Water and Environment Journal
Promoting Sustainable Solutions

Water and Environment Journal. Print ISSN 1747-6585

Factors influencing selection of drinking water technologies for urban informal settlements in Kampala

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Keywords
informal settlements; multicriteria analysis; prepaid meters; pro-poor; stakeholder preferences; technology selection.

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doi:10.1111/wej.12058

Abstract

Access to drinking water in urban informal settlements of developing countries still remains a challenge for the poor and depends on technology selected. This paper determines the score on criteria used for technology selection by two major stakeholders in the water service delivery chain, the users and the utility. The criteria are: affordability to connect, affordability of consumption, method of payment, ease of operation, ease of spare parts acquisition, access distance, access time, generating sufficient water continuously, service coverage, the possibility of cost recovery and security of installation (SOI). The study was carried out in Bwaise II and Kisenyi III, two informal settlements in Kampala, the capital of Uganda. Through a household survey and semistructured interviews of key informants, data were collected for the score on these criteria of four piped water distribution technologies: public water points (PWPs) with conventional meters, PWPs with prepaid meters, house connections and yard taps. Using multicriteria methods and preference elicitation by pair wise ranking, the most preferred factor for technology selection from the users' point of view is affordability to connect, while from the utility's point of view, it is SOI. These preferences were confirmed by data from focus group discussions and in-depth interviews.

Introduction

Access to water services in urban informal settlements

Poor access to water services in informal settlements may be attributed to inaccessible sites, poor social economic status of the informal settlers, illegal status of informal settlements that do not qualify for service provision (Solo *et al*. 1993; Kayaga *et al*. 2003; Kayaga & Franceys 2007) and poor institutions and regulatory management procedures for access to services (Solo *et al*. 1993; Smith 2004; Kyessi 2005; Schwartz 2008; Sabiti 2009; Franceys & Gerlach 2011).

Access to services like water is also affected by problems of rapid population growth, urbanization, climate change, widespread diseases and poverty according to Murphy *et al*. (2009) and Solo *et al*. (1993). Poor access to water services leads to high spread of water-related diseases like diarrhoea, typhoid, dysentery and cholera, deaths, lost productive time and resources, and overall reduced livelihoods for the affected individuals or communities (Mara 2003; Montgomery & Elimelech 2007; Basani *et al*. 2008).

Poor access to water services in informal settlements can also be attributed to overreliance on traditional/conventional type of service delivery systems that in most cases are way above the means of the urban informal settlers, may be economically viable but not financially attractive, and may not be socially, technically and environmentally compatible (Solo *et al*. 1993; Montgomery & Elimelech 2007; Murphy *et al*. 2009; Sharma & Vairavamoorthy 2009; Liang & van Dijk 2011). Water tankers and private water vendors using their taps or wells can be mentioned as traditional drinking water supply systems.

Access to safe water in urban informal settlements may be improved if different technologies like rain water harvesting, tankered water and prepaid meter (PM) taps to mention but a few are introduced, and the mode of service provision is selected on the basis of a multidisciplinary approach (Castro 2007; Montgomery & Elimelech 2007; Sharma & Vairavamoorthy 2009).

Evaluation framework

Identifying criteria for water service delivery and hence drinking water technology selection from literature was the first step in research. The criteria identified included: affordability to connect, affordability to meet consumption charges, cost recovery, service coverage, generation of sufficient quantity

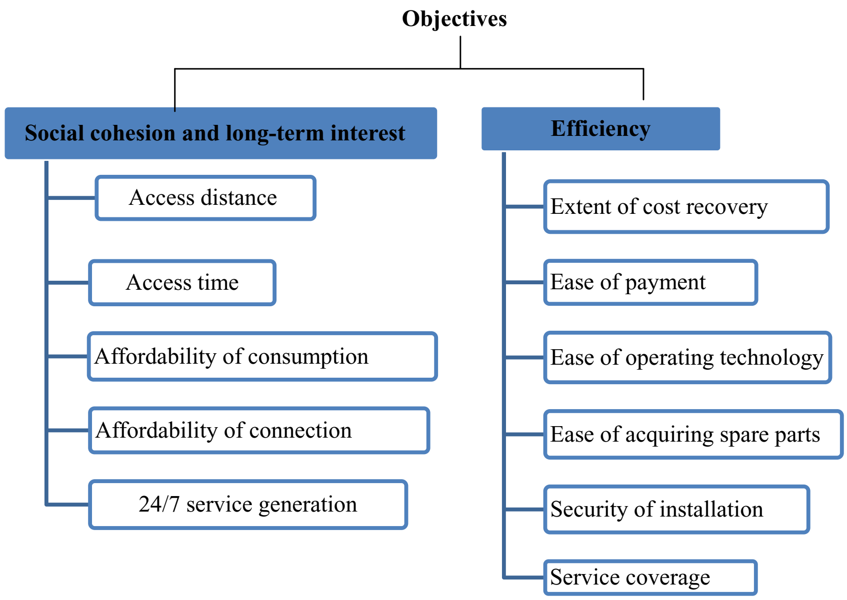

Fig. 1. Identified objectives and criteria for selection of drinking water technologies.

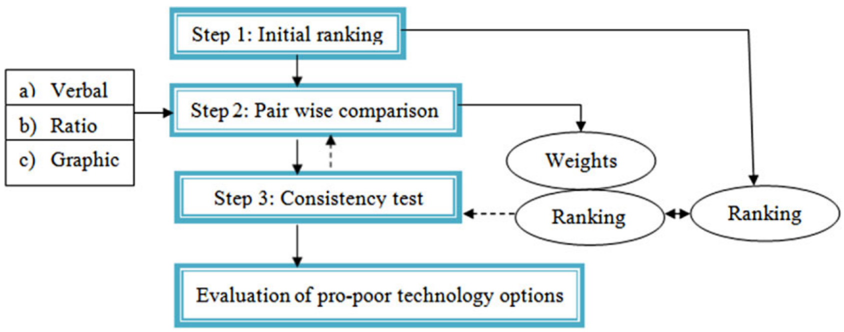

Fig. 2. Schematic representation of the preference elicitation.

of water during 24 h in 7 days, ease of operating technology, ease of spare parts acquisition, access distance, access time, ease of payment (EOP) and security of installation (SOI) (Howard 2002; Brikke & Bredero 2003; Basani *et al*. 2008; Ralda 2010). These criteria were used to evaluate four piped water drinking technologies: PWPs with conventional meters (CMs), PWPs with PMs, house connections and yard taps.

Access to water services in informal settlements has been challenging also because there has been little involvement of some stakeholders in the decision-making process, making interventions unsustainable (Montgomery & Elimelech 2007; Murphy *et al*. 2009; Grafakos *et al*. 2010). To do better, two objectives were identified and 11 criteria (Fig. 1).

The proposed mode of service delivery takes the form of a multicriteria analysis (MCA), eliciting stakeholders' preferences concerning technology selection. The schematic representation of the preference elicitation is presented Fig. 2 below.

The MCA or analytical hierarchy process (AHP), is a decision-making tool used to solve problems of conflicting needs and competing interests by structuring the problems into a hierarchy of preferences through a series of pair wise comparisons of important factors or criteria (Jaber *et al*. 2001; Grafakos *et al*. 2010).

The process involves:

- Identification and structuring problems into a decision hierarchy (see Fig. 3)
- Evaluating the elements of the hierarchy systematically by pair wise comparisons
- Checking consistency of material judgements
- Applying the eigenvector method to compute weights
- Aggregating the weights to determine a ranking of decision alternatives

Research area and data collection methods

Study area: Bwaise II and Kisenyi III

Bwaise II and Kisenyi III are two parishes in the Kawempe and Central Divisions of Kampala. Bwaise II comprises eight zones, namely Katale, Jambula, Lufula, Nakamiro, Nabukalu, Mukalazi, Mugowa and Tebuyoleka. Kisenyi III comprises six zones, namely Sapoba, Kiti, Luzige, Kiguli, Kawempe and Nook. The population estimates of these two study areas are 23 400 and 15 200, respectively (UBOS 2008). Bwaise II Parish comprises both low- and high-income communities, with the low-income communities dwelling in the four zones of Katale, Jambula and Nabukalu, found in the drainage belt of Nakamiro channel, while the high-income community lives in the remaining zones further uphill and dryer. Kisenyi III Parish comprises two commercial areas of Sapoba and Nook, while the remaining zones are residential, having a mixture of both low- and high-income communities. The status of water supply in the two parishes shows a remarkable difference, in that Bwaise II has more water coverage compared with Kisenyi III. According to Skye *et al*. (2011), Kisenyi III is one of the Kisenyi Parishes that is most underserved and lacks sufficient access to safe drinking water, while in Bwaise II, although it may also be experiencing insufficient access in some zones, efforts are currently underway to improve the situation. This is evidenced by the ongoing Replenish Africa Initiative (RAIN) project co-funded by Coca-Cola and National Water and Sewerage Corporation (NWSC) Uganda (Coca-Cola 2010).

Data collection

To determine the priorities of the inhabitants concerning drinking water technologies, we use MCA. The study is based on both primary and secondary data. Secondary data were collected through documentary review of peer-reviewed journal articles, government and NWSC annual reports. Primary data were gathered through a household survey, semistructured interviews, focus group discussions and field observations based on a checklist to assess the current status of water supply. The two parishes were selected based on population projections (UBOS 2008), previous studies carried out in both study areas and currently ongoing projects aimed at improving water services in the study areas. Projections were used because there are currently no realistic population values based on a recent population census.

The questionnaire for households provided data about the households, while more qualitative data were collected through administering semistructured interviews with NWSC staff and semistructured focus group discussions with local council representatives of the two parishes and representatives from the non-governmental organizations (NGOs) were held. Use of the various field instruments was important to triangulate the results of the study. One field assistant was trained to interview the selected households.

Sampling procedure

The sample size was calculated based on Sub National Projections Report 2008–2012 (UBOS 2008) summarized in Table 1 and a sample chart (Isaac & Michael 1981). The level of sampling error tolerated is 10%.

The sample size for each of the parishes should have been 100 based on the sampling chart with a 10% sampling error (Glenn 1992) because the population values for Kisenyi III and

Table 1 The population projections for 2011 considered

Parish	Projection
Kisenyi I	21 300
Kisenyi II	4 800
Kisenyi III	15 200
Bwaise I	25 100
Bwaise II	23 400
Bwaise III	14 700

Source: Adopted from UBOS (2008).

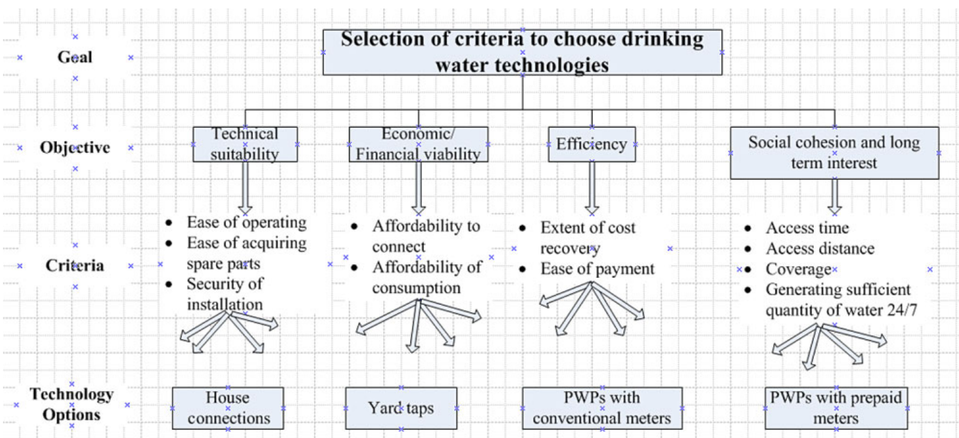

Fig. 3. Multicriteria analysis structured hierarchy for selection of drinking water technologies. PWP, public water point.

Bwaise II are 15 200 and 23 400, respectively. Instead of 200 respondents, only 127 respondents were interviewed because of time constraints and a reduced number of residents and service points in the Kisenyi III parish. The reason for reduced number of respondents especially in Kisenyi III, which may also contribute to the validity of the results, was because of the change in land use. The area is transformed from a residential slum to a commercial business-oriented development, meaning that the former residential occupants have been evicted or migrated to other settlements. This also reduced the number of water points. There is a discrepancy of geographical/political boundary defining Kisenyi III and what NWSC defines as its service coverage boundary. The geographical boundary shows fewer service points on ground compared with the service points in NWSC coverage, which also includes areas not defined under Kisenyi III geographical boundary. There was no special preference in selection of respondents; selection was random based on availability of respondents and being responsible for managing the tap. Women were more in control because of the role women play in water provision for a home.

The number of households sampled was distributed proportionately according to the zonal population as follows: Katale (5), Jambula (4), Lufula (14), Nabukalu (15), Nakamiro (17), Mukalazi (2), Mugowa (20), Tebuyoleka (23), Sapoba (3), Kiti (12), Luzige (24), Kiguli (18), Kawempe (26) and Nook (19). The sampling was a random stratified interviewing of only households that owned or were responsible for a particular water point. That could be a public water point (PWP) with CM, a PWP with PM, a yard tap or a house connection. In total, 14 zones were surveyed, eight from Bwaise II Parish and six from Kisenyi III Parish. The selection of the two parishes was based on population projections by UBOS (2008), the presence of more than one type of drinking water technology and excluding areas that had been previously researched.

Semistructured interviews were conducted with 10 staff members of NWSC, selected based on expertise and experience in drinking water provision. Three focus group discussions were conducted, two comprising 12 members each for the representatives of leadership of the two parishes (Bwaise II and Kisenyi III) and one comprising four members of NGOs.

Results and discussion

Social demographic characteristics of the study area

The majority of the respondents were household heads (64%) and female (78%). Most of the interviewed had only primary level of education (44%) and were self-employed (62%). The majority of the respondents earned an income ranging between 30 000 and 90 000 Uganda shillings (38%), with most of them (32%) spending a substantial part (between 11 000 and 30 000 Uganda shillings per month) on water bills.

Water supply characteristics of the study areas

The majority of the respondents access the service point within a distance of 0–10 m, and the access time is less than 10 min (69%). Most of the respondents also claimed that they purchased water at 100 Uganda shillings per 20 L (80%), having an average consumption of between 20 and 500 L/day. The majority of the respondents claimed 24-h availability (89%). The majority of the respondents approved the quality of water as good (95%), with 97% claiming that there was no management committee in place for the water point. The household size of most respondents ranged between 1 and 6 members (71%), with the service point being accessed by the highest number of households with between 2 and 10 members.

Data was analysed using SPSS software (IBM SPSS Statistics, London) to investigate whether there were significant variations of the characteristics between the parishes and if there were significant associations between the characteristics and the technology used. Significant variations were found with regard to: monthly expenditure ($P < 0.001$) and reasons for technology choice ($P = 0.001$), while associations were found with: distance ($P = 0.001$), collecting time ($P < 0.001$), availability ($P = 0.006$), management ($P = 0.043$), number of households accessing the service tap ($P < 0.001$) and reasons for technology choice ($P = 0.001$).

Preferred drinking water technologies

User perspective according to the household survey

The majority (35% or 45/127) from both Bwaise II and Kisenyi III preferred PWPs with CMs as shown in Fig. 4(a)–(c), while 34% (43/127) preferred PM taps, 19% (24/127) preferred yard taps and 12% (15/127) preferred house connections. However, when considering preferences at the parish level, Bwaise II favoured more public stand posts with CM (38%) as opposed to Kisenyi III (46%) where people favoured PM tap. However, when cross-tabulating the results of the two parishes using chi-squared test, there was no significant variation in the preferences for technology choice between the two.

Utility perspective

From the utility's point of view, almost all the key informants preferred the PMs. Only one key informant differed in opinion.

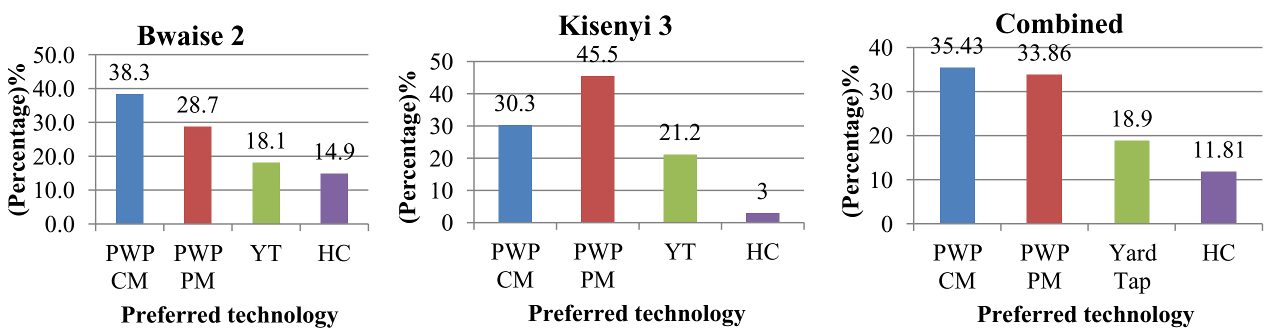

Fig. 4. Preferred technology percentages at parish level and combined. CM, conventional meter; HC, house connection; PM, prepaid meter; PWP, public water point; YT, yard tap.

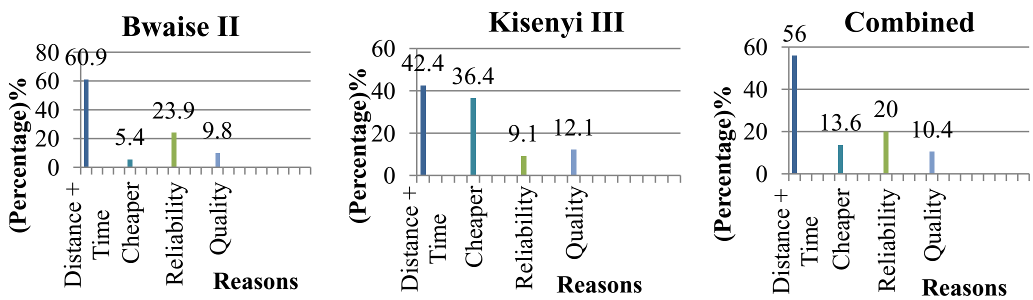

Fig. 5. Response proportions for reasons cited for technology choice.

Reasons for preferences

From the users' point of view

There were different opinions concerning the preferred technology because of a number of reasons, but the general results reflect the majority preferring PWPs with CMs. Quantitative data were collected on the reasons why respondents preferred the particular technologies from Bwaise II and Kisenyi III. The data are evaluated in terms of the significance of the indicators for water supply access. Preference with respect to users was based on the criteria of accessibility in terms of distance and time, cost of service, reliability of service in terms of 24 h 7 days water availability and quality of water supplied from the source, as shown in Fig. 5 (Table 2).

The results from analysis show that distance and time (access) were the most important reasons for preferring a particular technology in both parishes, with reliability as the second reason for choice of technology. However, at parish level, the two parishes differed in the second most important reason for selecting the technology. In Bwaise II, reliability (24%) was the second most important reason while in Kisenyi III, the cost (36) was the most important reason for technology choice. The reason for accessibility can be evidenced by the water supply characteristics of distance and time where the majority (69%) access the water source were within a distance of 0–10 m and time of 0–10 min. In relation to reliability, the majority of the respondents (89%) claimed they had 24-h water availability. Other reasons cited for choice of tap by the respondents included socializing, securing young children especially the girls from being abused sexually and discipline because far-away sources were responsible for children picking bad habits from bad company. Preference for a particular technology, for instance a PWP with a CM, was also attributed to the level of knowledge concerning other types of taps or financial interests. These taps are viewed as a source of income-generation activity by the unemployed especially women and the advantage of easily accessing their spare parts. However, preference for PM taps was attributed to the low service tariff of 25 Ugandan Shilling per 20-L jerrican as opposed to 100 at PWP with a CM and no connection fee required. PM taps were disadvantaged by the high failure rate, delayed response to reported faults and long bureaucratic procedures involved in accessing their spare parts. The same reasons were also confirmed during the focus group discussion.

From the utility's point of view

The preference of the utility managers is based on size of the population, cost recovery, level of congestion, obligations to

Table 2 Proportion of those who preferred the Technologies

	Bwaise II								Kisenyi II							
Source	Katale	Jambula	Lufula	Nakamiro	Nabukalu	Mukalazi	Mugowa	Tebuyoleka	Sapoba	Kiti	Luzige	Kigulli	Kawempe	Nook	Total	%
PWP with CM	4	6	3	9	2	6	4	3	1	4	3	2	0	0	45	35.43
PWP with PM	2	1	4	3	4	3	3	8	0	5	2	5	2	1	43	33.86
YT	0	0	7	2	4	2	1	1	1	1	1	0	4	0	24	18.90
HC	0	0	2	4	5	1	2	0	0	0	1	0	0	0	15	11.81
Total	6	7	15	18	15	12	10	12	2	10	7	7	6	1	127	100

CM, conventional meter; HC, house connection; PM, prepaid meter; PWP, public water point; YT, yard tap.

meet social responsibility, ability to cofinance with development partners and community, level of demand by the user community, tenure, income level of the user community and level of management. According to key informants of the utility, all of them preferred the PM (100%) because of the advantages it offers:

- Less administration costs
- Elimination of the middleman effect of not remitting the utility service fee and hence reducing accumulation of arrears
- Software provides a database for assessing the consumption patterns of the users, which helps both academics and organizations to assess the performance of the utility in service provision
- Improves cost recovery because users get to pay for service before it is consumed.
- Reduces nonrevenue water (NRW)
- There is no need to be a land owner
- Guarantees uninterrupted supply of water.

Stakeholders' perceptions and preferences in technology selection process

To establish the factors influencing drinking water technology selection, perceptions and preferences of the stakeholders were established through two procedures, adequacy rating (Fig. 6) and preference selection of criteria. Data were collected concerning the perceptions of different stakeholders on strengths and weaknesses with respect to the four technologies. The stakeholders were asked to first rate the four technologies based on the eleven criteria for drinking water supply. The rating was carried out on a 1–5 Likert scale whereby 1 represented not adequate and 5 very adequate. Results summarized in Fig. 6.

Service coverage

All the three categories of stakeholders rated PWP with PM very adequate in ensuring service coverage while the house connections were rated not adequate. House connections are rated not adequate because of the higher tariff levied on them and because they only benefit individual households rather than being shared. This result confirms findings of previous studies by (Kumwenda 2006) of improved access to water by use of PMs.

Extent of cost recovery

All the stakeholders rated PMs as adequate in ensuring cost recovery over all the other technologies while PWP with CMs were rated slightly lower than the other technologies. These results suggest that PM taps may be more effective in achieving cost recovery in a short period of time, but over the long period of time, they may not achieve this objective. From

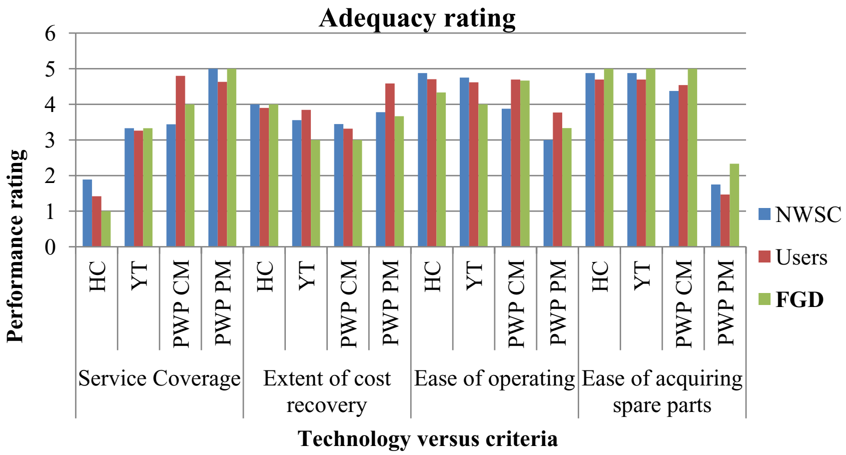

Fig. 6. Adequacy rating of technologies. CM, conventional meter; HC, house connection; PM, prepaid meter; PWP, public water point; YT, yard tap.

NWSC's point of view, PMs solve the issue of NRW due to nonremittance of the service charges by middlemen, but when it comes to maintenance, the long bureaucratic procedures of procuring spare parts for the taps, which may be unavailable on the Ugandan market, and the cost of rolling out this option without an input of donors or development partners, plus the transient nature of the slum population may affect recovery of the investment costs. According to NWSC, the return on investment is low when serving the poor.

Ease of operating technology

All the stakeholders rated three of the technologies apart from PWP with PMs as very adequate with respect to ease of operation, unlike the prepaid that is operated by a token, which is sometimes not known by all users.

Ease of acquiring spare parts

PMs were rated not adequate by all groups in ease of acquiring spare parts and also depending on battery life span of not more than 5 years of production compared with the other three technologies. These findings confirm previous studies citing people's failure to access water because of the difficulty of acquiring spare parts for PM taps that are not readily available on market. At the time, this challenge originated from the way the system was introduced. The project was politically motivated to appease voters because it was a campaign period, and election time was fast approaching. The technocratic phase of a feasibility study, functionality and sensitization was forgone a procedure that is meant to establish accountability, ownership and therefore sustainability. As a result, a particular type of PMs that were prone to failing was introduced without proper functional assessment, which ended up breaking down and were irreparable. This led to abandonment, delayed responses and in some instances field staffs assigned to follow-up the repair works demanding funding from consumers to enable them carry out the repair works, yet the original plan to undertake these repairs was the responsibility of NWSC.

Time to access service point

All three categories of stakeholders rated house connections and yard taps very adequate in achieving time to access a service point (Fig. 7).

Distance to service point

All the three categories of stakeholders rated house connections very adequate compared to the rest of the technologies, while PWPs with CMs were rated slightly lower.

Generating sufficient quantity of water continuously

All the three stakeholders rated house connections and PWPs with PMs higher compared with PWPs with CMs adequate in generating sufficient quantity of water.

Affordability of connection

There was a slight variation in rating technologies against the affordability of connection criteria. However, all the groups rated PWPs with CMs very adequate in affordability to connect, while PWPs with prepaid water were rated lowest. The results suggest that compared with the subsidized connection, fees to PWPs with CMs are more attractive (Fig. 8).

Affordability of consumption

All three stakeholders rated PWPs with PMs very adequate in affordability of consumption, while PWPs with CMs were rated

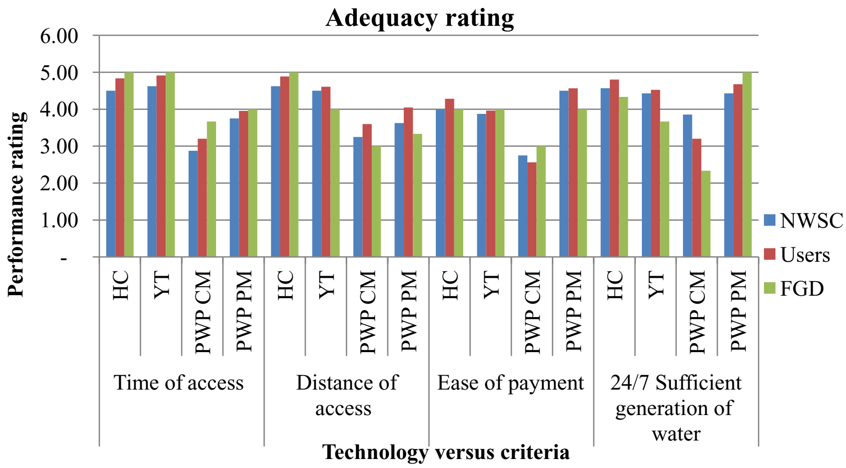

Fig. 7. Adequacy rating of technologies. CM, conventional meter; HC, house connection; PM, prepaid meter; PWP, public water point; YT, yard tap.

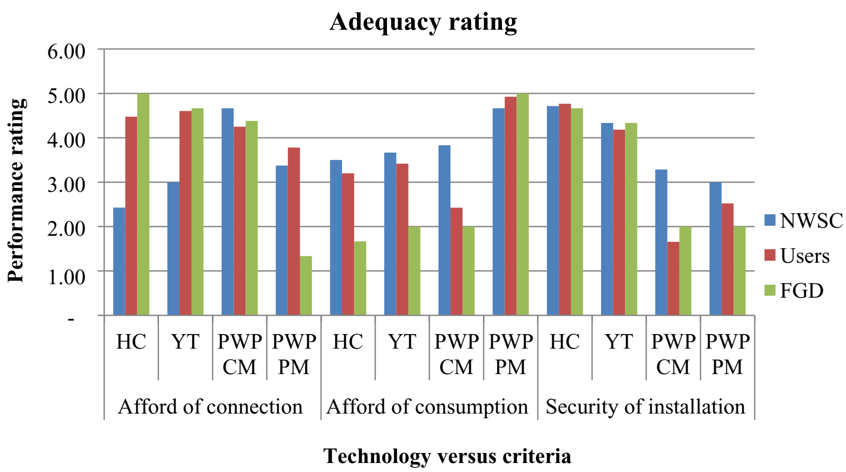

Fig. 8. Adequacy rating of technologies. CM, conventional meter; HC, house connection; PM, prepaid meter; PWP, public water point; YT, yard tap.

lowest on this criterion. The results suggest the expensive water tariff, which are sometimes charged at PWPs with CMs.

Security of installation

All the three stakeholders rated house connections very adequate in terms of SOI, while both the PWPs categories of taps were rated lowest. The results indicate that PWPs are more vulnerable to thefts compared with private individual connections.

Stakeholders perceptions regarding preferences of indicators

Having assessed the strengths and weaknesses of the technologies, the stakeholders were able to understand the basis for preference of indicators for drinking water to be used for technology selection. Having rated the technologies against the 11 criteria, the stakeholders were further taken through the MCA method of ranking the criteria at two stages (Grafakos *et al*. 2010), that is, the initial ranking of criteria whereby the 11 criteria were ranked in order of the most important to the least important criteria. The ranked order was later organized into 10 pairs for the second stage of ranking by pair wise comparison. The stakeholders first selected the most preferred criterion for each pair and later attached a weight to the criterion.

A summary of results for the ranking process is shown in Figs 9 and 10. The results were analysed through the AHP using the K Goepel model. The 11 × 11 matrices for the utility staff and users were derived by computing the geometric ratios. The normalized principal eigenvector was computed, from which the principal eigenvalue, consistence index and consistence ratio for the two matrices were determined. The normalized principal eigenvector matrices were iterated six times, after which there was no further change in the weights. Below is a summary of the ranking and corresponding weights of the indicators.

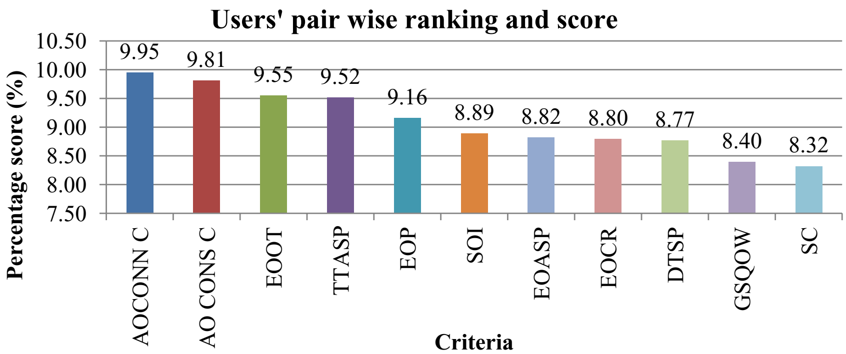

Fig. 9. Users' pair wise ranking of preferences. AOCONNC, affordability of connection; AOCONSC, affordability of consumption; DTSP, distance to service point; EOOT, ease of operating technology; EOASP, ease of acquiring spare parts; EOCR, extent of cost recovery; EOP, ease of payment; GSQOW, generating sufficient quantity of water; SC, service coverage; SOI, security of installation; TTASP, time of access service point.

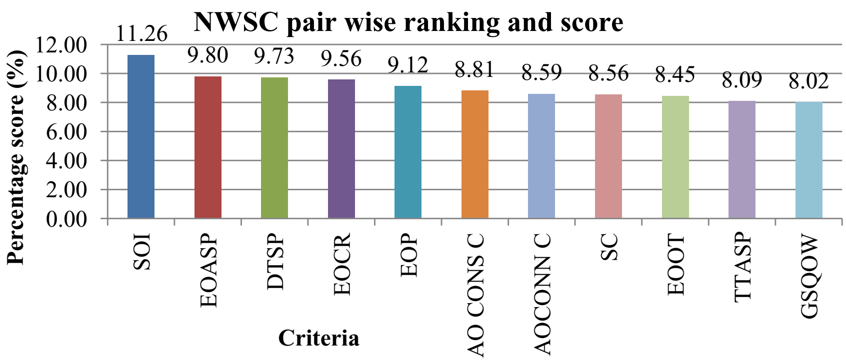

Fig. 10. NWSC pair wise ranking of preferences. AOCONNC, affordability of connection; AOCONSC, affordability of consumption; DTSP, distance to service point; EOOT, ease of operating technology; EOASP, ease of acquiring spare parts; EOCR, extent of cost recovery; EOP, ease of payment; GSQOW, generating sufficient quantity of water; SC, service coverage; SOI, security of installation; TTASP, time of access service point.

The results of the MCA above show that the most preferred indicator from the user perspective was affordability of connection (AOCONN in Fig. 9) while from the utility perspective was SOI. The results also show an interesting pattern between the two groups for the fifth most preferred indicator that is EOP. Considering again the first seven most preferred criteria, both groups share in common SOI, affordability of connection, affordability of consumption and ease of acquiring spare parts. Although users and utility managers had these similarities, the order of preference differed, thus confirming differences in preference and priorities.

General discussions

Preferences compared

In the case of preferred drinking water technologies, the users in both parishes overall preferred PWPs with CMs, while the utility managers preferred PMs. At parish level, however, households differed concerning their preference for the two PWP technologies. While Bwaise II preferred PWPs with CMs, Kisenyi III preferred PWPs with PMs similar to the utility managers' preference.

A number of reasons were forwarded for this difference in preference. For those users who preferred CMs, this was because of the technical reliability of these taps, which are easy to operate, and spare parts are easily obtainable on the local market and the financial interests involved especially by the caretakers of this technology. Because most of them are unemployed, especially the women, they operate the taps as a source of income. The financial interests attached to PWPs with CMs have raised concerns about the coexistence of the two PWP technologies. The difference in service tariff at the two water points has created a negative competition that has seen some of the PM taps deliberately damaged or destroyed allegedly by those who operate PWPs with conventional taps. To harmonize selling water at the two taps, operators agreed to sell water at the same price; that is, the price of water at a prepaid tap supposed to cost between 20 and 25 shillings was put at 100, five times higher than the utility tariff.

Preferences are also influenced by the level of experience with a technology. The PM taps in Kisenyi III were implemented on a project basis 4 years back with a high level of sensitization, which made it easy for them to be appreciated by the users. However, in Bwaise II, implementation was politically influenced and benefited a few users and came with limited sensitization. The result was that most prepaid taps failed or were deliberately damaged because of poor handling and malice from the group of users who either did not have access to the service or by competitors from the traditional PWPs with CMs, who thought the introduction of prepaid taps were a threat to the survival of their business.

On the other hand, preference for prepaid taps was attributed to the low tariff between Ugandan shilling 20 and 25 (US$0.40 and 0.50), which is applicable to those who own tokens to operate the system. Another disadvantage of the prepaid taps in the case of Bwaise II was the fact that users had to incur transport costs of travelling to the NWSC Urban Pro-poor Offices in Kisenyi to recharge their tokens, which is costly, leading to giving up use of the taps and resorting back to either the unprotected spring wells or expensive PWPs with CMs.

The preference for prepaid taps by the utility staff was thought to be attributed to the fact that this could be one way of eliminating the middleman effect of traditional public water taps' operators who are responsible for hiking the water service charges and also never remit the service fees to the utility, leading to high disconnection rates in urban informal settlements. Use of prepaid taps was viewed by most utility managers as a long-standing solution for reducing NRW through illegal connections by informal settlers who have always found it expensive to pay for water services. Reduction in administrative costs like disconnections, reconnections and preparation of invoices to mention but a few was another major reason for the utility managers' preference for prepaid taps.

Stakeholders' preference of criteria for drinking water technology selection

The purpose of first going through the process of rating the adequacy of the technologies by the stakeholders was to lay a foundation for stakeholders ranking, using 11 criteria to choose a drinking water technology. The ranking enabled to establish the preferred criteria from the two perspectives and to identify the factors that influence drinking water technology selection. Users ranked affordability to connect as most preferred criterion while the utility managers preferred SOI. The users attached high importance to having an individual connection managed on individual basis and being able to meet their water demands as opposed to sharing community taps. This could explain the high rating obtained for affordability to connect as opposed to SOI as shown in Fig. 9. Users would also prefer to have an affordable system of water service delivery in terms of consumption charges, ease to operate, accessibility, and providing a convenient and flexible method of payment for the service. The findings for preference for a connection are similar to those of a previous study by Kanyoka *et al*. (2008).

The utility managers attached high importance to SOI because of the high investment costs involved in installing systems like the prepaid taps. Because prepaid taps were perceived as one of the solutions to solve the high NRW in informal settlements, the emphasis is being redirected towards securing and maintaining this technology, which is seen as one way of water service provision that suits the low-income informal settlers while improving the cost recovery mechanism of utility.

Conclusion

(1) The results show that that users and utility managers have different perceptions regarding the factors that influence drinking water technology selection.
(2) The users are more inclined to factors that promote social objectives while the utility managers emphasize factors promoting efficiency and give SOIs as their preference.
(3) Although the MCA enabled stakeholders to choose preferences and express their opinions, the extent to which these results are implemented and who influences the final decision is yet to be understood.
(4) Field reports showed that the cost of water was perceived as still high.
(5) The MCA involved the major stakeholders in the technology-selection process.
(6) This study is one of the rare studies assessing the differences in preferences concerning drinking water technologies by government officials and users.
(7) The users preferred PWP with CMs while the utility preferred PWPs with PMs.
(8) While introducing new service delivery systems in informal settlements, careful consideration ought to be given to both positive and negative impacts in terms of their location with respect to the existing systems.

Acknowledgements

This research was funded by the PROBE project (UNESCO-IHE). We are grateful to NWSC for participating as one of the stakeholders and to the communities of Bwaise II and Kisenyi III.

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