya

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Challenges facing the rural water sector include meeting adequate operational performance levels, attaining financial sustainability and building institutions that are functional and fit-for-purpose. Using a water user survey (n=93), semi-structured interviews with key stakeholders (n=24), mapping and collection of financial records, an audit of water services and infrastructure in Kyuso District, Kenya provides data for comparison between different types of infrastructure, including service level (functionality, downtime, sufficient, safe, accessible and affordable water supply), institutional arrangements and revenues/operation and maintenance costs. Estimated volumes used from improved sources, reduce with rainfall, with implications for public health and financial sustainability. Unit water costs for handpumps are 2-4 times lower than for other systems, while treated pipeline supplies have high user satisfaction.

Introduction

Challenges facing the rural water sector include meeting adequate operational performance levels, attaining financial sustainability and building institutions that are functional and fit-for-purpose. Following the installation of smart handpump technology (Thomson, 2012) and the trial of a maintenance service provider model providing important data about handpumps in Kyuso District, Kenya (Oxford/RFL, 2014), a water audit was carried out to investigate and compare operational, financial and institutional aspects of sustainability with other 'improved sources' such as pipeline and groundwater kiosks. Results are presented fully in a working paper (Oxford/RFL, 2015).

Methodology

Study site

Kyuso Sub-County is situated in the north of Kitui County and 267km north-east of Nairobi (38° 10' E, 0° 35' S; 660-880m elevation; 2,446 km²) with a population of 50,766. The population is almost entirely rural (99%) with two out of three households classified as 'poor'. Average rainfall in the period 1961 to 2006 is 774 mm with increasing variation in decadal rainfall patterns during both the long rains (mean = 250 mm; March-May) and short rains (mean = 426 mm; October-December). Temperatures range from 14° to 34° with February and September marking increasingly severe and extended dry periods. Livelihood systems are largely agro-pastoral with cattle and goat husbandry combined with low-value, rain-fed agriculture (maize, beans) on small plots (<1 hectare). Households rely on casual labour and remittances for most of their cash income. Over half of the 512 water points (54%) are unimproved (streams, unprotected shallow wells, earth dams) (Tanathi WSB, 2011) and most are seasonal. In the dry season (July-September and February) people rely heavily on year-round sources such as the Kiambere pipeline, deep boreholes and many handpumps making the functionality and reliability of these sources critical for water supply.

Data collection

Forty-three kiosks were identified and data collected on operational, financial and institutional elements from primary water users and management authorities. The audit identified 18 piped systems (one large, 17 small) supplying 43 kiosks in the study area.

A sample of water users at each kiosk (n=93) was interviewed using snowball interviewing by local enumerators in the local language (Kamba) following training and piloting. Key individuals or institutions that emerged in the audit were requested to complete a semi-structured interview (n=29) following ethical procedures approved by Oxford University Central University Research Ethics Committee and a research permit approved by the Government of Kenya's National Council for Science and Technology. Financial and operational data of volumetric and financial records were collected from kiosk attendants, management committees and water service providers. All data collection was carried out with the approval and collaboration of Kyuso District Water Office. Interview notes were typed up, checked for accuracy by both interviewers and coded for relevant themes using NVivo 10 software.

Functionality and usage data for 66 handpumps were collected via transmitters installed as part of a previous research project (see Thomson, 2012 for details of the technology).

We are aware of a number of limitations that may restrict the findings of the study and their wider applicability, including:

- Financial and volumetric data for kiosks were not always available or not recorded, particularly groundwater kiosks;
- Environmental and technical data on installation of infrastructure by government, local NGOs or donors were not available;
- Water quality testing at kiosks was not conducted to triangulate the user perceptions reported;
- No attempt was made to audit 'unimproved' water sources such as rivers, ponds or household dug wells, though it is known these are used by local residents.

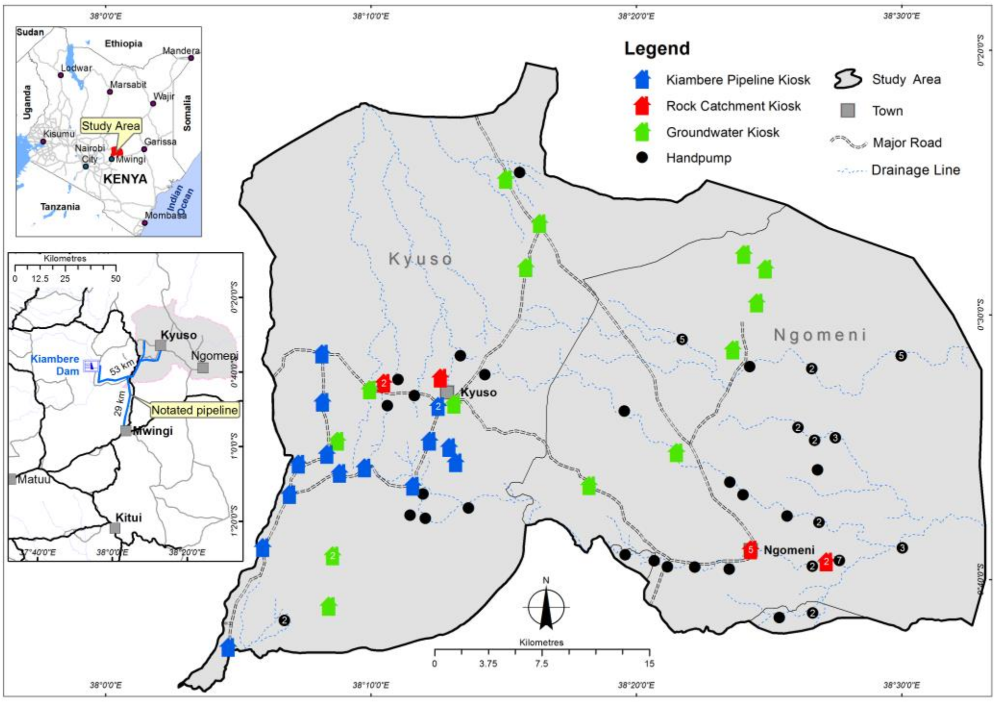

Figure 1. Location of water sources mapped

Results

Institutional context

The Kiambere pipeline is managed by a government-owned water service provider (KIMWASCO) and supplies water to 70+ kiosks as well as private connections in the wider area. Community-based management (CBM) is the prevalent model for small piped systems (boreholes and rock catchments) and handpumps which are often managed by local management committees that are elected by the community. However, committees rely on the Sub-County for different levels of operation and maintenance support, from all repairs, servicing and rehabilitation to none (although in these cases they have the support of a development partner).

In 2014, the maintenance service provider, FundiFix Ltd. began providing a free maintenance service for all 66 handpumps in the area, supporting community management committees, which led to a reduction in average breakdown times from 27 to less than 3 days (OXFORD/RFL. 2014). The company now offers a rapid maintenance service for handpumps for a monthly fee which was taken up by one third of handpumps.

The legal definition of who owns the infrastructure and land is crucial to a discussion of who has responsibility for maintaining and operating those assets. When asked who was responsible for repairs to the system, water users and committee members gave a variety of answers (committee, service provider, Sub-county water office, community members, MCA) implying a lack of clarity.

According to the commissioning process, after construction is complete “there is a ‘handing over’ to the community and it becomes their property”. Other requirements are that “there must be a committee with a chairman who is a bit literate. They should be registered as a legal entity.” However, once committees are in place, there is little oversight or regulation. Members of County Assembly (MCAs) and Area Chiefs may be involved in auditing committee accounts and pushing for committee elections, but only as a last resort when the need for action is critical. Regulation and oversight at kiosk level seems to take place more successfully for the Kiambere pipeline kiosks, managed by the water service provider KIMWASCO.

Operational performance by service level

As noted, not all data are available nor are we able to consistently report across the same years. In the absence of better data, we recognise these caveats but also the rare ability to compare equivalent metrics across multiple water service providers in a defined area of rural Africa. Three key points emerge which are expanded upon further below: 1) Handpumps supply the majority of the area with highest operational performance; 2) Rock catchments are more often than not non-functional with an unknown user base; 3) Submersible pumps are non-functional over two in five days taking almost two months to repair.

Table 1. Water infrastructure performance by service level

Infrastructure (source)	Water points	Estimated total users	Non-functional[1]	Mean downtime per failure	Maintenance provider
Kiambere Pipeline (surface)	1 (15 kiosks)	5,700	27%	9 days	KIMWASCO
Rock Catchments (surface)	4 (10 kiosks)	>300	90%	5 days	CBM/County
Submersible pumps (groundwater)	12 (17 kiosks)	5,000	44%	57 days	CBM/County
Handpumps (groundwater)	66	13,000	2%[2]	< 3 days	Fundifix Ltd.
Total	108	c. 24,000	2-90%	3-365 days	

Sufficient

For groundwater kiosks (March 2014-February 2015) the available records (n=5) show water was available 22-71% of days per year, showing a wide range of service level. This corresponds with the survey data which show that boreholes were more likely to have longer breakdowns. For Kiambere pipeline kiosks (n=8), kiosks showed a similar variability with water available from 18-67% of days over the year. Water supply to the pipeline was rationed to two days per week due to the capacity of the system. Availability is therefore determined by the volume of the storage tanks vs. demand. All but one of the rock catchment kiosks were non-functional. As the source is surface water, users can access this directly when the piped system is not in use. Some of the reservoirs are seasonal only, so sufficient quantities are not available all year round.

Safe
Although water quality testing was not within the scope of this study, user perception of the safety of water for drinking was evaluated. Kiambere pipeline supplies, which are chlorinated, is thought to be safer than groundwater kiosks and both are thought to be safer than the catchment (untreated surface water), which follows the expected risk levels for these sources.

Physically accessible
Travel time is used as a proxy measure for distance. Results from the user survey show that the average one way trip time stayed relatively constant across kiosks at 28-30 minutes for a one-way trip, regardless of the source. Seasonal queuing times showed that there is much higher demand in the dry season (63-144 minutes queue time vs. 10-24 in the wet season), and that people queue for longer at the pipeline kiosks.

Affordable
Tariffs were between 1-2.5 USD[3] per m^3. Almost a third of kiosks users pay for water from other sources, with prices up to USD 8 per m^3 for vended water or USD 5-6 per m^3 for private wells or scoop holes in riverbeds. Rainwater and surface water were generally free sources.

In the study, the average annual household expenditure was found to be USD 1,840. Based on reported volumes collected in dry and wet seasons (assuming six months of each per year), 67 per cent of households would spend less than 5 per cent of annual income on water at the lower tariff (USD 1 per m^3). This implies for one third of households, the lower tariff may not be affordable, and may partially explain why free water sources are preferred when available. Although few of the water systems surveyed would meet the universal access criteria, user satisfaction was high, with 77% of pipeline kiosk users, 63% borehole kiosk users and 53% of catchment users satisfied or very satisfied with the service provided.

Seasonal demand and rainfall

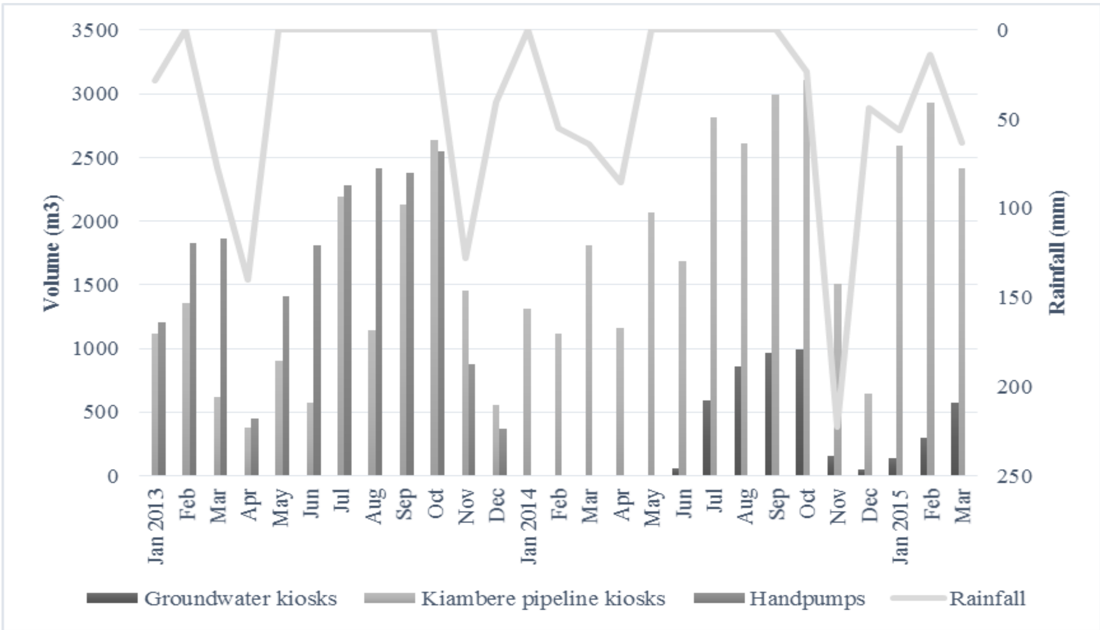

Figure 2. Rural water use by infrastructure and rainfall in Kyuso (2013-15)

Comparing volumetric water consumption by infrastructure and rainfall (Figure 2) highlights three key results:

1. Water consumption mirrors rainfall patterns - peak demand is in July to October, with a gradual increase from a December minimum. Demand may lag behind rainfall, as it takes time for infiltration into the shallow groundwater supplies that are one of the main alternative sources.

2. Handpumps are the major water source – assuming year-on-year figures are comparable, handpumps are the main water source followed by the Kiambere kiosks and then groundwater kiosks. Rock catchment kiosks are often broken with no volumetric data.
3. Water infrastructure investments alone will not deliver universal water services – a major implication of the data is that people shift from improved water infrastructure to unimproved water sources in higher rainfall periods. This raises major policy questions on strategies to the goal of universal service delivery, highlighting the importance of understanding water user behaviour and preferences, and recognising that the presence of functional infrastructure does not translate automatically into that water being used by all and the accrual of associated positive impact on health, productivity etc.

These trends are important when considering both financial sustainability and public health aspects. As demand drops, revenues also fall proportionally which should be factored into tariff calculations and maintenance costs, particularly as the survey has shown that kiosks may close for 2-3 months a year during rainy season.

Unit water costs

Data across periods were compiled to allow a provisional and incomplete understanding of relative unit costs of water by infrastructure provision. There are major caveats to the results which restrict the implications as revenue and expenditure data are not fully known with unit costs based on estimated consumption data and then compared using available revenue (assuming break-even outcomes) or cost data where known (handpumps). A reported subsidy (tax) for pumping Kiambere water to Kyuso is also discussed.

Table 2. Unit cost comparison of handpump and kiosk water supplies

	Handpumps[4]	Kiambere kiosks	Groundwater kiosks
1. Estimated annual volume (m^3)	19,415	18,932	4,680
2. Availability (% days)[5]	98%	50%	41%
3. Local O&M costs (USD)	$8,368[6]	?	?
4. Local revenues received (USD)	n/a	$17,880	$7,568
Crude cost per m^3 (USD)	$0.43	$0.94	$1.62

The analysis indicates:

- Handpump water supply cost is two to four times lower than alternative kiosk supplies;
- Including a government subsidy for Kiambere pumping costs increases the unit cost to USD 2.3 per m^3;
- Higher costs of Kiambere are tempered by high levels of satisfaction, water treatment and public regulation by WASREB;
- Water availability is highest for handpumps (98%) but seasonal demand and kiosk opening hours makes direct comparison difficult.

If these data reflect the true cost of reliable and safe rural water services it is greater than the tariff currently paid by local water users. Equally it is higher than the proposed USD 1 per m^3 suggested by the World Bank (2011) for African urban water supplies. The implication is rural water services are more expensive and user tariffs alone will not be sufficient to maintain services. The exception is for handpumps but uncertain water quality and the need for monitoring and regulation of infrastructure will inevitably raise the unit cost of provision. However, these cost estimates represent an uncoordinated and competing water infrastructure portfolio where significant cost savings are likely to be made if infrastructure and institutions are coordinated and regulated effectively at scale. With a local revenue base of over USD 25,000 per year there are significant local resources which could be harnessed with more effective coordination of investments by donors (transfers) or government (taxes).

Conclusion

- Financial analysis indicates the local unit cost of handpump operation and maintenance is two to four times less than water supplied from kiosks despite higher availability throughout the year. Rural water

tariffs cover around one third of costs (handpumps, kiosks) with government support higher for kiosks than the donor 'transfer' to launch a maintenance service provider for handpumps.
- Institutional analysis reveals no coordinated management of water infrastructure. A legacy of government, donor and NGO investments in water infrastructure have failed to build local institutions at the right scale and with limited accountability to maintain and monitor services over time.
- Rural water demand is influenced by rainfall events which shifts water use from improved water infrastructure (kiosks, handpumps) in the dry season to unimproved sources in the wet season. Pipeline kiosks generate 10 times the revenue of the FundiFix handpump maintenance service (n=22) but supply less water than the total handpump portfolio (n=66).

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Notes
[1] The kiosks were classified as (1) functional, (2) functional but not in use (where infrastructure is sound, but no water available; or out of use for the wet season) or (3) non-functional (where the kiosk was not able to deliver water because of breakdown in any part of the system), based on observation and discussion with the attendant if present or local community members on the day of visit.

[2] Functionality rate of handpumps relates to handpumps maintained by a maintenance service provider (FundiFix) in 2013.

[3] An exchange rate of 1 USD = 100 KES is used throughout.

[4] Data from 2013 to be consistent on volume and cost data;

[5] Reliability is the preferred metric but given some kiosks are functional but non open we choose availability here

[6] This is the cost of parts, labour and transport for repair of all 66 handpumps over one year, during the free maintenance service trial

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