DEMAND, INCOMES AND EXPENDITURES OF RURAL SMALL PIPED SCHEMES IN UGANDA

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ABSRACT

As rural water services are increasingly provided through small piped systems, it is necessary to develop new management models with more focus on business and entrepreneurship. However, there is a lack of data from the field in order to develop sound business plans. This paper provides data from three rural piped schemes in Western Uganda, which have been running over a number of years. Service levels are analysed, as well as income levels and the external factors that affect income levels such as rainfall. Secondly, local expenditures were grouped in the WASHCost categories part of the Life-Cycle Costs Approach, in order to understand how the scheme management spends their money. The paper shows that although individual schemes are able to cover operating costs, they are still not able to cover capital maintenance costs. Although households are generally willing to contribute extra money in case of a large breakdown, their ability to pay is not sufficient for rehabilitation and replacement. The paper provides important data from real communities that should be taken into account when developing new management models, support mechanisms and business plans for private sector involvement in the provision of rural water services.

Key words: Life-Cycle Costs, piped scheme, management model, entrepreneurship, Rural, WASHcost, Uganda

INTRODUCTION

One of the recent trends shaping the rural water sector in developing countries is the development of small piped schemes in rural areas (MWE 2011). Larger villages characterized as trading centres, so-called “Rural Growth Centres” (RGCs) and rural small towns show demand for piped schemes that have a higher potential for up-grading services than point water sources. Piped schemes can offer services closer to residents’ homes by providing several public taps at different locations in a village or small town, and as economic development increases household incomes, there is possibility for connection for households and institutions. However, governments, donors and NGOs move into this new technology option and service delivery model with few reliable sources of information at hand. Several management models are being tested in Uganda, but so far none has been officially promoted or backed up with policy guidelines (Koestler and Jangeyanga 2012a). At the same time, it is difficult to make decisions on management models without consistent data from the water schemes on incomes, expenditures and cost categories. This paper will present the data from three small piped schemes in Western Uganda over a period of three years in order to shed light on some of the most pressing questions when it comes to sustainability of small piped schemes: are schemes able to cover operating costs based on local revenue? What external factors influence income levels? Are schemes able to pay for large repairs and re-investments, and if not, is the community willing and/or able to contribute?

After an outline of the methodology, the paper will first describe the communities and technology options more in detail, and then look at levels of consumption with a link to the levels of service actually provided. The paper will then present an analysis of the data from the villages with regards to incomes and expenditures grouped in WASHCost categories (see below). Finally, the paper will draw some conclusions that can be helpful for governments, policymakers, the private sector and NGOs in planning sustainable water supply schemes.

Methodology

The Life-Cycle Cost Approach

Currently, many water scheme improvement methods are valued based on initial start-up costs only. Life-cycle cost tracking is a method utilized by the International Research Centre on water supply, sanitation, and hygiene, hereby known as IRC, that includes all aspects of water service delivery like operation, rehabilitation, and replacement. Both hardware and software components are included in the total costs. This approach refers to all costs required to ensure indefinite water service to a specific population in a determined region (Moriarty et al 2010).

Life-cycle costs represent the aggregate costs of ensuring delivery of adequate, equitable and sustainable WASH services to a population in a specified area (IRC 2011). These costs include the construction and maintenance of systems in the short and longer term, taking into account the need for hardware and software, operation and maintenance, capital maintenance, any cost of capital, and the need for direct and indirect support, including source protection, training and capacity development, planning and institutional pro-poor support.

The delivery of sustainable services requires that financial systems are in place to ensure that infrastructure can be renewed and replaced at the end of its useful life, and to deliver timely breakdown repairs, along with the capacity to extend delivery systems and improve service delivery in response to changes in demand. This is the 'life-cycle' at the heart of this approach – what is needed to build, sustain, repair and renew a water (or sanitation) system through the whole of its cycle of use. Whereas data with cost details on these categories from organisations and governments can be extracted from their accountability systems, data from the individual water schemes is scarcer and rarely collected. However, since most of the operation costs and also some of the capital costs and capital maintenance costs happen at community level, this data is key for any life cycle cost analysis.

The term 'life-cycle' in this context does not refer to conventional 'cradle-to-grave' system analysis, but indicates that in a sustainable system, the costs follow a cycle, from initial capital investment, to operation and minor maintenance, to capital maintenance and replacement of infrastructure that has come to the end of its useful life (which may well be extended or renewed with additional capital expenditure). The life cycle refers both to the life of the individual system components and to the overall costs required to develop and run a service indefinitely (IRC 2011).

The life-cycle costs approach (LCCA) goes beyond achieving the technical ability to quantify and make costs readily available. It is not (or only partly) about what it costs to have the infrastructure in place. The approach is much more about what service level is provided at what costs, independent from the technology that is used. It seeks to improve understanding about life-cycle costs and the ability to analyse them in relation to service delivery (IRC 2011).

The life-cycle cost components relevant for this particular paper are (adapted from Fonseca et al 2010):

CapEx: Capital Expenditure is composed of both hardware (construction materials and engineering works) and software components. The software part includes the studies done prior to implementation (such as feasibility studies, assessments and willingness to pay surveys) and also the initial interaction with stakeholders and water users, as well as the establishment of management structures such as water user committees. CapEx also includes new investments for extensions that can be added on further down the road. In the context of the individual water scheme, CapEx is normally an investment coming from outside, from a donor, organisation or government. It could still include the contribution in cash or kind made by the community towards the initial investment, and any contribution or whole payment by the community or water scheme operator towards new investments at a later point of the life span of the scheme, such as an extension.

OpEx: Operating and minor maintenance expenditure covers the costs of daily operation of the water system as well as minor repairs. For small piped schemes it means replacement of taps and valves as well as expenses on fuel and chemicals. OpEx also includes the payment of allowances for the people involved in running the systems. In Uganda, this can mean paying sitting allowances for committees or boards, or paying pump caretakers or scheme plumbers. In principle, these costs should be covered by water sales or contributions from water users if the scheme is to be self-sustaining, however in many cases OpEx still has to be subsidized. A study on piped schemes in southwestern Uganda showed that most schemes can barely cover operating costs and that the support mechanism (Umbrella organisation) still has to step in and pay overdue power bills or fuel bills to keep the systems running (MWE 2008).

CapManEx: Capital maintenance expenditure includes asset renewal, replacement and rehabilitation costs. These are expenses on work that goes beyond the daily running of the systems, but that is required to keep them running. Examples in Uganda are borehole rehabilitation, major repair on a pump or storage tank in a piped scheme or the replacement of a faulty generator. In the context of Ugandan small piped water schemes, these costs are ideally to be paid for by savings made by the individual scheme. Where this is not enough, the district local governments or town councils receive grants from the central government to cover this. However, these funding instruments often include long delays, and the amounts are minimal per district (Koestler and Jangeyanga 2012b).

Collection of cost data

The Fontes Foundation implements this method by categorizing the expenditures of their water schemes in Queen Elizabeth National Park. Expenditures related to the project also in the years following implementation are organised according to the cost categories outlined in the LCCA framework. Information is collected based on the monitoring and evaluation framework outlined below. It includes expenditures incurred by the community, by other local partners and local authorities and by Fontes Foundation as the supporting mechanism. This paper will mainly focus on the expenditures by the community.

The main sources of information at community level are the monthly reports. Currently, the communities are required by the foundation to submit monthly reports. This is necessary to incentivise accountability and transparency both within the community and between the committee and the supporting agency. The water committees complete the reports at their monthly meetings and submit a carbon copy to the headquarters of the foundation in Kampala.

The reports ask the water committee to identify the amount of chemicals added per filled settlement tank and the amount of chemicals left in the store. They are also asked how often the storage tanks are filled (quantity), what price the villagers are paying for water, and how much time it takes to fill the settlement and storage tanks (fuel consumption). In addition, the committee is requested to account for total collected income and to list expenditures by category. Finally, the report documents the number of families using the treated water, problems encountered, and possible solutions. The monthly reports also indicate where the water system has received financial support from other local entities, like the Sub County or a local politician.

Until now, the organisation has been carrying out these tracking exercises approximately every 2 years. The first exercise took place in 2010 and led to the publication of Koestler et al (2010), which was presented during the IRC International Symposium in The Hague in November 2010. The paper summarised data from four water projects from 2004 to 2010, including the expenditures incurred by the organisation and other stakeholders contributing towards the project.

Collection of other data

To gather information about the villages, semi-structured interviews were conducted in June and July 2012 on site. Interviews were personally conducted among villagers within the three communities. Interviewed were 34 Committee Members, 54 Water Users, four local governmental authorities, and one representative from the Uganda Wildlife Authority (UWA). The committee members were asked questions regarding their involvement in water system maintenance, such as how often they hold meetings and how quick they are to respond to problems or breakdowns. Water users were asked about their water usage patterns, in order to reach a deeper understanding of the meaning of the system to the community.

The interviews were conducted with the assistance of a translator between English and the local dialect. In some instances, this translator was directly affiliated with the Fontes Foundation, which may somewhat limit the reliability of the results because the interviewees may have felt pressured to respond appropriately in the presence of the donor affiliate. It is also possible that minor misunderstandings exist due to the language barrier and that nuances were not captured in translation. Overall, the results of interviews were designed to capture a snapshot of each village's experience with its water system.

Community overviews

The villages in Queen Elizabeth National Park, Western Uganda, face unique challenges because they are restricted from agricultural activities and hunting to protect the wildlife within the park's borders. Villagers face dangers daily from wild animals like hippos and crocodiles near the water sources. The Kazinga Channel, which connects Lake Edward to Lake George, serves as the primary source of water in the region, due to salty ground water. In addition, the quality of water is unsafe for human consumption and requires a comprehensive treatment process to become potable. Water is abstracted from the Channel and allowed to settle by adding Aluminum Sulphate for few hours, before it is pumped through pressurised sand and activated carbon filters and finally chlorinated. All systems mentioned in this paper use the same technology, which is showed to be simple enough for communities to operate by providing safe and clean drinking water. Based on field interviews conducted in June and July 2012, no members of these communities use untreated water for drinking when treated water is available.

The water projects are run by water committees, which are elected democratically by community members. This is one of the management models currently used for piped water schemes in Uganda, where systems are too small to attract the involvement of the private sector (Koestler and Jangeyanga 2012a). The model can be characterized as an extension of the community management model, where business principles are introduced in a largely voluntary and local setup. The model is illustrated by the figure below, and has been tried and developed by Fontes Foundation since 2004. It has several advantages over other models in Uganda, like the fact that members of the committee are elected and not appointed by government.

The committee members are trained by Fontes Foundation to take on different roles, such as chairman, treasurer, secretary and members. The committee acts in fact like a small business management (see figure 1); they collect money from water sales, pay running costs and salaries to the pump attendants and tap attendants and bank the "profit" for future repairs. In this way, the model is in essence based on voluntarism, but still has a business structure and is managed using accounting and management principles. The main role of Fontes Foundation after the installation of the scheme consists in maintaining and training these structures and giving them incentives and tools to run their "business" in a sustainable manner. Although the margins are small, the committees are able to pay themselves a small allowance for the work they do, and some are even able to bank money to finance future repairs.

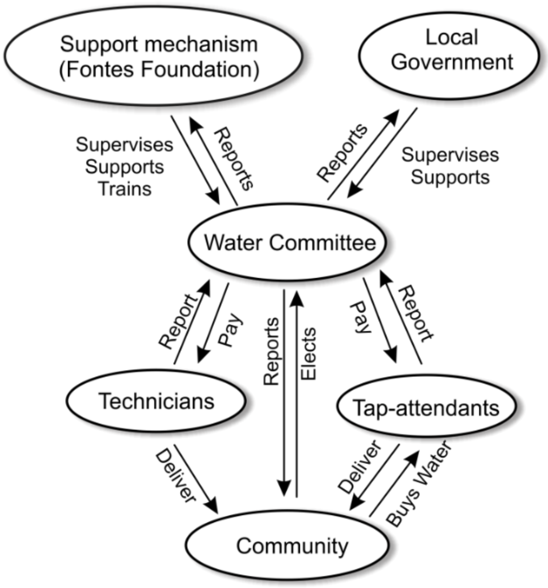

Figure 1. Management model in Fontes Foundation projects.

KATUNGURU-RUBIRIZI

The water purification scheme was first installed in February 2004 to serve a population of 530 villagers. Water in Katunguru-Rubirizi is distributed at one public tap stand with four taps, and one at the local primary school. The community members buy water paying for every twenty litre container, and the primary school is metered and pays on a monthly basis. Based on surveys, members of this community use, on average, 19.8 litres of treated water per capita per day. Villagers report an average of nine minutes total to collect water each time, and they would be willing to contribute an average of 800 UGX per household for an emergency repair to the system.

KISENYI

Kisenyi is another fishing village that faces a seasonal difficulty. With heavy rainfall, the roads become inaccessible and the community is effectively isolated. The water system was installed in 2007, and serves about 770 villagers. It uses solar technology to pump the water when the weather is good, and is able to provide water at a considerably lower price than the other villages due to the reduced running costs. Water is provided at two public tap stands, each with four taps. On average, villagers use 22.1 litres per capita per day. It takes water collectors an average of three minutes, and villagers would be willing to contribute 1550 UGX for an emergency repair to the system.

Kazinga

Many wild animals occupy the slope between the village and the Kazinga Channel, which impacts the safety of approximately 710 villagers. A piped water system was installed in 2007 and average daily water consumption is 21.5 litres per capita. Villagers report an average of three minutes to collect water each time, and they are willing to contribute and average of 3400 UGX to repair the system in case of an emergency.

Community Involvement

One of the main conditions for the proper functioning of the systems, in the experience of Fontes Foundation, is community involvement. The management committees meet once monthly to submit reports documenting cash inflows and outflows, problems faced and resolutions sought. The financing arrangement outlines that money is acquired through the sale of water, grants and donations, loans, and fines. Currently, the communities remain heavily dependent on the Foundation to support major repairs. Hopefully, an understanding of the villages' long-term financial needs will enable communities to plan and budget for their future needs. Prior to the implementation of the system, water was collected from a surface water source or harvested from rain and simply boiled as treatment. Now, the villagers can access substantially higher quality water for 100 UGX per twenty-litre jerrycan, which is about $0.04 USD. Interviews were carried out in each village with committee members in order to assess their commitment towards running the water schemes, and to assess if they could be able to cover capital maintenance costs in future as well. Community involvement can also be evaluated based on the responsibility of the reigning water committee. Given the opportunity to engage with members from each water committee, we were able to discern a few distinguishing factors about them that may impact its corresponding service delivery level.

Katunguru-Rubirizi Water Committee

Members of Katunguru-Rubirizi's water committee are typically diligent about meeting monthly and they maintain regular attendance. Whenever there is a problem with the water scheme, they call a meeting to analyze and decide a method for action. Repairs are performed internally when possible, but a local technician or even the Fontes Foundation can be summoned for larger issues. For example, a pump once broke and the water committee decided to send it to Kampala for repairs. A larger problem arose when a pump was beyond repair. In this case, the community raised half of the necessary funds internally, and received assistance from the Fontes Foundation to fully replace the unit, an equivalent of USD 900. This shows that although the committee fails to perform some duties such as meeting regularly, they were still able to take adequate action once a problem occurred. The fact that they were able to raise half of the necessary funds to replace a pump, a major expenditure and part of capital maintenance, shows that their commitment to keep the system running is there. This is despite the fact that the willingness to pay for a repair was the lowest recorded amongst the villages. This is the oldest water project where people have been trained on the fundamentals of water system management the longest, so it is a promising development.

Kisenyi Water Committee

Kisenyi's water committee is unique because the village has decided not to hold re-elections for the existing members. The leaders operate efficiently and have built a high level of trust with the community. Their first response when there is an interruption in service delivery is to call a meeting and decide what to do next. For example, a broken filter was replaced with some money raised internally. Although the expense was also subsidized by the Fontes Foundation, this demonstrates the ability of willing water committees to begin to raise funds for large repairs from within.

Kazinga Water Committee

The water committee of Kazinga holds regular meetings and boasts regular near-perfect attendance. They are able to complete most repairs internally, most likely because they have a trained technician in the village. In 2010, the generator had to be replaced due to repeated failures resulting in high operations costs for the committee. This cost was covered entirely by Fontes Foundation.

Service Delivery

When analysing cost data, it is necessary to also assess the service delivery of the water committee in question. According to Patrick Moriarty and others of IRC, service delivery is commonly defined by the quality, quantity, accessibility, and reliability of clean water to a community (Moriarty et al 2011). Quality is typically measured by one or more indicators, which demonstrates its chemical and biological quality. Quantity is measured by litres per capita per day. Accessibility can be measured as a combination of both distance to the improved water source and time taken to collect water. Reliability is defined by the amount of downtime during which water is unavailable.

A high level of service delivery is defined by a minimum of 60 litres per capita per day of high quality water. Intermediate service delivery is defined by a minimum of 40 litres per capita per day of acceptable quality water from an improved source, spending no more than 30 minutes per day doing so. Basic service means accessing a minimum of 20 litres per capita per day of acceptable quality water from an improved source, spending no more than 30 minutes per day. Any service level below these levels will be labeled as sub-standard or no service (Moriarty et al 2011).

A table of interview results is displayed below.

Table 1. Service levels in the three villages.

	Katunguru-Rubirizi	Kisenyi	Kazinga	Benchmark
Average jerrycans per household per day	3.58	5.56	5.91	-
Average litres per person per day	22.95	32.81	26.78	20
Average number of minutes to collect water	8.15	8.19	4.39	30
Percent of households willing to contribute to repairs	95%	100%	88%	-

Based on the sample of the village that was interviewed, all community members are above the threshold for basic service delivery because they have access to more than 20 litres per capita per day in fewer than 30 minutes per day. It is important to note that all villages have an abundant supply of untreated water within 30 minutes as well, which is used for washing, bathing and cleaning. Adequate levels of quantity and accessibility are met in each village. However, we can see that small differences exist within the communities. For example, the village of Kisenyi consumes substantially more water per person than the other two villages, and they boast 100% willingness to contribute extra money to repair a broken water system. This may reveal a correlation between understanding the importance of the system and general service delivery. Or perhaps, the villagers are more likely to financially support the water scheme because it benefits them so effectively.

Regarding quality, we do not have consistently reliable data on the quality of water that is being treated in the villages. Technicians are trained to measure free residual chlorine levels regularly at the taps in order to make sure the water is safe, however there are no records. A monthly quality test may be implemented in the future as a way to increase advance awareness of possible problems.

INCOME

The income in the water schemes comes mainly from water users paying for water at the tap. Some schemes occasionally receive donations locally, either from local politicians during elections or campaigns, or from local government as part of a subsidy arrangement. Institutions such as schools and health centres are metered and pay on a monthly basis.

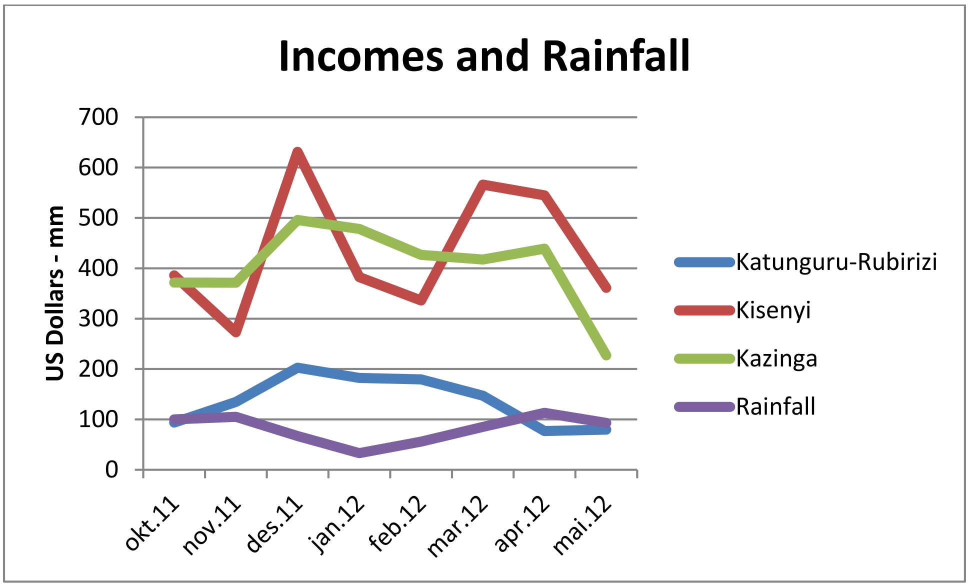

Figure 2. Income levels per month in three villages.

The figure above shows the income levels over a period of 7 months for all three villages. All incomes are converted from Uganda Shillings to 2012 USD. It is clear how Katunguru-Rubirizi generally has the lowest incomes, ranging between 90 and 200 USD per month. Kazinga and Kisenyi both have considerably higher incomes, which could be linked to larger populations and the fact that they have two taps and not one where water can be sold. The income data is important because it shows that even in extremely poor communities, like these in Queen Elizabeth National Park, villagers are able to pay up to more than 600 USD per month for drinking water in Kisenyi, which means 0.77 USD per capita per month.

The main external factor to influence water sales is rainfall. This is because many households still harvest rain water since it is conveniently done at home and free. This becomes clear when graphs with rainfall data are compared to the incomes of the water project. Figures 3 and 4 below clearly show the connection between income levels and rainfall. The most pronounced connection can be seen in January 2012, where rainfall was at a low and income levels rose to more than 200 USD per month. This shows that although people have access to treated water, the cost-barrier is still strong and people tend to use rain water whenever it is available. This is to be expected in a poor community where cash money is scarce. However, rain water is not always as safe as roofs are not always permanent and clean, and most houses lack proper collection systems.

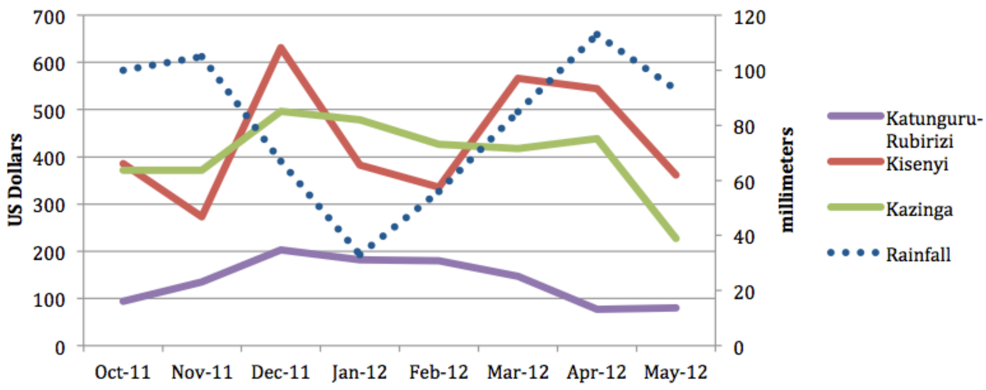

Figure 3. Incomes and Rainfall of the Villages.[1]

The analysis shows that there are significant fluctuations in income, mostly related to rainfall. In Kisenyi, the differences can be more than 300 USD per month, which is significant when the average income is approximately 400 USD per month. This finding is important to be taken into account when planning and budgeting for operation and maintenance expenditures. It is also a significant feature to include in any business plan for individual small piped schemes.

EXPENDITURES

Expenditures were grouped in the three WASHCost categories CapEx, CapManEx and OpEx. CapEx is manly new investments, such as setting up a new fence or adding washouts on the storage tanks. CapManEx includes rehabilitation or replacement of existing infrastructure, such as the replacement of a faulty pump, rehabilitation and painting of a tap-stand or fixing a significant leak in a tank. OpEx includes mainly three categories: Fuel and chemicals to run the systems (or payment of power bills in the case of Katunguru-Rubirizi), minor maintenance and allowances to staff. Since fuel and power costs are high in Uganda (one litre of petrol is currently 1.42 USD) they represent the majority of the OpEx expenditures. This also means that the well-functioning of the systems is prone to abrupt fluctuations in power or fuel prices. Only expenditures covered by the individual schemes are captured here.

[1] The rainfall data is taken from a tourism website, which showed to have more specific data on the different locations compared to official sources:

http://www.audleytravel.com/Destinations/Africa/Uganda/Places-to-Go/Queen-Elizabeth-National-Park/Climate.aspx

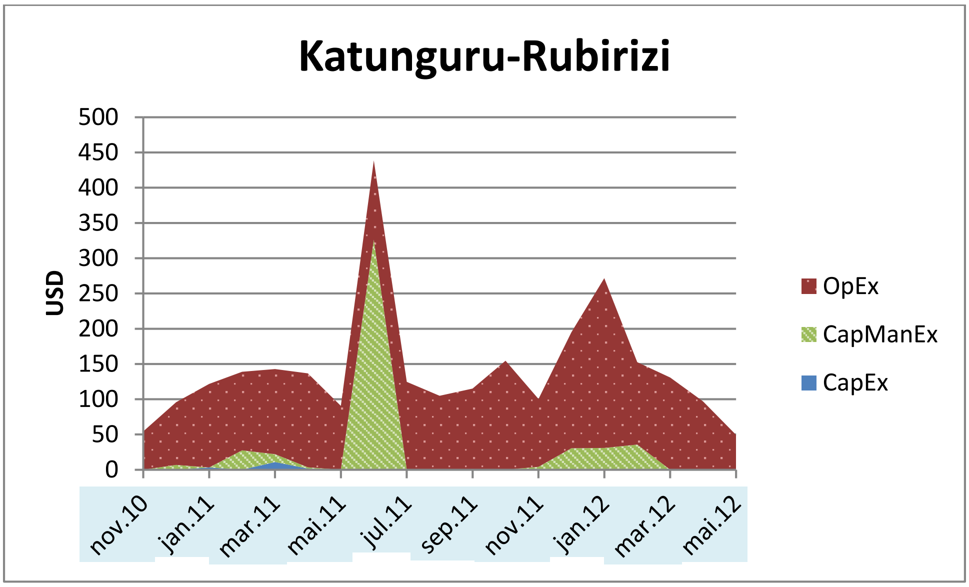

Figure 4. Expenditures in Katunguru-Rubirizi in 2012 USD.

The data shows a relatively steady OpEx between 100 and 150 USD over time. The peak in OpEx in January 2012 correlates with the low rainfall (see Figure 4) which confirms the fact that a large part of OpEx is used on direct running costs of the schemes such as power bills and fuel for the backup generator. Katunguru-Rubirizi is the only scheme connected to grid power, but power cuts are notorious in this part of Uganda so the backup generator is used frequently. The peak in CapManEx in June 2011 is due to a faulty pump that had to be sent to Kampala for repairs at the expense of the committee. Luckily, due to a partnership with Uganda Wildlife Authority and creative solutions found by the scheme technicians, the system could keep operating even while the pump was being repaired. The data also shows that even in a system with expenditure levels between 50 and 150 USD per month, the committee and the community are still able to come up with a capital maintenance expense of over 300 USD when necessary.

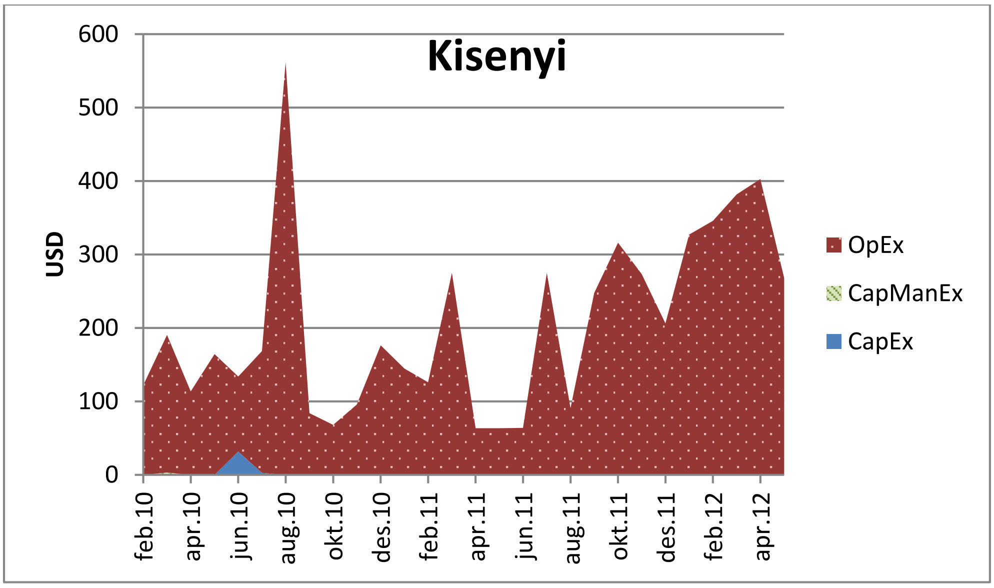

Figure 5. Expenditures in Kisenyi in 2012 USD.

Kisenyi sees much higher fluctuations in expenditures. This can be linked to more fluctuating income levels (see Figure 2), but is probably also linked to the fact that Kisenyi has a solar system where fuel is not required when there is sufficient sunshine to run the pumps. Another reason for the fluctuations could be inconsistent reporting of the data. In August 2010, there was a temporary electrical problem with the solar panels and consequently the operation costs peaked as the committee had to use the backup generator to pump water every day. The increased operations costs in 2012 are due to several small repairs necessary to keep the submersible pump running. On average, expenditures are between 100 and 400 USD per month, although there is an upward trend from October 2010 to April 2012.

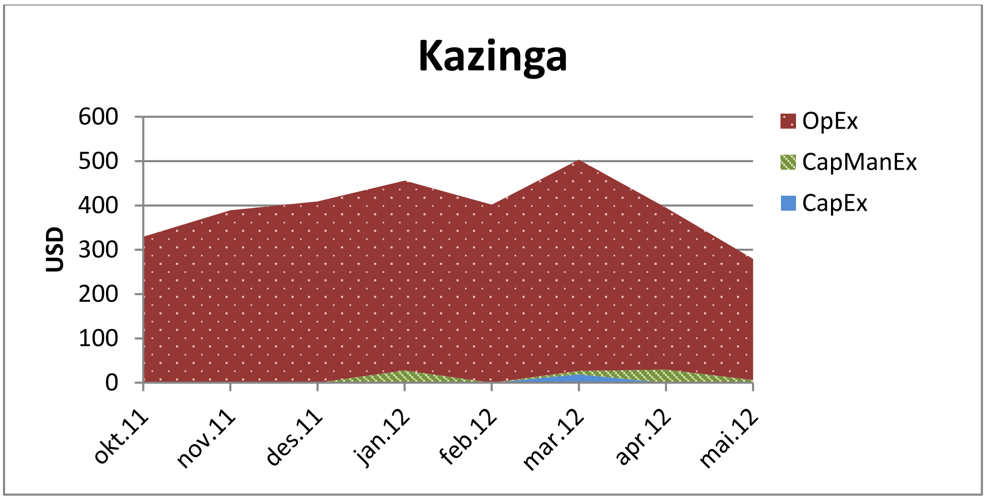

Figure 6. Expenditures in Kazinga in 2012 USD.

Expenditure levels in Kazinga look much more uniform. Operation expenses are stable between 350 and 450 USD per month, except for a peak in March 2012. This village uses a lot of money on fuel since they have no alternative power source, and consequently expenditure levels are higher than in the other villages. Due to a higher load on the generator, they also spend more than the other villages on servicing and maintaining the generator.

FINANCIAL VIABILITY

If income levels are compared with expenditures, the projects are not always in positive. A look at the graph below shows the balance between incomes and expenditures on a monthly basis in Kisenyi. This project should in normal terms be the most viable project since it has the lowest running cost expenditures due to the solar panels. However, it can be seen that at certain points the balance is as low as 300 USD. The negative balances can be explained by the fact that this village has an active village savings and credit scheme, and the water system uses this village bank to take small loans to cover deficits but also to keep money safe before it is banked. In remote villages safe storage of money is always a challenge, and Kisenyi is about a 3 hours journey from the nearest commercial bank. However, using the village bank can also have its challenges; in another village the water scheme lost all its savings when the village bank went bankrupt.

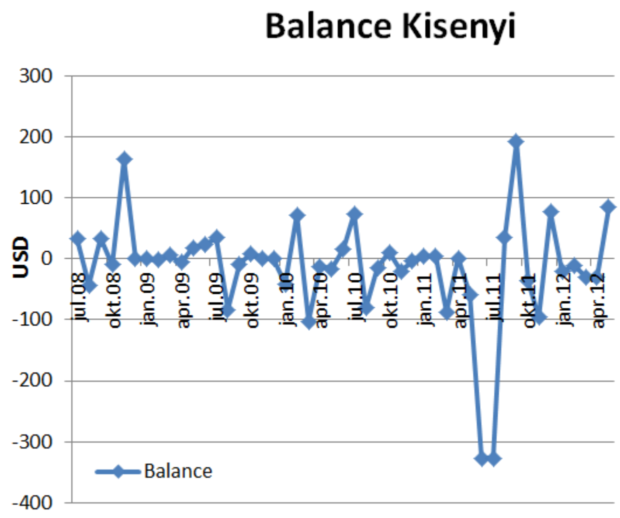

Figure 7. Balance with the water committee in Kisenyi.

Mostly, however, the balance is close to zero. It also does not show an increasing trend that should be visible if the committee was able to bank money every month for future large repairs. In conclusion, the water scheme is able to cover expenses with the use of small loans once in a while, however the margins are not large enough for the committee to bank any money for future breakdowns.

CONCLUSIONS

By focusing on data from the individual water schemes, with the expenditures grouped in the WASHCost categories, a number of important conclusions can be drawn.

First, the water schemes are able to show considerable income levels simply by selling water to consumers, in communities that are poor and faced by a number of challenges by being located in a National Park. In fact, the incomes are sufficient to cover all operations expenditures and even some capital maintenance and capital expenditures. In a country where 24.5% lives below the poverty line[2], it is impressive that they can afford to spend up to 0.77 USD per capita per month on safe drinking water. Considering an average family has 5 children and two adults, this means 5.39 USD per family per month. It shows that the population values the safe drinking water highly, and this is especially encouraging knowing that all communities have abundant access to free surface water at any time. Although it is still necessary to sensitize communities on the benefits of safe water, there is ample demand for safe drinking water in rural communities, especially when it can be delivered conveniently near the households.

A second important consideration is the impact of external factors such as rainfall on the income levels. This is specifically important to take into consideration when drawing up business plans so that regular maintenance expenditures that are not related to water quantity, such as service on pumps and generators, can be planned and budgeted for adequately. It also shows that people still look for cheaper options

[2] CIA World Factbook https://www.cia.gov/library/publications/the-world-factbook/geos/ug.html

of getting access to water apart from the surface water source, and that rain water is an important complementary source for rural households in Uganda.

The study also shows a relatively high per capita consumption in the villages, all of which meet the target of 20 litres per capita per day. This shows that although water is expensive and an alternative free source is available, people still consume relatively high volumes of treated water, mainly for drinking and cooking. This is again an indicator that the demand for treated water near the households is high, even in poor rural communities.

When considering the expenditures of the schemes, it can be seen that most expenditures are related to operation and minor maintenance, and that the individual schemes have contributed little towards capital maintenance expenditures in the period analysed. This does not mean that capital maintenance costs have not been necessary, as organisation records show. When asked about their willingness and ability to pay, between 88% and 100% of respondents in the three villages answered that they would be willing to contribute towards a large repair. These are encouraging numbers and show that the villagers understand the importance of their water system, that they feel ownership towards it and that they trust that the management of the system will handle their funds truthfully. However, when it comes to the actual amount they are able to contribute, the numbers are less encouraging. For example, Katunguru-Rubirizi with approximately 110 households would be able to raise only 34 USD. Kazinga has the highest ability to pay with 269 USD, but even this is not enough to replace a pump or a generator which would be in the range of 800-1500 USD. The findings show that although communities show positive attitudes towards contributing and making sure their water systems are running, the ability to pay is still too low to ensure financial sustainability of the systems over time. This means that although rural communities are able to cover operation costs, there is still need for outside support when it comes to large repairs.

The completed analysis yields an understanding of the periodic needs of three water systems. A community existing under similar circumstances to the ones studied here could expect to spend approximately 100 USD per month on operating and maintenance expenses, while financing additional repairs and replacements through money saved by extra income generated during the dry seasons. Tracking monthly costs is a good way to start understanding the financial needs of any water scheme, and comparing this data to seasonal patterns may yield deeper insights to the inner-workings of the system as a whole.

Operations expenditures can be predicted in small piped water systems by recording expenses over a period of time. In these villages, operation and maintenance can vary between $50 and $300 per month per system. Capital maintenance expenses typically are more difficult to predict. This can be because major repairs can be required unexpectedly, due to damage from wild animals, or theft or vandalism. However, if water committees are responsible about saving extra income on a monthly basis, additional costs are more likely to be manageable. At this time, however, the Fontes Foundation is still an active supporter of major repairs and replacements in every village that it works with.

Considerations for the future

How can these conclusions be relevant to the future of the rural water sector? First, the findings add important local data to a debate that is too often shaped around assumptions. For example, the data shows that by using a management model that introduces certain business principles into the traditional community management model, individual schemes are able to break even without outside subsidies even in relatively small and poor communities. This is despite the fact that the technology option is relatively expensive in running costs, having to treat surface water in addition to distributing it. From the interviews with villagers, this is mainly because the demand and willingness to pay for water is there, even with alternative free water sources available. Therefore, the traditional community management model might not be effective for small piped schemes, however certain principles such as a democratically elected committee can be maintained. It has to be noted that this paper does not consider the efforts required in external support to train and follow up this committee. At the same time, when looking at the financial data it is clear that in terms of covering running costs, the business is viable.

At the same time, the data underlines the need for outside support when it comes to large repairs. It shows that the margins are too small for the committees to be able to make any savings, and the contributions from households are too small to fix larger breakdowns. This means that in terms of covering life cycle costs, the business is not financially viable in the long run. This is not a surprise, as many rural water supply systems in developed countries are subsidised as well. However, it is an important point that needs to be carefully considered when designing management models and support mechanisms for the rural water sector in developing countries, and this paper provides data to support this conclusion. In practice, when budgeting for the life cycle costs of small rural piped schemes, CapManEx needs to be covered from a source outside the individual water scheme.

This study addresses a pervasive gap in water sector research regarding financing strategies based on empirical data. It provides a framework and understanding of the financial needs and capabilities of the water schemes in three small communities in Queen Elizabeth National Park. This project shows a glimpse into the types of studies that are necessary to understand the functioning of rural water schemes on an individual level, which helps to repair a lack of cohesion between practice and research across the charity water sector.

Future work would be useful to develop more concrete recommendations for transitioning between short term and long-term service delivery. In addition, continued reporting and monitoring these three communities would enable an even more thorough interpretation of what it takes to ensure continued water service delivery in a rural area. As the global population increases and water resources become more polluted and scarce, we need to reevaluate the standard approach to fulfilling the promise of adequate safe water access as a human right by continuing to research and evaluate existing practices.

All these conclusions are important when considering water services as small businesses or when involving the private sector and local entrepreneurs. This is increasingly the trend also in Uganda, and this adaptation of the community management model is a testimony to this trend. Other piped schemes in Uganda are managed by "scheme operators" that have even more characteristics of a business manager, or even by a "private operator" that is a legally registered company (Koestler and Jangeyanga 2012a). Whenever water services are considered as a business, it is necessary to develop sound business plans including the planning and budgeting of life-cycle costs. This paper gives important data for the development of such business plans, including considerations on demand, willingness and ability to pay, external factors and expenditures.

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