Market Assessment: Commercial Provision of Water at the Community Level in Kenya

September 2012
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<tr>
<td>AWSB</td>
<td>Athi Water Services Board</td>
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<td>BOT</td>
<td>Build-Operate-Transfer</td>
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<td>CBO</td>
<td>Community Based Organization</td>
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<td>CDN</td>
<td>Catholic Diocese of Nakuru</td>
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<td>GPOBA</td>
<td>Global Partnership for Output-based Aid</td>
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<td>Ministry of Local Government</td>
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1. Executive Summary

Commercial investors, lenders and operators currently play a minimal role in the provision of water to communities in Kenya. This report represents the final stage of a multi-phased project to carry out an in-depth market assessment of the safe water markets in Kenya, in order to establish the role that market-based decentralized solutions (both entrepreneur and community owned) could play in the provision of safe water.

This market assessment examines the current environment for the commercial provision of water, including the policy and business environment, as well as the willingness and ability of the population to pay for water at prices necessary to fund private investment. It reviews existing models to determine whether they could be replicated at scale. Considering the low level of private investment at present, it also includes comparative analyses of efforts in other countries, to identify gaps and hurdles in order to ascertain what changes might be needed for similar models to take hold locally.

The scope of work included a desktop literature review, interviews with sector participants, review of models in other countries with possible applicability, and evaluation of multiple projects including preparing detailed analysis of the most promising.

Sector Overview and Environment

Kenya has made tremendous strides towards sustainable water provision since 2002, when the sector was restructured under a new Water Act. There is evidence of increased acceptance that water should have a price, though this is still not a universal view. Unfortunately, the basis for the price is not well-understood by consumers, which leads to convictions about maximum acceptable levels of kiosk pricing, regardless of the actual expense of bringing water to the consumer.

Kenya is a water-challenged country, with a variety of hydrological, geographic and demographic conditions faced in the commercial provision of water. Optimal solutions for key functions of a given project – abstraction, conveyance, treatment and delivery – lead to very different capital and operating cost structures. To be feasible, pricing requirements can range from KES 2 (US$0.02) per 20 liter jerry can for low-investment options that tie into existing networks, up to KES 12 ($0.13) per 20 liters for systems that require borehole extraction, piping and removal of fluoride. Consumers are generally unaware of the cost implications of different technical parameters. The existence of a KES 2 per 20 liter price cap at community kiosks that are part of regulated systems contributes to the sense that this is a “fair” price for water, regardless of the underlying cost.

General Feasibility

A significant focus of this report was to examine the feasibility of decentralized, kiosk-based water systems to serve a meaningful role in the commercial provision of water to poorer segments of the population in Kenya. It was found that decentralized projects that aim at capital recovery are generally not feasible at prevailing prices, except in exceptional circumstances that allow low operating expenses and higher pricing than is typical. As a result, the focus of the report was expanded to include some discussion of small piped systems, where economics are generally more favorable. There are a number of barriers to commercially viable kiosk systems, some of which can be addressed and others that are more structural in nature. To illustrate the gap that would need to be bridged, this report examines the cost structure and economics of the rural decentralized kiosk market in India, which has many
similarities to Kenya in terms of population distribution and source water challenges, and where private operators have installed kiosks in approximately 4,000 villages. Figures from India provide an indication of the cost and pricing needed for a capital recovery model, though higher pricing would be required in Kenya to compensate for higher capital and operating costs.

Hurdles

The key hurdles preventing widespread adoption of commercial models for decentralized water provision in Kenya include:

- **Ability and Willingness to Pay**: The Kenyan market remains mainly focused on access to water, with drinking water safety a secondary concern. In poorer communities, users will opt for cheap or free untreated alternatives rather than pay for safe, treated water.

- **Seasonality of Demand**: Most of Kenya experiences significant seasonal fluctuations in surface water availability. In times of abundance, kiosk revenues can fall 90% as users turn to available rainwater and surface water sources.

- **Low Kiosk Pricing**: Customary kiosk pricing is driven by large Water Service Providers expanding coverage under a cross-subsidy model subject to a price cap, or by donor/NGO and Water Services Trust Fund projects in both urban and rural settings. Neither model is designed for stand-alone commercial self-sufficiency; both contribute to unrealistic price expectations.

- **Erratic Supply of Source Water**: The most cost-effective means of extending supply is through network extensions under delegated management models, but most existing WSP networks lack reliable source water supply to support meaningful expansion.

- **Treatment Cost**: A significant proportion of the groundwater supply in Kenya has harmful levels of fluoride. The cost to remove or reduce fluoride to safe levels is very high, and would require a significant price adjustment for community systems, or a subsidy for decentralized providers.

- **Respect for Contracts and Agreements**: Investors and lenders are not confident that communities will respect contracts or repay funding. There are examples that validate the concern.

- **Asset Security**: Examples of theft and vandalism undermine the viability of decentralized systems; cash flow is typically not sufficient for a private operator to support 24-hour security.

- **Financing Availability**: The banking sector does not currently play a meaningful role in the financing of private water investments. Financing for major infrastructure comes from the government and development partners, and at the decentralized end it is still primarily from the W STF, NGOs or is self-financed.

**Commercial Opportunities – Urban Market**

Most urban markets are served by existing, regulated Water Service Providers, with widely varying degrees of coverage. Regulation and tariff adjustments are meant to extend coverage to populations that are currently un-served, including the many fast-growing informal settlements and slums. This is a challenge for many regulated WSPs, and commercial suppliers could provide a complementary role. The most attractive models to develop urban supply should focus on piped network extensions and delegated management models. The demographic environment is supportive of these approaches, though local hurdles require a careful and transparent process that offers strong support to the private
operator. A significant barrier comes from scarcity of supply in many existing systems, which is exacerbated by extending these networks and may leave the new operator without a product to sell. In these cases, private investment must proceed in parallel with investment in source water supply and network integrity. These investments will typically fall outside of the capability of the private operator.

Commercial Opportunities – Rural Market

Of the 104 Water Service Providers tracked by WASREB in the most recent IMPACT report, 31 are characterized as rural. In practice, these WSPs typically serve one or two towns in a given region rather than a broad rural area; in fact, 17 out of the 31 serve only one town, and the total population served by these regulated WSPs is 1 million, a small fraction of Kenya’s rural population of more than 30 million. The much greater portion of the rural market is served by thousands of small community piped systems, collectively serving 4 to 5 million people, along with kiosk projects (mainly donor-funded), borewells, hand dug wells and collection of rainwater or seasonal surface water. An initial focus of this study was to analyze the potential for decentralized, kiosk-based models to thrive in Kenya, as they have done in other countries. Considering the hurdles discussed earlier, we view it unlikely that these models will have a broad impact, unless water pricing becomes much more supportive, or a transparent mechanism is enacted to subsidize the high cost of treatment, mirroring the implicit subsidy available to a delegated management model that ties in to an existing urban WSP network.

The more meaningful near-term opportunity appears to reside with the existing community systems, many of which are operating under volunteer management agreements, but which offer an existing asset base and some level of cash flow to secure investment and financing. By combining these systems with professional management and fresh investment, these systems could achieve meaningful improvements in service and access.

Financing Opportunities

Water sector finance is mainly provided from the central government, either with budget funds or from “funding partners” (bilateral and multilateral credit lines and grants.) The major portion of this funding is supplied to the eight Water Service Boards (WSBs) and the National Water Conservation and Pipeline Corporation (NWCPC) to fund infrastructure improvements. In the past, the government subsidized losses among Water Service Providers, but this has been diminishing as sector accountability improves. Two new initiatives for the sector hold promise – one, an effort to open up commercial financing options for the better-performing WSPs, the second, the Maji ni Maisha program aimed at the expansion of existing community systems through the incorporation of an output-based aid subsidy with traditional project finance. Purely commercial finance is still essentially absent from the sector. Banks are in principle willing to lend to water projects that meet their credit criteria, but in practice community water projects do not meet these minimum credit standards without subsidy or external support.

The initial Maji ni Maisha program, which is more fully reviewed in the Financing Opportunities section, is drawing to a close. We recommend that the template be expanded and modified. In its first iteration, the program dealt either directly with a community or else via incumbent large WSPs for the community’s benefit. By shifting the program to support a build-operate-transfer (BOT) model or other comparable form of private investment, the loan process will be less burdensome for lenders, while the BOT investor can provide the initial equity that communities often lack. Incorporating the private operator as an investor will also transform private operators from being viewed as a cost burden by communities, to being seen as providing a complete solution of increased investment and service.
BOT Program Focused on Community Systems

To accomplish significant reform outside of the large WSP sector, a focused initiative supported by the Kenya government, development partners and other leading non-governmental organizations is needed. The improved Maji ni Maisha program could form one plank, but a much broader effort must be advanced to establish clear criteria for community screening and broad engagement. Key steps, more fully discussed in the body of this report, would include:

- Create Accurate Database for Projects
- Provide Clear Toolkits and Selling Sheets to Communities
- Publicize Success Stories
- Develop a BOT framework with Easily-Understood Incentives
- Investigate Structural Modifications to Improve Capital Efficiency
- Provide a Process to Vet and Approve Qualified Operators
- Consider Different Levels of Subsidy (for example, to support new systems vs. expansions)

Enabling Environment

Additional support from government could improve the enabling environment to be more supportive for private investors. In the short term, subsidies could be used to provide decentralized projects with the same cross-subsidy benefit that WSP network kiosks enjoy. In the longer term, a broader array of government and sector players must support regulator WASREB in the push to establish transparent tariffs that reflect the true cost of water provision, not only for large WSPs but also for community systems.

More generally, Kenya should commit to moving beyond a focus on water access and commit to the provision of safe water to all of its citizens. This will entail a long-term shift in philosophy that requires concerted support from government, non-government and commercial structures, in order for the cost of safe water to be acknowledged and absorbed by the population as a whole. Accepting the reality of the cost of providing safe water, particularly in areas that face expensive treatment of unsafe water sources, will allow the conversation to shift to analyzing the combination of commercial principles and subsidies needed to accomplish this goal.
Recommendations and Next Steps:

Our review of the market and the possibilities for commercial provision of water indicate that the greatest impact could be achieved by focusing in the following areas:

Urban Water:

- Beginning with the excellent, existing MajiData database of high density urban areas, complete a detailed review to identify promising opportunities for network extensions and Delegated Management Models
- Prioritize opportunities where current or expected source water supply is sufficient to support network expansion under Delegated Management Models (DMM)
- Engage Water Services Trust Fund to include a DMM alternative in its Urban Projects Concept, rather than focusing only on existing WSPs
- Investigate possible mechanisms to provide synthetic cross-subsidies to developers that must invest in source water supply to extend a network

Rural Water:

- Bring key participants together to develop and implement a structured approach to securing private investment in the community water sector under BOT/delegated management models
- Support this effort with training, toolkits, technical assistance, and development of private operator capability.
- Provide incentives for community systems and independent entrepreneurs to bring their systems into regulatory compliance, in a simplified process
- Test results of automated dispensing and payment system tied to lower-cost projects
- Consider special regimes to address the cost of fluoride removal

Financing:

- Develop a next-generation Maji ni Maisha program that is geared to private operators taking equity or loan positions in community systems
- Work with commercial lenders to set up financing facilities dedicated to individual high-payback projects, administered under a master arrangement with the WSP

Enabling Environment

- Support the above reforms with simple and transparent messaging about water safety and economics, supporting private investment initiatives
2. Sector Overview

The primary focus of this report is to identify commercial opportunities and business models for decentralized water provision in Kenya, rather than to review the regulated provision of water through the larger water service providers. Nevertheless, it is important to understand the overall sector framework as well as the priorities for investment and the likely outcomes of continued reform of the regulated, piped water sector. Any efforts to promote decentralized supply must complement the primary sector strategy.

The report assumes a base level of knowledge regarding the structural reform of the Kenya water sector that began with the publication of the Water Act of 2002, namely the division of functions between water resource management and water provision, and within the water provision sphere the creation of eight Water Services Boards (WSBs) as owners of the main infrastructure, along with a large number of urban and rural Water Service Providers (WSPs) to manage these assets for the purpose of providing water to commercial and residential users.

Key Accomplishments

Though the sector structure is likely to change slightly as a result of the new Constitution, we expect that the record of accomplishment has established key underlying trends that will continue:

Creation of a Strong Regulator

Established in early 2003, the Water Services Regulatory Board (WASREB) has taken on the difficult task of moving a dysfunctional and uneconomically structured water sector toward a standard of self-sufficiency, while continuing to recognize the social aspect of water provision and the need to improve water access among the poor.

Tariffs Based on Cost Recovery Principles

Prior to the sector reform initiated in 2002, water was priced without regard to the cost of providing sustainable service. In view of this history, great progress has been made in terms of setting tariffs that cover operating and maintenance costs, while moving towards the longer term goal of Water Service Providers repaying accrued debt and financing investment in network expansion.

Following an “extraordinary” adjustment in early 2009, which increased tariffs at most WSPs between 70% - 100%, the process for setting tariffs has been made much more transparent. WASREB is also using its tariff approval authority to push improvements to efficiency, and eventually to consolidate the sector among the most efficient operators.

Improved Sector Transparency and Accountability

The cornerstone of this effort toward greater transparency and accountability is the annual “IMPACT Report” published by WASREB. This survey of the main urban and rural Water Service Providers, along with the eight Water Service Boards, has shown general improvement in sector performance. The
assessment is remarkable for its clear language and willingness to criticize not only the WSPs and WSBs, but even the Ministry of Water and Irrigation for acting in ways counterproductive to continued reform.

Focus on Sustainable Operating Performance

WASREB has clearly defined a path to sustainability for the water sector, which includes a multi-staged approach for assessing the WSPs, to be accomplished through a combination of efficiency improvements and tariff adjustments. As a first step, each WSP is expected to achieve coverage of operating and maintenance expenses, followed by a second stage focused on paydown of existing debts. The third step is to generate enough operating income to finance investment in improved and expanded service.

Expansion of Service

Though most Water Service Providers still do not deliver reliable, 24-hour water supply to customers, and there are significant population segments that remain completely un-served, tariff policy and investment have combined to improve these metrics. To expand service specifically to the poor, WASREB has included in the tariff review process, a provision that gives credit for expanded coverage to poor communities through the construction of new kiosks. A life-line tariff block, as well as low kiosk pricing cross-subsidized by household customers, help to keep water pricing low for the poorer segments of the population.

Priorities for Ongoing Sector Reform

Consolidation (“Clustering”)

WASREB has pursued a policy of consolidation, an attempt to force weaker operators to merge with stronger in order to reduce costs, improve efficiency and otherwise achieve economies of scale. There has been considerable resistance to this effort by entrenched providers, but recently there have been some encouraging examples of mergers and potential mergers.

WASREB’s main tool is to apply pressure via the tariff process, with a combination “carrot and stick” approach. Rather than granting requested tariff increases to inefficient providers, the regulator will withhold approval in order to push combinations and mergers that can provide more competitive tariffs to consumers, then approve tariff levels that allow these combinations to succeed. The new Kenya Constitution, which has in general transferred political power and spending authority to the 47 counties, has provided an additional opportunity to pursue this consolidation. Although the new Water Act of 2012 (being written to align regulation with the new constitution) has not been finalized, it currently includes a plan to shrink the number of large WSPs to 47.

Although in theory a larger WSP should enjoy some efficiencies of scale, the correlation is far from perfect. The recent Shadow Credit Rating process, which provided a consistent financial analysis and benchmarking of the sector, showed significant performance variability regardless of size. It is important that the consolidation plan focus on the efficient absorbing the less efficient, rather than inefficient providers growing even larger. In addition, care must be taken not to force a non-viable WSP onto a stronger one in a way that leaves a weaker combined entity. In the words of one sector expert we interviewed, “let’s try to avoid creating any DaimlerChryslers.”
Expansion to Serve Poor

WASREB pursues a dual mandate, not only to promote the economic viability of the sector, but also to encourage expansion of water service, especially for the poor.

Among the tools for achieving this goal, the following measures stand out:

- A staged tariff approach that includes a “lifeline block,” a reduced tariff for the first 6m$^3$ per month of water consumption per customer, intended to differentiate “essential” versus “discretionary” consumption
- Credit via the tariff process to WSPs for expanding service to underserved areas, generally through community kiosks
- A KES 2/20L cap on community kiosk pricing, in essence a cross-subsidy from household customers to low-income kiosk customers

Diversifying Sector Funding

Investment in the sector is overwhelmingly financed directly from a combination of Kenya government budget funds and funding from other governments, NGOs and multilateral agencies. Traditionally, the private sector has not played a significant role in providing finance. Sector funding is limited, and is not able to close the water provision gap in the face of continued population growth and source water challenges. By identifying the types of project that can be financed commercially, and by implementing changes to introduce commercial financing, the limited public resources can be focused where there are no commercial alternatives, and the level of safe water provision can increase. A corollary benefit of introducing commercial principles is to require changes to operating structures and methods that reduce cost and improve operating sustainability, to cut down on the number of failed projects.

Two nascent but important efforts are aimed at expanding the sources of funding. One is for the larger and more creditworthy Water Service Providers to secure commercial credit to fund network development. The second is Maji ni Maisha, which incorporates an output-based subsidy and is focused on community systems.

These efforts are important to setting a framework that can be followed and expanded, though each is likely to remain small relative to overall sector funding needs.
3. Gaps and Opportunity

The overall approach of the Kenya government and regulators is rational, focuses on the highest impact areas, and has made demonstrable progress. For the first Impact Report, only 28% of WSPs were even able to submit data to WASREB, and the report overall showed a sector that was not operating in a sustainable manner. By contrast, the most recent Impact Report, published in 2011, contained data for 87% of the regulated WSPs, as well as marked progress in key metrics, including coverage.

Results for Kenya Water Service Providers (Source: IMPACT Reports)

Supported by the extraordinary tariff adjustment of 2009 and subsequent tariff increases based on analysis of actual operating costs, WSBs and WSPs are building a much stronger foundation for the improvement of the centralized water infrastructure. Nevertheless, there remain significant gaps in service and coverage.

While the focus of the state and regulators should rightly remain on the areas where there is maximum impact and return, the “trickle down” effect of this investment will be slow to arrive to the communities that are currently unserved or under-served.

Considering the focus of WASREB and the major funding sources to continue to expand and professionalize the sector from the “top down,” in general, we identify the following categories of opportunity for private commercial operators to work in concert with sector reform:

1. Work with WSBs and WSPs to Expand Network Coverage

There are several areas where investment could provide a return to an investor/operator, while improving water service, coverage and quality. These include the delegated management models that have been pioneered in cities including Kisumu and Mombasa, or other network extensions. Key to the success of the model is supportive population density and adequate source water availability. The economic attractiveness of this model lies in the availability of low-priced or subsidized bulk water, allowing the private operator to benefit from the cross-subsidy embedded in the regulated sector, to minimize capital investment, and to earn a return while providing water at acceptable tariffs.
2. **Rehabilitate and Expand Community Systems under Build-Operate Transfer (BOT) Model**

According to the IFC report undertaken by Rural Focus and published in October 2011, there are 1,220 Community Piped Systems known to the Water Service Boards, with the true number likely double this figure. Community systems are expected to align with WSPs/WSBs, signing License Agreements (essentially simplified versions of the Service Provision Agreements signed between larger WSPs and WSBs.) In reality, over 95% of community systems are not operating under these agreements and as a whole this segment of the market is not following the same path toward professional, sustainable management as is seen in the larger WSPs. The Maji ni Maisha loan program (see “Financing Options”) was intended as a source of capital for these community systems, but the pilot project highlighted both the promise and the pitfalls of working with the communities to improve their own supply.

Bringing new funding together with professional management to this segment of the water sector could provide a major complementary track to the ongoing reform and consolidation of the larger WSPs. To be successful, it will require a separate, focused initiative that addresses the current shortcomings of the community systems, as well as the shortage of qualified (and interested) private operators. Without external support, involvement of investors will be erratic and insignificant in the scope of sector reform.

3. **Decentralized Models/Kiosks**

There are several varieties of these stand-alone, off-grid systems. These are generally thought of as appropriate for small and isolated communities that could not support a piped system. In practice, however, decentralized kiosk operators can often serve more people than the smaller community piped systems, some of which report serving as few as ten customers. In fact, a well-structured, decentralized kiosk system can represent an initial point of service, which can expand coverage over time, evolving to become a small piped system. These models are generally not viable in the current market unless they charge higher tariffs than are the present norm, or are provided with subsidies or low-cost source water.

Although there are virtually no examples of fully commercial kiosk solutions, certain elements of these solutions, such as automated payment systems, could play a role in the move to commercial water provision.
4. Moving “Up Market”

One of the greatest challenges facing the commercial provider of water is the comparison of kiosk pricing versus the residential tariffs of larger water service providers. It seems fundamentally wrong to many that the poor pay more on a volume basis for their water. This circumstance arises because (a) large piped systems are more efficient, and (b) tariffs for large piped systems do not cover all of the costs of the underlying infrastructure, much of which was installed long ago.

On the other hand, pricing of treated water at kiosks is still a fraction of the price paid for bottled water, or for the jugs sold in “water shops” or other automated dispensing solutions in supermarkets or elsewhere. This opportunity has been explored in some depth by Aquaya Institute, and has generated some encouraging business models, though considering the nascent state of this market, it will not play a significant role in water service at the community level for the foreseeable future.

Source: Aquaya, Safe Water Network Analysis
4. General Hurdles

The lack of private commercial involvement in the sector is the result of multiple hurdles, including those listed below:

- Ability and Willingness to Pay
- Seasonality of Demand
- Low Kiosk Pricing
- Erratic Supply of Source Water
- Respect for Contracts and Agreements
- Asset Security

Ability and Willingness to Pay

Currently, focus in Kenya remains squarely on access to water. Although surveys and testimonials often show that people claim to value safe water and to understand its health benefits, results from the field contradict these assertions.

At a professional policy level, WASREB has been able to improve the understanding of the economics of water provision. But this understanding is not found at the consumer level. The recognition that the process to make water safe requires sometimes expensive treatment, which may increase the cost substantially, is not well understood, or else disregarded.

Among low income populations, willingness to pay for water appears overwhelmingly based on necessity and survival, rather than quality or health considerations. Discussions with NGOs and other agencies dedicated to serving the poor, including the Water Services Trust Fund, confirm that the main thrust is access to water rather than provision of safe water.

Our study of the WSUP Karagita scheme near Naivasha is instructive. Recognizing the high cost of fluoride reduction, the project was designed to deliver two separate water streams to residents, one untreated groundwater for general use, and one for drinking and cooking. The prices for both water options were lower than residents had previously paid for untreated and less convenient water. Even at the lower prices, residents initially chose overwhelmingly to consume the cheaper untreated water for drinking purposes. In response, WSUP is evaluating the root causes of the lower consumption, and is developing a plan working with district public health officials and other local stakeholders to increase adoption of the de-fluoridated water.
Prior to initiation of the project, sponsor Water and Sanitation for the Urban Poor (WSUP) estimated that 20% of the water sold would be treated and 80% untreated. Instead, 94% of the water sold was untreated, even though the treated price was lower than the previous price for untreated water. Results also indicate that average per capita consumption of treated water was less than 0.2 L daily, which would appear to be far below minimum drinking amounts. This indicates that residents are drinking untreated water, though a contributing factor to the lower figure is that the community includes large numbers of flower farm laborers who consume water elsewhere during the workday.

Our initial analysis of the WSUP system in August 2011 (see Appendix 1) predicted that it would have a difficult time maintaining profitability at its initial tariffs, even with the capital investment provided on a grant basis. To achieve full economic viability without capital subsidy would require pricing of untreated water to increase approximately two to three times current levels, or between KES 4 and KES 6 per 20L. Pricing was revised in early 2012 based on actual costs, which should ensure operating sustainability.

The experience of WSUP highlights the economic challenge that exists in the large areas of the country that require expensive abstraction and treatment to provide safe water, especially those areas suffering from excessive fluoride in groundwater. Similar circumstances in India reveal pricing equivalent to KES 8 – 12 per 20L jerry can for treated water would be required to sustain decentralized kiosk businesses on a full capital recovery basis.
Seasonality of Demand

One of the primary challenges to commercial provision created by the low willingness to pay is that systems suffer from severe seasonality. During times where rainwater and other surface water are available, sales from commercial providers drop precipitously.

The following graph plots monthly volume for the Onesmerc system in Mbooni West (Machakos), one of the projects we reviewed in depth, against recorded rainfall from the nearest weather reporting station.

Seasonality is expected at any water project. But the magnitude of the observed decline in demand from September through November – approximately 91% - puts a tremendous strain on project finances. During the dry season, the system cannot supply enough water to meet demand; our analysis of daily sales at each kiosk revealed many days with no water to sell. Meanwhile, during the rainy season, sales cannot cover direct costs of personnel.

Although the price charged by the privately funded Mbooni project is considered high (KES 2 – KES 15 at kiosks, depending on transportation distance), we have observed similar seasonal swings at Grundfos LIFELINK sites in comparable regions; this, despite much lower typical pricing of KES 2 – KES 3 per 20L jerry can.

The LIFELINK examples are especially useful to analyze because the systems installed in various communities are identical, removing some variables that could otherwise affect the analysis. Though most systems show a typical seasonal pattern (consistent with the Kishamba site shown on the following page) the KMC location shows a much lower seasonal fluctuation.

The KMC site is located along the Nairobi-Mombasa highway, in a low income but nevertheless vibrant commercial area, compared to the more typical rural LIFELINK, such as the Kishamba location shown on the right. The two lines show the minimum volume required to pay the monthly service charge at the KES 2 and KES 3 pricing that Grundfos has used at the majority of its LIFELINK sites. At the higher KES 3 price, the KMC site generates enough sales to meet this minimum service charge in all but one month, whereas the Kishamba site struggles to break even. As a result, pricing at Kishamba has been increased to KES 5.
The World Health Organization water guidelines consider 7.5L per capita to be a minimum daily survival consumption level. If the community at Kishamba were consuming this level year round, the monthly income would comfortably exceed the cost of service. Instead, the per capita figures (based on the entire population) range from 3L per capita in the dry season to 0.5L per capita in the rainy season. Our analysis of other systems, both in Kenya and elsewhere, show that in most cases the WHO guidelines are optimistic when considering “pay-as-you-fetch,” kiosk-based systems.

Pronounced seasonal swings typically go hand in hand with low overall consumption, so that communities already presenting a challenge to commercial sustainability in terms of volume levels exacerbate this hurdle with higher responses to seasonality, including months with virtually no sales in many cases.

This seasonality effect makes it difficult for an entrepreneur or operator to manage a system efficiently. A system with light seasonal variations can size its processing at a lower level, and compensate with additional storage to manage peak volumes. But it is challenging to manage peak volumes that are five to ten times higher than trough volumes.

Capital investment is particularly difficult to optimize. Considering the social dimension of water as a basic human right, systems should be sized to meet peak demand, which by definition occurs at times of maximum scarcity and need. This is often at odds with what makes sense from an economic feasibility standpoint.

In many industries this problem is solved by peak season pricing, so that investment in capacity that is only needed at peak times can still be profitable. But the idea of higher prices for poor communities in times of water scarcity is, understandably, anathema to many in the sector.

**Low Kiosk Pricing**

Expectations surrounding pricing may be the most significant obstacle to overcome if decentralized water provision is to grow in the Kenyan market.

*Kiosk Pricing: the KES 2 per 20L Jerry Can “Cap”*

As previously mentioned, the regulated WSP sector includes a KES 2 /20L cap on pricing for kiosk water (IMPACT #4, section 2.11). In our conversations with WASREB representatives, it was made clear that
the KES 2 cap does not apply to decentralized projects, and that the regulator will allow (and in fact has already allowed) higher prices when supported by reasonable cost recovery principles. Nevertheless, we found widespread confusion over this point. In multiple conversations with residents and even other sector professionals, we heard people refer to prices in excess of KES 2 - 3 for a Jerry can as “illegal.”

The report pictured at right provides a good illustration of the general view on pricing. Published by the Water and Sanitation Program of the World Bank, a broadly recognized expert and a leading force for sector reform in Kenya, it includes a discussion of the pricing environment in Kisumu that prompted a new (and promising) delegated management model.

“…. The price of water for consumers purchasing from kiosks was high by any standards, soaring up to 5 KES or even 10 KES for a 20-liter Jerry can during water shortages.”

The specific example may be justified, as it cites vendors obtaining municipal supply at little or no cost and reselling at a significant markup, but the language and general sentiment reflect a pervasive viewpoint.

Meanwhile, our analysis of systems both within Kenya and elsewhere has shown that this price (KES 2) cannot form the basis for a sustainable business of selling safe, treated water without significant subsidies. Indeed, the same WSP report indicates the expected economics for a master operator in Kisumu managing 8 kiosks plus 60 household connections (where said operator would need to maintain the system, as well as handle billing and revenue collection). The example shows a gross margin potential of KES 7,700, or about $85 per month. From this, kiosk vendors and other operating expenses would have to be paid before the operator saw a residual profit. Simply put, these economics will not attract serious private operators.

Cost Realities of Different Systems

There is little recognition of differences in costs of abstraction, conveyance, treatment and delivery that could require significantly higher prices. Following are examples of different cost structures for various systems. While actual system costs will vary greatly, the examples below provide some rough parameters to show the price that needs to be charged solely to repay capital, that is, before considering system operating costs. It shows that for a typical mid-point of about $30,000 for a project to serve 2,000 people well, the price needed solely to apply to capital recovery from commercial financing is about KES 3. Adding the cost of operation and a margin for the operator yields minimum pricing of at least KES 5, depending on operating cost structure.

Moreover, the 7.5L consumption figure used for the analysis, while low for piped systems, is higher than any paid consumption level that we saw at any of the decentralized projects we investigated in Kenya.
Meanwhile, operating costs for a kiosk-based system can range from about about KES 1.5 per 20L, up to about KES 10. The lowest cost options are generally network line extensions where the bulk water sold to the private operator is priced at favorable rates, usually about 50% of the selling price (or about KES 1 per 20L in the case of Kenya). Systems that require electricity and treatment (such as UV or Reverse Osmosis) can often have operating costs of KES 5 to KES 10, depending on factors such as volume, population density and seasonality.

This is particularly relevant for Kenya due to the widespread problem of high fluoride levels in groundwater. According to the Catholic Diocese of Nakuru (CDN), 53% of the counties in Kenya suffer from high fluoride in groundwater, leading to high incidence of fluorosis, exceeding 90% in many areas of the Central and Rift Valley districts. Reverse osmosis technology provides a physical barrier that effectively removes fluoride, but requires high investment and ongoing operating costs for electricity, repair and membrane replacement. A locally produced alternative is the use of bone char (cremated, pulverized animal bones) that reduces the level of fluoride through a process of ion adsorption. The only scale supplier in Kenya is the CDN, which has invested heavily in the bone char production process as well as education efforts surrounding fluorosis.

Though bone char has been used at community projects throughout Kenya, to our knowledge the WSUP-Karagita project represents the first attempt to use the process as a long-term commercial solution at scale. The experience base of WSUP-Karagita is still too short to determine whether this approach can provide cost-effective fluoride reduction over the long term. The highest volume kiosk from the project has required replacement of the bone char earlier than expected, while the other kiosks have not attained volumes where replacement is necessary. Over time, based on the experience of all kiosks with multiple cycles, and hoped-for efficiency gains from the Catholic Diocese of Nakuru, it will be possible to determine whether this approach is sustainable. Our observations of the initial experience of the WSUP Karagita project with this method, though far from conclusive, indicate that the process may not be more cost-effective than reverse osmosis.

Our pricing analysis is supported by our examination of different systems in Kenya and elsewhere. As an exercise, we took the most successful commercial example from our research, the Onesmerc system in Mbooni West (Machakos), to see whether it might in theory have qualified for financing under the Maji
ni Maisha program (see Financing Options). The analysis shows that Onesmerc generates operating income just slightly below the required levels under the Maji ni Maisha credit model, including the benefit of output-based aid financing:

<table>
<thead>
<tr>
<th>Onesmerc Mbooni as a Maji ni Maisha Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Cost</td>
</tr>
<tr>
<td>Est Operating Income (pre-interest)</td>
</tr>
<tr>
<td>Construction Phase</td>
</tr>
<tr>
<td>OBA</td>
</tr>
<tr>
<td>Equity</td>
</tr>
<tr>
<td>Debt</td>
</tr>
<tr>
<td>Debt Service</td>
</tr>
<tr>
<td>Construction Phase Interest</td>
</tr>
<tr>
<td>Annual Debt Service (Operating Phase)</td>
</tr>
<tr>
<td>Required Income (125% coverage)</td>
</tr>
<tr>
<td>Annual Repayment Without Subsidy (6 Year Mortgage Style)</td>
</tr>
<tr>
<td>24% interest</td>
</tr>
<tr>
<td>16% interest</td>
</tr>
<tr>
<td>12% interest</td>
</tr>
</tbody>
</table>

Source: Onesmerc, Safe Water Network Analysis

This exercise illustrates the pricing and volume levels that might be required for a new, private project to qualify for Maji ni Maisha financing. Onesmerc charges KES 5 at its main site, with higher pricing of KES 10 and KES 15 for kiosks that must be reached by delivery truck (based on distance). Sales to schools and for home delivery are made at prices ranging from KES 12 to KES 20.

The Onesmerc system benefits from low-cost abstraction (spring source) and conveyance (gravity-fed pipeline). A similar system based on boreholes, pumping and treatment would need higher pricing to survive.

Erratic Supply of Source Water

Even where there appear to be supportive economics, an overriding risk to the operator is the certainty of the bulk supply. The example of the Shining Hope for Communities project in Kibera, where Safe Water Network provided technical assistance, illustrates the risk. In order to counteract potential supply issues, system design included a large storage tank (sufficient to supply several days of demand), and also included separate line connections to three different zones of the Nairobi Water Company supply.
Despite the additional investment to secure constant supply, the system was overwhelmed by city-wide water shortages in February 2012, its second month of operation. As a result, the system was left without water to sell on 15 days, and with less than 100% availability on an additional 10 days.

![Shining Hope - Water Station Volume](image)

*Source: Shining Hope for Communities, Safe Water Network analysis.*

A local operator attaching a so-called “spaghetti” line to a single polytank may still earn a living under these conditions, as long as investment is kept to a minimum and the source water is cheap (or free.) But to attract entrepreneurs and private operators where the goal is to assure a reliable supply to the community, these operators must be assured of sufficient water supply.

If the private operator must invest capital to provide secure back-up supply, projects would require substantial subsidies or increased overall pricing, or a “peak” pricing model.

**Respect for Contracts and Agreements**

Any private investment in infrastructure requires long-term respect for agreements and contracts. Though true of all investments, this is particularly an issue for infrastructure projects, which involve a large upfront capital commitment, followed by long payback, characterized by relatively low unit operating costs. This raises the temptation for communities to renege on commitments after the investment has been made. Assets and installations cannot be effectively repossessed or economically redeployed even if the investor were willing to do so, and generally investors and banks are not eager to repossess community water systems.

An example of this risk is highlighted in the experience of Grundfos LIFELINK. At two LIFELINK sites in 2011, local church officials claimed that the Grundfos-funded systems belonged to the community, refused to pay for water and circumvented the LIFELINK dispensing and payment system, which allowed residents to take water without paying. The fact that these “expropriations” were initiated by representatives of the church gave the actions moral backing in the eyes of many residents. Grundfos was able to resolve the situation through negotiation with the community. A private operator trying to sustain economic viability would be hard-pressed to survive a protracted fight of this sort.
**Asset Security**

A private operator has to ensure not only the integrity of his directly controlled assets, but is also exposed to failures of infrastructure outside his control. As an example, at the WSUP Karagita project, vandals destroyed the nearest electric transformer several times, stripping the transformer of all valuable components including copper and oil. Although the WSUP Karagita water system was designed with strong physical security measures to protect the boreholes and treatment systems, as well as water source redundancy (2 borehole sources), both sources relied on the same electric supply. Even if the operator had the funds to restore power, he did not have the authority to do so. As a result, he had to spend valuable time pursuing the power authority to restore the transformer, something that was quite understandably not their highest priority given the potential for a similar attack of vandalism. During this time, the system remained idle.

Private operators have proven to be better managers of assets when it comes to comparable arenas such as preventing water theft and managing non-revenue water, private operators working under delegated management schemes have proven better able to minimize these losses. For example, according to KIWASCO, non-revenue water in the Nyalenda delegated management project is averaging just 7%. This compares with 50% non-revenue water for KIWASCO overall. The operator at the WSUP-Karagita system also has minimal water losses, compared to 44% for NAIVAWASS. Applying the same level of motivated oversight to power supply could produce similar benefits, and the Karagita operator is in fact negotiating a similar delegated management agreement with Kenya Power Co.

Alternative approaches for a private operator would be to attempt a self-contained power solution, or to implement additional 24 hour security measures. In each case this would add cost to systems that are already economically challenged.

Discussion with participants in some of the delegated management models within urban settlements indicate that cartels and water “mafias” are often present, and represent a significant obstacle for a private operator. These local cartels are also a serious impediment to scalability, because each community (and often neighborhood within a community) must be approached on a unique basis, taking into account local players and power structures. This limits the ability of a large operator to deploy a standardized solution that can reap the benefits of economies of scale.
To estimate the size of the market, we extracted data from multiple sources, including the census bureau and Majidata, a comprehensive database covering all of the high-density, low-income areas of Kenya. Following is a summary of the figures compiled on a county by county basis. Revenue:

<table>
<thead>
<tr>
<th>County</th>
<th>High Density Population</th>
<th>% With Access to Safe Water</th>
<th>% Without Access to Safe Water</th>
<th>Population Without Access</th>
<th>Revenue Potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nairobi</td>
<td>2,925,942</td>
<td>50%</td>
<td>50%</td>
<td>1,455,071</td>
<td>366,677,881</td>
</tr>
<tr>
<td>Mombasa</td>
<td>1,321,833</td>
<td>35%</td>
<td>65%</td>
<td>863,805</td>
<td>217,678,808</td>
</tr>
<tr>
<td>Kilifi</td>
<td>294,348</td>
<td>27%</td>
<td>73%</td>
<td>214,433</td>
<td>54,036,995</td>
</tr>
<tr>
<td>Nakuru</td>
<td>427,070</td>
<td>59%</td>
<td>41%</td>
<td>169,938</td>
<td>42,824,252</td>
</tr>
<tr>
<td>Kisumu</td>
<td>192,823</td>
<td>19%</td>
<td>81%</td>
<td>155,357</td>
<td>39,150,088</td>
</tr>
<tr>
<td>Turkana</td>
<td>175,212</td>
<td>43%</td>
<td>57%</td>
<td>100,064</td>
<td>25,216,020</td>
</tr>
<tr>
<td>Usain Gishu</td>
<td>187,099</td>
<td>50%</td>
<td>50%</td>
<td>93,662</td>
<td>23,602,763</td>
</tr>
<tr>
<td>Machakos</td>
<td>156,213</td>
<td>43%</td>
<td>57%</td>
<td>89,198</td>
<td>22,477,801</td>
</tr>
<tr>
<td>Kajiado</td>
<td>131,624</td>
<td>35%</td>
<td>65%</td>
<td>86,082</td>
<td>21,692,684</td>
</tr>
<tr>
<td>Kwale</td>
<td>87,950</td>
<td>8%</td>
<td>92%</td>
<td>80,984</td>
<td>20,408,059</td>
</tr>
<tr>
<td>Kakamega</td>
<td>85,702</td>
<td>18%</td>
<td>82%</td>
<td>67,625</td>
<td>17,041,611</td>
</tr>
<tr>
<td>Bungoma</td>
<td>84,467</td>
<td>24%</td>
<td>76%</td>
<td>63,806</td>
<td>16,079,206</td>
</tr>
<tr>
<td>Trans-Nzoia</td>
<td>71,663</td>
<td>14%</td>
<td>86%</td>
<td>61,666</td>
<td>15,539,835</td>
</tr>
<tr>
<td>Busia</td>
<td>70,749</td>
<td>13%</td>
<td>87%</td>
<td>61,601</td>
<td>15,523,491</td>
</tr>
<tr>
<td>Wajir</td>
<td>52,395</td>
<td>0%</td>
<td>100%</td>
<td>52,395</td>
<td>13,203,540</td>
</tr>
<tr>
<td>Siaya</td>
<td>56,848</td>
<td>4%</td>
<td>96%</td>
<td>48,656</td>
<td>12,261,363</td>
</tr>
<tr>
<td>Nanyarua</td>
<td>38,974</td>
<td>34%</td>
<td>66%</td>
<td>25,546</td>
<td>6,491,585</td>
</tr>
<tr>
<td>Meru</td>
<td>110,548</td>
<td>78%</td>
<td>22%</td>
<td>24,199</td>
<td>6,098,137</td>
</tr>
<tr>
<td>Laisipia</td>
<td>80,086</td>
<td>70%</td>
<td>30%</td>
<td>23,704</td>
<td>5,995,975</td>
</tr>
<tr>
<td>Nyeri</td>
<td>70,288</td>
<td>68%</td>
<td>32%</td>
<td>22,738</td>
<td>5,730,018</td>
</tr>
<tr>
<td>Nandi</td>
<td>24,471</td>
<td>16%</td>
<td>84%</td>
<td>20,673</td>
<td>5,209,621</td>
</tr>
<tr>
<td>Migori</td>
<td>23,851</td>
<td>14%</td>
<td>86%</td>
<td>20,397</td>
<td>5,140,139</td>
</tr>
<tr>
<td>Kericho</td>
<td>32,843</td>
<td>42%</td>
<td>58%</td>
<td>19,036</td>
<td>4,797,022</td>
</tr>
<tr>
<td>Kimbri</td>
<td>44,139</td>
<td>58%</td>
<td>42%</td>
<td>18,666</td>
<td>4,703,929</td>
</tr>
<tr>
<td>West Pokot</td>
<td>22,586</td>
<td>22%</td>
<td>78%</td>
<td>17,554</td>
<td>4,423,567</td>
</tr>
<tr>
<td>Makueni</td>
<td>35,737</td>
<td>57%</td>
<td>43%</td>
<td>15,374</td>
<td>3,874,262</td>
</tr>
<tr>
<td>Narok</td>
<td>16,559</td>
<td>15%</td>
<td>85%</td>
<td>14,110</td>
<td>3,555,701</td>
</tr>
<tr>
<td>Bomet</td>
<td>15,871</td>
<td>20%</td>
<td>80%</td>
<td>12,683</td>
<td>3,195,994</td>
</tr>
<tr>
<td>Emur</td>
<td>48,028</td>
<td>75%</td>
<td>25%</td>
<td>12,108</td>
<td>3,071,756</td>
</tr>
<tr>
<td>Muranga</td>
<td>32,761</td>
<td>65%</td>
<td>35%</td>
<td>11,443</td>
<td>2,883,741</td>
</tr>
<tr>
<td>Wihiga</td>
<td>14,005</td>
<td>19%</td>
<td>81%</td>
<td>11,351</td>
<td>2,860,465</td>
</tr>
<tr>
<td>Isiolo</td>
<td>32,360</td>
<td>67%</td>
<td>33%</td>
<td>10,763</td>
<td>2,712,260</td>
</tr>
<tr>
<td>Garisa</td>
<td>61,911</td>
<td>84%</td>
<td>16%</td>
<td>10,042</td>
<td>2,530,575</td>
</tr>
<tr>
<td>Kirinyaga</td>
<td>17,148</td>
<td>53%</td>
<td>47%</td>
<td>8,097</td>
<td>2,040,516</td>
</tr>
<tr>
<td>Nyamira</td>
<td>8,012</td>
<td>23%</td>
<td>77%</td>
<td>6,188</td>
<td>1,559,494</td>
</tr>
<tr>
<td>Lamu</td>
<td>14,460</td>
<td>67%</td>
<td>33%</td>
<td>4,844</td>
<td>1,220,713</td>
</tr>
<tr>
<td>Elgeyo Marakwet</td>
<td>12,200</td>
<td>69%</td>
<td>31%</td>
<td>3,789</td>
<td>954,909</td>
</tr>
<tr>
<td>Samburu</td>
<td>8,024</td>
<td>57%</td>
<td>43%</td>
<td>3,482</td>
<td>877,367</td>
</tr>
<tr>
<td>Tharaka</td>
<td>3,772</td>
<td>0%</td>
<td>100%</td>
<td>3,772</td>
<td>423,762</td>
</tr>
<tr>
<td>Total</td>
<td>7,471,483</td>
<td>43%</td>
<td>57%</td>
<td>4,237,762</td>
<td>1,067,915,952</td>
</tr>
</tbody>
</table>

5. Commercial Approaches: Urban Market

The urban market appears to represent the greatest near-term opportunity for commercial water provision, with a number of positive characteristics:

- Higher population densities leverage the fixed investment in infrastructure (such as kiosks)
- Populations are growing faster than rural areas (from 4% to 7% annually)
- Populations more likely to be paying for water already (often at higher prices)
- In some cases, bulk supply can be made available at an attractive rate
- More likely to have electric connection
We further analyzed data matching systems to the Water Service Providers responsible for each county, looking at the ability of each Water Service Provider to serve its existing population. For example, if the incumbent WSP serves its population only a few hours per day, this indicates that significant “upstream” investment is needed to secure and expand the source water, which likely limits the opportunity for commercial provision in network expansion.

The following charts illustrate the challenge. The first chart shows the percentage of population served by each Water Service Provider (that is, the percentage of the population in a WSP coverage area that are actually served by the WSP.) Gaps could indicate areas of opportunity for a commercial provider to install and manage network extensions. The second chart, however, illustrates a major issue preventing such an approach – only 6 WSPs report providing 24 hour coverage to their existing served populations.

Furthermore, these self-reported statistics are likely to overstate water coverage and supply particularly during the most water-stressed periods of the year. To extend these networks with additional investment in distribution lines, kiosks, and connections would not make sense unless a simultaneous investment were made by the Water Service Board to guarantee sufficient water supply.
An alternative solution would be for the independent operator to invest in the abstraction, conveyance and treatment, but in general this would require some level of cross-subsidy from the main network operator if tariffs were to be maintained at the same levels as in-network tariffs.

As might be expected, there is a rough correlation between the two measures, meaning WSPs that cover smaller percentages of their assigned populations also struggle to provide consistent, round-the-clock supply. But there are a number of outliers, WSPs that are providing more than 20 hours per day of service, but with large sections of population not currently served.

![WSP Population Coverage vs Hours of Service](image)

A WSP that provides full coverage to a small portion of its assigned territory would appear to be a candidate to attract private investment and operators to expand network coverage, provided that the reason for poor coverage is not rooted in challenges of distance, geography and population density. A careful review of WSPs that fit this profile could show opportunities where coverage can be improved through private investment in network expansion rather than the comparatively higher capital investment areas of dams, reservoirs and trunk pipelines.

Alternatively, the areas providing the poorest coverage in both metrics may represent the opportunities more supportive of higher pricing. This is the case at Onesmerc, where the Machakos WSP provides average supply of 2h per day, to only 7% of its assigned population, mainly the city of Machakos itself. Against this backdrop, the privately operated Onesmerc project is able to charge prices sufficient to support O&M costs as well as capital recovery.

The actual opportunity will require deeper analyses of each location, prioritizing those with:

- Adequate system water availability for expansion
- Favorable geography for further network development
- Supportive population density and demographics
- Credible Water Service Provider and Water Service Board with which to partner.
Revenue and Profit Opportunity

Assuming a system consisting primarily of kiosks at a retail price of KES 2 to KES 3 per 20L jerry can, and a per capita daily safe water consumption of 7.5L, which is the minimum recommendation for drinking and cooking, the near-term revenue opportunity to serve this market can be estimated between 1.1 billion and 1.6 billion Kenyan shillings (approximately $12 million to $18 million). In the medium term, as systems mature and approach the WHO-recommended minimum per capita consumption for personal use including washing and other non-consumption activity of 20L per capita, the revenue opportunity would be KES 3.1 to 4.6 billion, or about $34 million to $51 million. Long-term investment in piped systems, expanded distribution and household access would generate significantly higher potential revenue, though probably not proportionally with volume increases, as tariffs should decrease to meet the norms of more efficient distributed systems.

The above are “idealized” figures, to illustrate potential market size, but the opportunity will be very slow to penetrate given its highly fragmented nature, as well as the previously-cited struggles to get paid consumption to the 7.5L benchmark.

The profit opportunity for a private operator would depend greatly on the specifics of the system, particularly the cost of abstraction and treatment. The lowest-cost source of supply for a private operator will be a form of line extension, with treatment limited to residual chlorine protection.

Generally a utility may sell bulk water at a subsidized rate, as part of its efforts to increase access to low-income populations. The rate is usually about 50% of the selling price, though we have seen cases of low, flat rates primarily given to school operators, as in the case of the Shining Hope for Communities project in Kibera, where the Nairobi Water Company agreed to a flat rate of $50 per month. Though results will depend on scale and penetration, we estimate that the overall annual profit opportunity could approach 15%-25% of revenue.

As previously discussed, however, a successful program to develop delegated management models must be coupled with sufficient investment in source water supply.

In the event that this is not feasible on a large, utility-wide scale, a private operator could potentially invest in borehole supply to serve as stand-by capacity in times of scarcity. This would require either a “peak” pricing model, or else some type of balancing payment from the main utility whenever it failed to deliver water as promised. A peak pricing scheme would be vulnerable to accusations of price gouging, but if it were supported by regulators, transparently tied to the cost of running pumps, and lower than alternatives during times of scarcity, it might be accepted.

1 Domestic Water Quantity, Service Level and Health, World Health Organization, Howard and Bartram, 2003
6. Commercial Approaches: Rural Market

The rural market poses significant challenges to commercial development, including:

- Dispersed and smaller populations
- Lower income levels
- Seasonality of income and demand
- Lack of payment history
- Tradition and continued presence of donor projects
- Significant cost to source and treat water (compared to urban network extensions)

Quantifying the market opportunity for decentralized rural provision is very difficult. Although data exist regarding the unserved rural population, this only identifies the need. To size a market, one needs to find examples of successful models to assess the potential of these models to scale up. During our field work, we saw a small number of projects that aimed to cover operating costs, without considering capital repayment. This proved to be a challenging enough hurdle. We found only one example of significant private capital investment in a system designed to serve a broad population, where the system developer aimed to recover and reinvest capital (see Onesmerc Mbooni case study, Appendix B).

Speaking broadly, the avenues to pursue within the rural market are the following:

1. Promote the development of decentralized operators of kiosks and “Water ATMs”
2. Focus on bringing private investment to rehabilitate the asset base and management of the thousands of existing community systems.

It should be noted that the definition of a community system includes some serving as few as ten customers, which blurs the distinction between the system types.

Decentralized Kiosk Operators

Decentralized kiosk operators are widespread in East Asia, primarily in dense urban areas, as well as in more rural locations mainly in India. They employ a variety of business models (community-owned, entrepreneurial and franchise). They generally involve connecting to a new or existing groundwater supply and dispensing water in 20L jerry cans. For high quality water sources little to no treatment is needed, though these systems are often located in areas with significant groundwater challenges, and therefore employ reverse osmosis purification. Typical plant sizes run from 500 liters per hour to 2,000 liters per hour, with actual output limited in most cases by intermittent electric supply. Depending on size and technology, such installations cost between $10,000 and $30,000, where they connect to the electricity grid, with higher amounts for solar power.

A subset of the kiosk operation is the “Water ATM,” which is usually a smaller, often skid-mounted device where operations and payment are automated to reduce operating expense, as well as to allow a single entrepreneur to manage multiple points of sale. The project concept has some similarities to the Grundfos LIFELINK system (see Appendix 3), though the Grundfos approach can accommodate much larger volumes (since it does not provide treatment, output is only limited by the flow capacity of the well, and with solar power there is little incremental cost to increasing throughput.) At present, capex for the LIFELINK system is significantly higher than Indian Water ATMs.
Comparative Analysis – India vs Kenya

Following are key differences in project economics between potential Kenya decentralized projects serving rural communities, and the more established Indian business model:

Capital Cost

Components for a system in India are sourced from local, low-cost manufacturers, with delivery times measured in weeks and full warranty coverage available for 1 year or longer. For a standardized scale program in Kenya, components could be delivered at prices 10% - 15% higher. For initial projects, the difference would likely be far greater, ranging from 25% - 50%.

Operating Cost

A typical annual operating cost structure for a 1,000 Liters-Per-Hour (LPH) Indian Reverse Osmosis kiosk system is shown below. While labor rates in rural Kenya and India are comparable, most consumables and spares will be imported at higher cost in Kenya. We estimate a 25% cost increase for imported components, though we note that local supplier Davis & Shirtliff provides not only more expensive imported systems such as GE, but also has introduced lower-cost alternatives under the Dayliff label, which may narrow this gap. This generates an overall cost structure increase of about 13%.

<table>
<thead>
<tr>
<th>Category</th>
<th>Amount</th>
<th>%</th>
<th>Kenya vs India</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator</td>
<td>$840</td>
<td>28%</td>
<td>Comparable</td>
</tr>
<tr>
<td>Electricity</td>
<td>250</td>
<td>8%</td>
<td>Comparable</td>
</tr>
<tr>
<td>Cartridges/Chemicals</td>
<td>420</td>
<td>14%</td>
<td>Kenya 25% higher</td>
</tr>
<tr>
<td>Membrane Replacement</td>
<td>500</td>
<td>17%</td>
<td>Kenya 25% higher</td>
</tr>
<tr>
<td>Maintenance Contract (Labor)</td>
<td>240</td>
<td>8%</td>
<td>Comparable</td>
</tr>
<tr>
<td>Spares and Replacement Parts</td>
<td>600</td>
<td>20%</td>
<td>Kenya 25% higher</td>
</tr>
<tr>
<td>Miscellaneous/Unforeseen</td>
<td>120</td>
<td>4%</td>
<td>Comparable</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$2,970</td>
<td>100%</td>
<td></td>
</tr>
</tbody>
</table>

In addition, most systems need field coordinators, accountants, and technical support, as well as education and demand building to reach sustainable sales levels. These costs can amount to about $1,500 per site per year initially, though cuts are possible as systems reach self-sufficiency. Considering the shortage of rural technicians trained to maintain these systems, the support structure for Kenya, at least initially, would likely be more costly.

Though most of the companies in India are private and do not publish financial results, discussions with executives, shareholders, donors and other sector participants indicate that the major players struggle to achieve consistent profitability. The price per jerry can charged by the key players in the sector therefore represents a good indication of minimum levels required for sustainability.
(a) The Safe Water Stations and iJal brand are managed by Safe Water Network in India.

Based on these figures, a system in Kenya with a mechanized borewell and Reverse Osmosis treatment would need pricing of KES 10 - KES 12 per jerry can for sustainable operation, if the goal included capital repayment, and KES 5 - KES 6 per jerry can if the capital were provided on a grant basis, to maintain operating sustainability, including timely replacement of membranes and other components.

Existing Community Systems

Apart from the larger Urban and Rural Water Service Providers that have signed Service Provision Agreements with the Water Service Boards and are tracked by WASREB, there are a large number of community systems. According to the published report of Rural Focus, these systems range in size from 30,000 customers down to as few as 10 customers, which greatly blurs the line between a small piped system and a decentralized kiosk-based provider.

In accordance with WASREB’s plan for the sector, these systems are expected to sign License Agreements with the appropriate WSB, or a sub-agreement with the main area WSP. This process is intended to move the community systems along a similar trajectory toward professional management and cost recovery. In practice, less than 5% have signed such agreements, and the majority of these systems are volunteer-managed, community-based entities that lack the management expertise or capital structure to modernize without support.

According to the IFC/Rural Focus report, this segment of the water market may serve many more Kenyans than generally acknowledged. According to the figures supplied by the Water Service Boards, 3.7 million people were covered by these systems, but attempts by Rural Focus to confirm the figures, focusing on smaller subsets, indicate much larger numbers.

The sheer number of these systems, coupled with the lack of information and the difficulties of approaching each community individually, suggest that reform will not occur naturally via the larger WSPs, nor can it be left to interested private operators and engineering firms. A coordinated and clearly defined approach is needed, with easily understood incentives and outcomes, supported with training, education and finance. Potential approaches are discussed more fully in the Financing Options section.

The positive aspects of the approach, versus the decentralized kiosk model, are that the economics are generally more favorable, particularly where existing infrastructure can be utilized, with investment focused on higher-return opportunities to increase volumes and coverage.

The biggest drawback surrounds the tariff implications of moving from a subsistence level model to a commercial model. This will in many cases require price increases, and can ignite political issues within communities. These problems are exacerbated by “rent-seeking” behavior commonly found among those involved with the existing systems. Each case will require significant effort on the part of the potential operator, and the potential rewards are often not sufficient to justify the struggle.

To counteract this problem, the community needs to be provided with a complete solution, rather than just a tariff hike. The solution should include financing, investment, improved service, simplified billing and better water. It would also be helpful to have a strong training program for operators and technicians, as well as for business management, so that the improved systems could eventually be managed locally.
In approaching this sector reform, it is especially important to employ very conservative assumptions. The backlash against a private operator who invests in a system, creating indebtedness that cannot be repaid, would be severe and could have a knock-on effect. It is important to focus on high-probability projects, and publicize the success stories.

7. Financing Options

Current Situation Overview

Currently, the majority of the financial capital for investment in water infrastructure comes from the Kenyan government and its Development Partners, channeled via the Ministry of Water and Irrigation to the Water Service Boards or the NWPC. Of the total budget of approximately KES 32 billion in 2010 (about $355 million), KES 12 billion (37.5%) came from the general budget, with KES 20 billion (62.5%) from outside donors and multilateral agencies, primarily in the form of grants and loans to the government.

Major infrastructure investment and asset ownership falls under the Water Service Boards. Meanwhile, most sector revenue is generated by the Water Service Providers, which in turn make leasing payments to the Water Service Boards. Though these payments are intended to compensate the WSBs for use of the infrastructure, in practice they are only sufficient to pay WSB administrative and operating costs.

WASREB has clearly stated that “partnership with the private sector (is) critical in plugging the finance gap for infrastructure development,“2, and with other sector participants is seeking to accelerate the upgrade and expansion of water delivery infrastructure using commercial finance. Two separate undertakings are currently underway to move this endeavor forward:

- An effort to support stronger Water Service Providers in a process to obtain commercial credit
- A program aimed at Community Systems, which incorporates an element of subsidy, via an Output-Based Aid arrangement

Commercial Credit for Water Service Providers

Since it is the WSPs that earn the bulk of the commercial revenue, and since they are structured in corporate form, they should be able to secure commercial finance. The size and characteristics of typical WSP projects are also better suited for funding from commercial sources. While Water Service Boards will continue to be responsible for major infrastructure investment, the Water Service Providers can focus on investments that are typically higher return and more directly connected with providing water to customers. These include network densification, expansion, metering and other improvements to reduce non-revenue water.

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A major step forward in this effort was undertaken with the assistance of WASREB and the Water and Sanitation Program of the World Bank (WB-WSP), which was to put the urban WSPs through a credit review and analysis process, culminating with the publication of “shadow” credit ratings for the 43 Urban Water Service Providers. These ratings, published in late 2011, provided for the first time a clear financial profile of the WSPs, complementing the operating profile provided in the annual Impact Reports.

On a positive note, the figures show that there are a number of WSPs that could be candidates for commercial finance. In terms of impact, however, progress is likely to be slow due to the number of creditworthy entities, the lack of history in accessing commercial finance, and the total borrowing capacity given the level of cash flow.

For example, the thirteen WSPs deemed creditworthy in the report (local ratings of A or BBB) had a combined revenue of $75 million and combined EBITDA of about $8 million in 2010. Although many of the entities are debt-free, the total credit capacity is still small relative to investment needs. Debt levels of 2x - 3x EBITDA would probably be considered aggressive at the outset, especially at market-based interest rates. This implies aggregate credit capacity of about $16 million - $24 million. Nevertheless, if we assume an average investment per additional connection of $20 - $60 per capita, deploying this financing efficiently could in theory expand coverage to an additional 400,000 to 1.2 million people.

Debt capacity will expand with improved results, sector growth, and as lenders become comfortable with the sector. But for the medium term, central government sources will need to provide the majority of sector funding, disbursed through the WSBs (and in future, county governments).

**Maji ni Maisha**

The landmark Maji ni Maisha program undertaken by K-Rep Bank, with the support of the WB-WSP stands as a major accomplishment for sector finance, although at about $3 million it is modest in terms of total funding. Designed as a means to use output-based aid to partially subsidize expansion projects for community water systems, it is an important attempt to bring commercial finance to the sector. The experience has been generally positive, but has also highlighted the significant challenges to working directly with community water systems.

In summary, the terms of the program called for 20% equity funding from the community, 80% debt finance from K-Rep Bank, with half of the loan (40% of total project cost) forgiven when the project achieves agreed metrics, which were typically based on incremental water volume and new connections.

**First Phase (Pilot):**

The $1 million, 10 project pilot phase of the Maji ni Maisha program was designed to assist communities to obtain project finance, with a direct lending relationship between the community and the bank. According to K-rep bank, the program has been successful in terms of loan repayment, with no payment defaults to date. Nevertheless, it exposed challenges that have constrained efforts to roll it out broadly and quickly.

The principal limitations encountered were:
• **Administrative Burden:** Community systems were to take responsibility for all aspects of the preparation, management and operation of the project, as well as loan repayment. This required a tremendous expenditure on the part of the lender to bring the projects to the point where they could be funded. This challenge is a natural consequence of the level of financial and operational sophistication of a typical community system, coupled with the need for some level of legal restructuring in order to create a legally responsible entity acceptable to lenders.

• **Credit Quality:** The second challenge was related to the fundamental creditworthiness of a community-owned project. Although the terms of the program required the communities to incorporate a “sue-able” entity to undertake the obligation, a lender has little hope of recovery in the event of a project failure, or even of a refusal to pay. Despite a positive repayment experience to date, this concern remains as an obstacle to a broad roll-out of the program, and to the willingness of additional banks to participate in similar projects.

**Second Phase:**

Though the community-centric approach continued, the program sponsors also experimented with some modifications following the initial 10 project pilot phase. Primarily, they encouraged communities with projects to channel the funding requests through existing larger WSPs. The community would still identify the need and the fundamental parameters of the project, but the preparation and negotiation would be undertaken by the larger WSP under whose jurisdiction the community falls. Thus, although the loan proceeds are used to expand the community system, the loan itself is a general obligation of the WSP, with the Output-Based Aid subsidy providing a reduced finance cost and better project economics.

This puts the lender in a more comfortable position, because it can look to the overall financial strength of the WSP, and rely on the fact that the amount of debt (typically $30,000 - $50,000 after the subsidy) is small in relation to the WSP’s balance sheet.

Though these changes improve the program from the lender’s standpoint, they also essentially incorporate *Maji ni Maisha* as part of the top-down push to expand access through a process of fortification and expansion of the incumbent WSPs. The WSPs have stronger financial and operating resources, but also may have other core investment priorities in their own systems and could easily be a bottleneck in the process of preparing and overseeing new community projects. It is not realistic for the responsibility for project preparation to fall on the lender, and therefore the building of this capability among community systems should be a priority for the sector.

Other limitations of this program are:

• **Focus on Expansion / Existing Systems** – Expansions represent a better credit risk because they can use both existing and incremental cash flow to repay the loan. Likewise, all system assets can guarantee loan repayment. With most community systems consisting of assets that are fully depreciated and unencumbered, the hurdle to pay for an expansion is more reasonable. The program is unlikely to benefit communities without existing functional water systems.

• **Focus on Access (vs Safety or Quality)** – In theory, projects that include improved treatment are acceptable candidates for the program. In practice, most projects are designed to increase
access, as measured by liters delivered and households connected. These are the primary metrics to qualify for the output-based subsidy, and are also most likely to produce the greatest cash flow increase without increasing tariffs. Thus, a project that would upgrade water supply via treatment, or improve the security of supply by adding a redundant source or other comparable improvements, might find it harder to qualify for Output Based Aid.

- **Capital Inefficiency** – The principle of Output-Based Aid requires that the project achieve certain milestones before receiving the subsidy, rather than enjoying the benefit from the outset. This is a cornerstone of the results-based philosophy, but it comes with a financial cost, both for the community as well as for the local lender, which has its capital tied up during this time.

- **Lack of Liquid Assets** – Many communities lack the ability to finance a 20% equity contribution. This problem is often exacerbated due to the requirement that communities secure their water source, typically with more than one borehole, before receiving the loan.

**Bank Finance Availability**

Conversations with banks indicate interest in principle to provide finance to the sector, assuming projects can meet bank lending criteria, but there is a high level of skepticism that project cash flows can be strong enough to support loan repayment.

Additionally, the local banking sector lacks the financial profile to support a typical water project, due to:

- **Tenor and Rate**: Local lenders lack the credit lines of sufficient duration and low enough interest rates to support a long-lived investment in water

- **Lending to Communities**: Lenders are wary of becoming creditors of community-owned and managed systems, even if the projects have been organized into “sue-able” entities

The commercial banking sector could potentially be most helpful with credit lines to support individual household connections, in structured programs arranged through well-managed community water systems. In instances where WSPs have strong billing and revenue collection measures in place, the water provider can act as repayment conduit by directly via the payment for water. Once main lines have been laid in a neighborhood, individual metered connections can usually be added at low cost, and with repayment profiles of 6 to 12 months, a master financing facility for these projects could be provided to the system operator, who would in turn administer repayment. This shifting of the administration burden from the banking institution to the private operator should make the loan facility more economic. The work of Water.org is a helpful prototype for these types of projects.

**Recommendations:**

The *Maji ni Maisha* program provides a template that should be expanded and improved. The subsidy should be used as a tool to change an operating paradigm, not just as a means to reduce financing cost.

The first phase of the program encouraged communities to retain a private operator, but this measure sometimes met resistance as it often appeared only to impart extra cost on already tight project economics. A modified program in which approved, better-capitalized operators joined as financing
partners, bringing a turnkey solution of capital, management and improved performance, could form the basis for a program to transform the sector.

A number of variations could be pursued, two of which are outlined below:

**Alternative 1: Operator/Investor in Control of Joint Venture**

In this example, the operator/investor contributes capital to the project to take a controlling stake in a venture with community participation. The project signs a management agreement with an affiliate of the operator/investor, with duration at least equal to the duration of the financing, including any extensions. The community could provide cash and in-kind contributions, including existing system assets. The lenders would have a stronger counterparty to deal with, and each loan would require less administrative burden. The operator could develop a cluster of these equity interests, building a diversified portfolio that could attract investment from socially-oriented funding parties.

Using the *Maji ni Maisha* template, the private operator could contribute all or a portion of the 20% equity requirement for the project. Additional features could be included, such as an option for the community to repurchase the operator’s stake.

**Alternative 2: Operator/Investor as Subordinated Lender**

In this example, the operator-investor essentially lends the equity funding requirement to the community, and signs a management agreement for the duration of the loan. The operator/investor exercises contractual management control and is a subordinated creditor, but does not have ownership control.

The first alternative likely would provide more security to the lender, as it would have a direct relationship with the controlling shareholder of the project. From the standpoint of the owner/operator...
it is a mixed bag, providing the benefit of ownership control but also increasing the level of involvement and possibly exposing it to financial contingencies as well as local political risk. The transfer of ownership could create political and emotional issues for a community.

The second alternative has its own set of advantages and disadvantages. From the standpoint of the lender, although there is a professional manager, ownership still resides with a community-owned organization, which is not ideal. The operator is less exposed to contingent liabilities, and his capital is now senior to the community’s capital, but it has now made a very risky loan. The community retains ownership if not operational control.

There are many variations that could be pursued, including where the operator injects the majority of its funding as debt, for enhanced security, but uses a small portion to hold ownership control.

Requirements for a BOT Model to Succeed

For a program promoting these BOT models to succeed, it would need strong leadership and support from government, regulators, professional advisors and development funding partners to create an enabling framework including:

**Assemble Accurate Database of Projects to Streamline Analytic Process**

Information about existing systems is incomplete, leaving a daunting front-end task for any private party interested in partnering with a community. The ongoing information-gathering process of Water Point Mapping for rural systems should be expanded, and also enhanced so that it is gathering the basic information that would allow the creation of a “data room” for potential operators to review projects. This would involve a rapid assessment of source water, community demographics, technical issues, local political structures and a snapshot of operating/financial performance.

**Provide Clear Toolkits and Selling Sheets for Communities**

Any program must be clearly articulated to communities, and provide a roadmap for them to professionalize their systems. It should include the alternative to retain management, but also provide clear and straightforward analysis to enable communities to understand the benefit of bringing in a professional operator, including a process for selection.

**Publicize Success Stories**

The existence of the current *Maji ni Maisha* program is reasonably well-known, but the results are not. Even among well-versed sector participants interviewed in our field work, we heard a wide array of opinions about the relative success of the program. Among communities, there is no sharing of program results. The primary objective of this effort would be to create a “pull” dynamic, so that communities are disposed to actively seek the participation of professional operators, and where existing managers are pressured by their constituents to improve supply and service.

**Develop a BOT Framework with Incentives that are Easily Understood**

The beauty of the current *Maji ni Maisha* model is that it is simple and straightforward (although this also means it lacks flexibility). With the input of potential investors and communities, a small
number of two to three specific models should be chosen and promoted. There are a wide array of potential approaches, but it would be better to focus on a few that provide clear benefits to different community profiles, and commit the resources to explain and implement them.

**Investigate Structural Modifications to Improve Capital Efficiency**

If private operators are involved as capital partners, it may be possible to modify the current “delayed subsidy” in favor of the operator posting some form of performance guarantee or bond, which would be lifted when the project hit its operating targets, thereby reducing upfront financing costs. This could form an additional economic incentive for a community to pass project control to a more creditworthy private operator.

**Provide a Process to Approve Qualified Operators**

The bank’s credit process should essentially accomplish this step of approving qualified operators, but it would be better to give the communities a list of qualified, approved operators, and provide a clear process for communities to judge the relative qualifications and capacities of different candidates.

**Consider Greater Subsidies for New Systems Versus Expansion Projects**

Part of the program’s attractiveness lies in the simplicity and uniformity of its terms. But a one-size-fits-all approach is inconsistent with the vastly different circumstances facing many community systems. We suggest waiting until the process of building a data room is complete, which would allow the assessment of the inventory of projects and prospects. Dividing these projects into different types, with different combinations of smart subsidies and incentives, may make sense if it turns out that only a small proportion are viable in the current approach.
8. **Enabling Environment**

The small commercial operator faces significant hurdles to create a viable business, and there are many challenges that lie beyond the scope and capability of an individual investor to address. Kenyan authorities have made substantial progress reforming the sector, but the environment is not yet supportive of commercial efforts. Some recommendations to create an improved environment, which could be implemented in support of a specific program:

**Explore ways to extend cross-subsidies beyond existing WSP networks**

A central plank in the platform to increase water coverage is the pro-poor kiosk pricing policy of existing WSPs, which is subsidized by the tariffs of their remaining user base. A decentralized operator does not enjoy a comparable subsidy, even where he is filling a gap due to a failure of the larger WSP. Such efforts to expand coverage should receive the same benefit that would accrue to an in-network expansion.

**Establish the case for safe water, with improved oversight**

Part of the reluctance among people to pay for safe water is a very reasonable concern of whether the consumer gets what he pays for. According to WSUP, consumers in the Karagita settlement were in many cases skeptical that the bone char process was effective, with some even sharing concern that it might be harmful to the “pure” water coming from underground.

Consumers are bombarded with messages from many different sources. Reputable operators can make some headway through transparent communication, including publishing reports of third party testing, but a government validation of what is safe versus unsafe, combined with improved education on the health and economic benefits of safe water, would be a significant boost. Until consumers value safe water, commercial providers will not be able to operate sustainably.

In India, strong demand often comes from villages where the government places red tape on the local wells, with the undeniable message that these sources are unsafe. A simple message like this can be more powerful than detailed quality analysis and education. Hygiene messages should be complemented with consumer-driven, “aspirational” messages that equate drinking safe water with a step forward in terms of economic and social standing.

**Continue to Formalize Sector with Better Incentives**

Provide clear incentives, first for systems to register and begin to report, and eventually to upgrade management and embrace commercial operating models. The current requirement for registration does not provide sufficient incentive to take this step.

**Streamline Permitting Process**

The process for obtaining extraction permits and other licenses is difficult for home-grown entrepreneurs. As a result, many operate in a completely unregulated manner. A simplified process would be helpful as a first step to bringing these operators into compliance. As with community systems, tying this formal step to economic benefit, including the possibility of finance or subsidies, would be a powerful incentive.
9. Next Steps

Our review of the market and the possibilities for commercial provision of water indicate that the greatest impact could be achieved by focusing in the following areas:

**Urban Water:**

- Complete a more detailed review of high-density urban areas to identify promising opportunities for network extensions and delegated management models
- Prioritize opportunities where current or expected source water supply is sufficient to support network expansion under Delegated Management Models
- Engage WSTF to include a DMM approach in its Urban Projects Concept
- Investigate possible mechanisms to provide synthetic cross-subsidies to developers that must invest in source water supply to extend a network

**Rural Water:**

- Bring key participants together to develop and implement a structured approach to securing private investment in the community water sector under BOT/delegated management models
- Support this effort with training, toolkits, technical assistance, and development of private operator capability.
- Provide incentives for community systems and independent entrepreneurs to bring their systems into regulatory compliance, in a simplified process
- Test results of automated dispensing and payment system tied to lower-cost projects
- Consider special regimes to address the cost of fluoride removal

**Financing:**

- Develop a next-generation Maji ni Maisha program that is geared to private operators taking equity or loan positions in community systems
- Work with commercial lenders to set up financing facilities dedicated to individual high-payback projects, administered under a master arrangement with the WSP

**Enabling Environment**

- Support the above reforms with simple and transparent messaging about water safety and economics, supporting private investment initiatives
Appendix: Case Studies

1. WSUP-Karagita (Naivasha)

Summary

The WSUP-Karagita project, sponsored by the organization Water and Sanitation for the Urban Poor (WSUP) began operations in late 2009. It comprises a network of kiosks selling untreated water, as well as water treated to remove high fluoride levels to the Karagita settlement outside Naivasha. Previously-existing, privately-owned boreholes were rehabilitated and used for the water supply. At launch, the system had 8 kiosks, expanding to 14 in mid-2011.

The system has gained wide acceptance in the community, though overall volumes have been lower than the project sponsors had projected. In addition, there has been a much lower than expected proportion of treated water in the mix of overall sales, with residents overwhelmingly opting to purchase cheaper, untreated water.

A central project goal was to balance commercial viability with pro-poor tariffs, but initial tariffs were set based on volume projections that proved to be overly optimistic. As a result, by the end of 2011, the second year of operation, the system was struggling to maintain viability. An early 2012 tariff increase (50% on treated and 100% on untreated water) was approved, which according to our forecast will allow the system to generate an operating surplus for the private operator. If de-fluoridated volumes remain low, these sales can be subsidized by cash flow from untreated sales.

The project was not structured to repay capital; for the system to generate sufficient funds to achieve capital repayment over seven years, untreated water pricing would need to increase to between KES 5 and KES 6 per 20L from a current level of KES 2.

Objectives

The primary objectives of the project were:

1. To demonstrate a model for pro-poor regulation of informal water services in low-income areas, by linking small independent providers with WSP/WSB under formal contracting arrangements for their services and assets in accordance to set regulatory standards.

2. To provide low-cost access to safe water, at prices below existing donkey cart vendor supply

3. To test a delegated management approach for a decentralized fully integrated, stand-alone system under a private operator with a local consumer oversight mechanism (i.e. as opposed to the more basic network extension/delegated management models used elsewhere)

4. To test the effectiveness of a dual supply system based on bone char media as a fluoride removal method

Project Region Characteristics

The Karagita settlement outside the town of Naivasha is a medium density settlement of some 24,000 people. The majority of residents work in agriculture, many at the flower growing operations that are common in the Lake Naivasha area. Safe water provision in the region is a challenge, as the groundwater naturally contains high levels of fluoride, while Lake Naivasha is considered eutrophic, largely from flower farm runoff water with high concentrations of chlorophyll, nitrogen and other chemicals (R.
Becht, 2006). Turbidity and pH levels of the lake vary greatly over time, which would pose an additional challenge and require a sophisticated treatment approach difficult to manage for smaller-scale private or community systems.

Project Implementation

The project involved extensive planning and negotiation to formally align the various stakeholders under a model designed to bring the benefit of a private operator within an inclusive community project, all in full compliance with the various regulatory requirements. Key participants included:

- Water and Sanitation for the Urban Poor (WSUP), a partnership of private business, civil society and research organizations working to improve water and sanitation in Asia and Africa.
- Naivasha Water, Sewerage and Sanitation Company (NAIVAWASS), the area WSP
- Rift Valley Water Services Board (RVWSB), the area WSB
- Karagita community, represented via a Water Users Association
- Private borehole owners, water vendors, entrepreneurs, and other community members

Initial capital cost of KES 20,733,844 (US$276,451 at 2009 exchange rate of KES 75 : US$1) included rehabilitating borewells, constructing the main site with elevated and surface tanks, as well as creating an initial reticulation network of 8 kiosks in the densely populated center of the settlement (red dots on system map below). Each kiosk includes a bone char system for fluoride removal.

An additional network of six kiosks was completed in June 2011 at a cost of KES 9,457,481 (US$105,083). The total Karagita population is estimated at 24,000, which implies a cost per person served of about $16, or $19 including the value of contributions of land and existing borewells.
System Overview

Water from two primary boreholes is pumped and piped to the central storage area in four elevated tanks and two ground tanks. From there, it is piped to the kiosks, where it is either sold untreated, or after being treated with bone char to remove fluoride.

Kiosks are spaced 80-100m apart with the aim of ensuring that 1) each household in the target area has access to at least one kiosk within a reasonable distance, and 2) each kiosk serves a potential population of at least 1,000 people – a figure that was calculated to allow each kiosk to achieve financial sustainability. The design was based on financial projections that assumed consumption of 15 liters per capita, with an 80%/20% split between untreated and treated water. The volume assumptions, as well as the anticipated product mix proved to be too optimistic.

The project’s original business model envisioned creating separate businesses of borehole owners, a private operator, and a network of independent kiosk operators with economic incentives for each party; planned relationships between stakeholders are shown below:

*Utility in turn transfers 6% of its revenue to Rift Valley Water Services Board (the Asset Owner), which is responsible for major system maintenance.*
Later, it was decided that the kiosk operators should be employees of the private operator rather than independent businesses. Currently one entrepreneur, Geoffrey Macharia, is essentially responsible for the entire system, serving as private operator, owner of the primary borehole, and employer of the kiosk attendants. Prior to the project, Mr. Macharia operated a borewell and had constructed several basic kiosks, which he was willing to replace with the upgraded assets of the WSUP project. Community leaders and WSUP reported being satisfied with the performance of Mr. Macharia.

Although Mr. Macharia controls all of the commercial portions of the system, we analyzed the economics for each separately, to see what conditions would be required for the intended approach to succeed as initially conceived.

**Results and Project Outcomes**

The project began operations in late 2009, expanding from its original eight kiosks to a network of 14 in June 2011. All kiosks now sell both treated water (initial tariff of KWS 2/US $0.02 per 20L, increased in early 2012 to KES 3) and untreated water (initial tariff of KES 1/US$0.01 per 20L, increased in early 2012 to KES 2).

By all accounts the delegated management model is functioning well, with community participation and with the full agreement of regulators and the larger WSP. It appears that the entrepreneur Mr. Macharia has remained active and aggressive in dealing with the challenges and operating issues.

The operator has had to face and overcome financial challenges primarily from lower than expected initial sales volumes. Average sales per kiosk of 2,494,800L of untreated water and 166,320L of treated water for 2011 were lower than was projected for the second year of operations at the outset of the project: at that time, the sponsors forecast sales of 8,640,000L of untreated and 2,160,000L of treated water. This assumed consumption of 12L (untreated) and 3L (treated) per capita per day for a population of 2,000 people per kiosk. Neither WSUP nor the private operator has tracked customers on an individual basis, so it is not clear whether this reduced volume results from lower than expected customer counts or lower than expected consumption per customer. Our discussions with local participants indicate high community penetration levels, so our assumption is that lower per capita consumption is the primary factor. A key factor may be the large percentage of the population that either travels daily for school or to work on flower farms, leaving the system area to consume substantial amounts of their daily water consumption.

The revenue shortfall is compounded by lower than expected sales of treated water as a proportion of total sales: while sales were originally projected to be 80% untreated vs. 20% treated, the actual figures show a breakdown of 94% untreated vs. 6% treated. This generates revenue 72% lower than the projections. Discussions with local residents indicate a range of explanations. Some doubted the efficacy or even the safety of the process. Others felt that fluorosis was inevitable. Economics likely played a significant role; here, as elsewhere in Kenya, the process to convince populations of the value of treated water is a long-term challenge.
Though it may seem contradictory, the lower consumption of treated water is positive in terms of system economic sustainability; our projections show that the treated water pricing is not sufficient to accrue funds to replace the bone-char media on the expected schedule, and higher volumes will only deplete the bone char sooner. At the main site, which has had the highest volumes, treated water is now showing fluoride concentrations in excess of 2mg/L, higher than the maximum WHO guideline of 1.5mg/L. The initial quotation from the supplier to replace the media was KES 250,000, which would have implied a treatment cost on the 40,000 jerry cans treated since opening of more than KES 6. Negotiations have continued, with more recent indications of KES 150,000, still a cost that would be difficult to recover through tariffs.

There is no national or international market for bone char, and the Catholic Diocese of Nakuru is still working to transition its operations to a fully commercial basis. This means that for the present time there is uncertainty regarding the full cycle manufacturing cost for bone char, and whether it can be produced and sold on an attractive basis for WSUP and others, while providing sustainable economics to the CDN. If treated volumes continue to make up a small portion of total sales this could potentially be covered through a cross-subsidy from untreated sales, but if the share of treated volumes grows, then either pricing will need to increase, the cost of supply will need to come down, or an alternative treatment method will need to be found.

<table>
<thead>
<tr>
<th>(Kenya Shillings)</th>
<th>Current</th>
<th>WSUP Model</th>
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<tbody>
<tr>
<td>Revenue Per Kiosk</td>
<td>Est. 2011</td>
<td>Year 1</td>
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<tr>
<td>Volume - Untreated</td>
<td>2,620,800</td>
<td>6,840,000</td>
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<tr>
<td>Volume - Treated</td>
<td>151,200</td>
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<tr>
<td>Volume Share - Untreated</td>
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<td>80%</td>
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<tr>
<td>Volume Share - Treated</td>
<td>5%</td>
<td>20%</td>
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<tr>
<td>Price/20L - Untreated</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Price/20L - Treated</td>
<td>2.00</td>
<td>2.00</td>
</tr>
<tr>
<td>Revenue - Untreated</td>
<td>131,040</td>
<td>342,000</td>
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<tr>
<td>Revenue - Treated</td>
<td>15,120</td>
<td>171,000</td>
</tr>
<tr>
<td>Total Revenue</td>
<td>146,160</td>
<td>513,000</td>
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</table>

WSUP Karagita - Treated Volume
Cumulative Jan 2010 - Dec 2011
The system was not operating during one of our site visits, as a result of the destruction of a nearby transformer. This was highly frustrating to the operator Macharia, who was struggling to convince the Kenya Power Company to restore service. Thus we saw donkey cart vendors next to empty project kiosks, with water for sale at KES 10 per 20L jerry can. Since that time we understand that the operator is negotiating to assume direct management control of the power supply.
Financial Results

The projected results for each participant in the system have been modeled in detail, and are included in Annex A.

Based on information available an initial August 2011 site visit, we projected that the system would not be able to sustain itself without meaningful tariff increases. During a follow-up visit in November 2011 it was confirmed that the operator was seeking an increase, which was granted by Naivawass in early 2012.

Projections for the three business lines controlled by the private operator are aggregated below. They show the expected impact of the tariff increase, which we assume will not have an appreciable impact on volumes as it is still priced below local alternatives. The relative profitability of the Kiosks and Private Operator is an issue of transfer pricing, and could be adjusted if it was decided to pursue the original model of setting up the kiosks as independent vendors rather than employees.

We note the significant cost to replace bone char, which we are currently projecting at KES 4/20L (versus the initial WSUP projection of KES 1/20L). This is a key assumption and will require further refinement based on performance of the kiosks over time to see if the experience of Kiosk 1 is typical or not, as well as whether the CDN is able to improve manufacturing efficiencies and provide bone char at a lower cost. It will be interesting to see the consumer reaction not only to the overall price increase, but also to a smaller price gap (at least in percentage terms) between untreated and treated water.

The project was not designed with the intention to recover capital, except that the cost of rehabilitating Macharia’s existing borewell (approximately KES 800,000) is to be paid to Naivawass over a period of 8 years, setting up a maintenance fund for future rehabilitation and refurbishment. Our understanding is that as a result of some of the initial lower than expected cash flows, the operator has not been meeting the original payment schedule.

If the project were to attempt capital recovery over 7 years without interest, we estimate that pricing for the untreated water would need to increase by an additional KES 3 per 20L or to a new level of KES 5. To repay commercial finance, the price would need to increase to KES 6. (This analysis does not attempt to consider price elasticity of demand, which might be expected to have a negative impact on volumes.)

Health Outcomes

The primary health benefits targeted by the project were:

- Reduction of diseases related to high fluoride level e.g. dental and skeletal fluorosis, organ damage and cancer
- Reduction of water borne diseases as a result of improved water quality and reduction of avenues for water contamination by informal water vendors & donkeys

There is no study of health outcomes currently underway. Considering the relatively low per-capita consumption of de-fluoridated water, it is unlikely that the project will have achieved significant impact in terms of fluoride-related ailments. WSUP commissioned a comparative study by Halcrow prior to selecting the bone-char method of fluoride removal; it would be useful to conduct a similar, longer-term comparative analysis of the actual effectiveness based on field performance, compared to other approaches.
Conclusions, Issues and Questions for Further Study

To date, the project has achieved several of its principal objectives, despite the lower than anticipated volumes.

- The delegated management model appears to be a success, and the formalization of contractual relationships with community participation and the full involvement of regulators and the larger WSP. By all accounts, the entrepreneur has been active and aggressive in dealing with operating issues.

- The conveniently-located kiosks have provided significant water volumes and financial savings to the community. If we assume that the volume of untreated water replaced water fetched or delivered at prices of KES 3 to KES 5, then the savings to the community in 2011 ranged from KES 2 million to KES 4 million.

The issue of profitability can be addressed with the planned tariff increase, ensuring system stability. Future system design might incorporate slightly wider kiosk spacing, to improve individual kiosk volumes and economics.

The issue of low consumption of treated water will require a concerted campaign to educate the population and to promote the benefits of treated water, an effort that WSUP is now leading in cooperation with the community and government health structures.

Additional issues to study would include:

- The reasons behind lower than projected usage and volumes (study household participation versus per capita usage, as a function of income, distance and other variables)
- How to streamline the process of setting up the legal structure, and the advisability of separating operations into multiple independent businesses
- The impact on volumes of different spacing between kiosks
- Knowledge of health impact of fluoride, and the effectiveness of different approaches to hygiene education and demand generation
- Depletion rate of bone char, and complete comparison of life cycle cost versus reverse osmosis
 Annex A – Financial Results By Business Unit

a) Single Kiosk Economics

The kiosk operators were originally planned to be independent business owners, but are currently employees of the private operator and were paid a salary of 150 KES per day (US $560 per year) in 2011. There has been pressure to increase salary to levels comparable to the wages paid by nearby flower farms (about KES 200 per day). Treated and untreated water are sold at each of the 14 kiosks – 1 KES/US $0.01 per 20L of untreated water and 2 KES/US $0.02 per 20L of treated water. Water wastage has been roughly 11% for untreated water and 6% for treated water.

Key assumptions:

- 2011 household penetration stands at 70% and will rise over the next 6 years to 85%
- Consumption per household increases 5% per year
- Costs increase at 5% per year
- Water prices remain constant, after the large 2012 increase

Under these assumptions, the kiosks are unprofitable on a standalone basis. Said differently, they do not generate enough cash to pay an independent vendor a minimum salary expectation. This could be solved by adjusting the wholesale water price paid to the Private Operator.

SAFE WATER NETWORK
WSUP KARAGITA CASE STUDY
SINGLE KIOSK PROJECTED ECONOMICS

<table>
<thead>
<tr>
<th>Headcount and Expenses</th>
<th>Number</th>
<th>Salary/Year</th>
<th>Incentive</th>
<th>Amount</th>
<th>Growth</th>
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</thead>
<tbody>
<tr>
<td>Admin &amp; Staff</td>
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<td>52,500</td>
<td>5.0%</td>
<td>(one-time increase to KES 72,000 in 2012)</td>
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<tr>
<td>Total Salary</td>
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<td>52,500</td>
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<tr>
<th>Transfers (% of Revenues)</th>
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<tr>
<td>Private Operator</td>
</tr>
<tr>
<td>Untreated</td>
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<tr>
<td>Treated</td>
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<table>
<thead>
<tr>
<th>Other Expenses</th>
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<tbody>
<tr>
<td>Maintenance</td>
</tr>
<tr>
<td>- Untreated</td>
</tr>
<tr>
<td>- Treated</td>
</tr>
<tr>
<td>Miscellaneous</td>
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<tbody>
<tr>
<td>Volume - Treated</td>
<td>197,520</td>
<td>151,200</td>
<td>158,630</td>
<td>173,502</td>
<td>189,464</td>
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<td>1.0</td>
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<td>2.0</td>
<td>2.0</td>
<td>2.0</td>
<td>2.0</td>
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<tr>
<td>Price/20L - Treated</td>
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<tr>
<td>Untreated Revenue</td>
<td>118,937</td>
<td>116,626</td>
<td>244,734</td>
<td>262,558</td>
<td>281,252</td>
<td>297,117</td>
<td>313,681</td>
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<tr>
<td>Treated Revenue</td>
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<td>14,213</td>
<td>22,367</td>
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<td>26,734</td>
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<td>30,963</td>
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<td>130,838</td>
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<td>287,021</td>
<td>307,966</td>
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<td>344,644</td>
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<table>
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<tr>
<th>Direct Operating Costs</th>
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<td>Transfers to Private Operator</td>
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<td>Total Salary</td>
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<tr>
<td>Maintenance</td>
</tr>
<tr>
<td>Miscellaneous</td>
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<td>Total Operating Cost</td>
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<table>
<thead>
<tr>
<th>EBITDA</th>
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<td>(27,382)</td>
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<table>
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<tr>
<th>Beginning Cash</th>
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<tbody>
<tr>
<td>(27,382)</td>
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</tbody>
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<table>
<thead>
<tr>
<th>Ending Cash</th>
</tr>
</thead>
<tbody>
<tr>
<td>(27,382)</td>
</tr>
</tbody>
</table>
b) Private Operator

With the kiosk vendors originally conceived as independent resellers, the private operator was expected to serve as a wholesaler, selling untreated water at KES 0.6/20L (60% of the retail price) and treated water at KES 1.6/20L (80% of the retail price). In practice, the private operator receives the full revenue from sales at each of the 14 kiosks and in return pays each operator a salary of KES 150 per day. The private operator is obligated to transfer 12.5% of revenues to the utility and another 2.5% of revenues to the water users association. The private operator also pays the borehole owner KES 16 (US $0.17) per cubic meter of untreated water.

Our projections assume bone char expense of KES 4/20L, beginning in 2012. This is less than the experience of kiosk 1, implying that WSUP and the private operator will be successful in negotiating lower prices than the supplier is currently offering. The projections also assume that the private operator will employ three staff members at an annual salary of KES 85,200. (About KES 255,600 or about US $3,000 per year for all three). As summarized in the table below, other expenses include power, maintenance costs, education and communication expenses and miscellaneous other expenses.

In our projection, the private operator is cash flow positive in 2011 despite lower pricing, because there was no need to replace bone char. The start of bone char replacement in 2012 necessitated the tariff increase, which is sufficient to maintain profitability throughout the projections.
c) Borehole Owner

The borehole owner received KES 16 from the private operator per cubic meter of untreated water through 2011, which was increased to KES 22 in early 2012. The borehole owner transfers 1% of revenues to the National Environment Management Authority (NEMA).

The primary determinant of economics for the borehole owner is the cost of electricity. According to power calculations by WSUP technical personnel, the cost should have been approximately KES 5 (US $0.05) per cubic meter, which compared favorably to the selling price of KES 16 (US $0.17) per cubic meter. Based on a review of actual energy bills, however, it appears that the cost was averaging about KES 13 (US $0.14) during 2011, which makes the economic proposition marginal. Further investigation is required to understand the reason for the lack of energy efficiency. Mr. Macharia explained that some of the bill related to non-WSUP activity, and though he did not have a metered breakdown, he estimated that his cost per m3 was about KES 10. On this basis, the borehole owner is profitable in all projected years, provided he can manage the supply without additional employees.

<table>
<thead>
<tr>
<th>SAFE WATER NETWORK</th>
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<tbody>
<tr>
<td>WSUP KARAGITA CASE STUDY</td>
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<tr>
<td>BOREHOLE OWNER PROJECTED ECONOMICS</td>
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**Headcount and Expenses**

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<tr>
<th>Number</th>
<th>Salary/Year</th>
<th>Incentive</th>
<th>Amount</th>
<th>Growth</th>
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<tbody>
<tr>
<td>Admin &amp; Staff</td>
<td>0</td>
<td>-</td>
<td>-</td>
<td>5.0%</td>
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<tr>
<td><strong>Total Salary</strong></td>
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<tr>
<td>Transfers (% of Revenues)</td>
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<tr>
<td>NEMA</td>
<td>1.0%</td>
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<tr>
<td><strong>Other Expenses</strong></td>
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</tr>
<tr>
<td>Power</td>
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<tr>
<td>Maintenance</td>
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<td>5.0%</td>
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<tr>
<td>Miscellaneous</td>
<td>1,000</td>
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<td>5.0%</td>
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<tbody>
<tr>
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<td>991,821</td>
<td>1,065,220</td>
<td>1,142,242</td>
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<td>Direct Operating Costs</td>
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<td>Transfers to NEMA</td>
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<td>11,422</td>
<td>12,079</td>
<td>12,767</td>
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<td><strong>Total Salary</strong></td>
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<tr>
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<td>27,525</td>
<td>29,092</td>
<td>31,096</td>
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<tr>
<td>Water Abstraction Permit</td>
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<td>18,000</td>
<td>18,000</td>
<td>18,000</td>
<td>18,000</td>
<td>18,000</td>
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<td>Miscellaneous</td>
<td>1,000</td>
<td>1,050</td>
<td>1,103</td>
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<td><strong>Total Operating Cost</strong></td>
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<tr>
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<td>286,845</td>
<td>259,949</td>
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<tr>
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<td>220,935</td>
<td>162,912</td>
<td>89,502</td>
<td>643</td>
</tr>
<tr>
<td>Beginning Cash</td>
<td>11,253</td>
<td>298,098</td>
<td>558,047</td>
<td>778,982</td>
<td>941,894</td>
<td>1,031,397</td>
<td>1,032,039</td>
</tr>
<tr>
<td>Ending Cash</td>
<td>11,253</td>
<td>298,098</td>
<td>558,047</td>
<td>778,982</td>
<td>941,894</td>
<td>1,031,397</td>
<td>1,032,039</td>
</tr>
</tbody>
</table>
d) Utility (NAIVAWASS)

NAIVAWASS receives 12.5% of private operator revenues, and transfers 68% of its revenues to the asset owner (Rift Valley Water Services Board).

We have assumed a minimal allocation of resources to the project on the part of the utility, amounting to personnel costs and other small expenditures for maintenance and miscellaneous expenses, totaling about KES 875,000 per year, or less than US$100 per month. Under these assumptions, the utility’s participation in the project is not profitable in any year.

Nevertheless, it is likely a much lower cost method of serving the settlement than any direct project would have been and therefore would be an attractive blueprint for the utility to follow with sponsors prepared to serve other settlements.

e) Asset Owner (Rift Valley WSB)

The asset owner receives 68% of the utility’s revenues. There are no projected operating costs. Nevertheless, the asset owner is responsible for major maintenance and upkeep of the system. It is clear that any major investment in system assets would well exceed the small amount of revenue.

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<table>
<thead>
<tr>
<th>SAFE WATER NETWORK</th>
<th>WSUP KARAGITA CASE STUDY</th>
<th>UTILITY (NAIVAWASS) PROJECTED ECONOMICS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headcount and Expenses</td>
<td>Number</td>
<td>Salary/Year</td>
</tr>
<tr>
<td>Admin &amp; Staff</td>
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<td>60,000</td>
</tr>
<tr>
<td>Total Salary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transfers (% of Revenues)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other Expenses</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


| Revenue | 14,639 | 143,979 | 155,476 | 167,480 | 177,183 | 187,239 | 200,629 |
| Direct Operating Costs | | | | | | | |
| Transfers to Asset Owner | 9,955 | 97,906 | 105,724 | 113,886 | 120,484 | 127,322 | 136,428 |
| Total Salary | 60,000 | 63,000 | 66,150 | 69,458 | 72,930 | 76,577 | 80,406 |
| Maintenance | 20,000 | 21,000 | 22,050 | 23,153 | 24,310 | 25,526 | 26,802 |
| Miscellaneous | 1,000 | 1,050 | 1,103 | 1,158 | 1,216 | 1,276 | 1,340 |
| Total Operating Cost | 90,955 | 182,956 | 195,026 | 207,654 | 218,940 | 230,701 | 244,975 |
| EBITDA | 9,955 | 97,906 | 105,724 | 113,886 | 120,484 | 127,322 | 136,428 |
| Cash Flow | 9,955 | 107,860 | 213,584 | 327,470 | 447,954 | 575,277 | 711,704 |

---

<table>
<thead>
<tr>
<th>SAFE WATER NETWORK</th>
<th>WSUP KARAGITA CASE STUDY</th>
<th>ASSET OWNER (RVWSB) PROJECTED ECONOMICS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenue</td>
<td>9,955</td>
<td>97,906</td>
</tr>
<tr>
<td>Transfer to Investment Account (reserve for capital maint.)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>EBITDA</td>
<td>9,955</td>
<td>97,906</td>
</tr>
<tr>
<td>Cash Flow</td>
<td>9,955</td>
<td>97,906</td>
</tr>
<tr>
<td>Beginning Cash</td>
<td>(76,315)</td>
<td>(38,977)</td>
</tr>
<tr>
<td>Ending Cash</td>
<td>(76,315)</td>
<td>(115,292)</td>
</tr>
</tbody>
</table>
2. Onesmerc (Mbooni West, Machakos District)

Summary

Onesmerc International Trading Company, Ltd. is a privately-financed and operated water delivery business that serves communities, households and schools in the Machakos region of southern Kenya. It is an example of an independent entrepreneur creating a business in response to the water scarcity of the region, and growing the business without the benefit of government or NGO support or subsidy.

Key Features:

- Very low operating costs – spring water, gravity pipelines, low-cost treatment (chlorine)
- Primary cost is for truck delivery to distant kiosks and customers
- Sales are balanced between kiosks, direct delivery to farms and homes, and delivery to schools
- Differentiated water pricing is based on cost, with more distant locations priced higher
- System earns approximately KES 2.2 million annually against a capital investment of 14.3 million

Onesmerc began selling water in December 2010, and has so far been financially successful: operating revenues have significantly exceeded operating costs, with cash flow primarily reinvested to expand the system. Results are highly sensitive to rainfall and water availability, and the entrepreneur is looking for cost-effective ways to expand to meet peak dry season demand. If prices and volumes remain within current ranges, the initial capital investment will be recovered within seven years, while the system provides a reliable source of safe water to this region of 21,500 people.

The Onesmerc case offers a successful example of a truly private business; however, questions remain about whether it is a one-off case, or whether it could be a blueprint for broader adoption.

Background and Objectives

Machakos is a water-scarce region that has been experiencing especially severe seasonal drought conditions since 2008. The situation led local businessman Onesmus Muthoka, who had lost some of his own livestock to the drought and watched his neighbors struggle to meet their needs, to explore ways that water could be made more accessible and more reliable.

Mr. Muthoka pursued a number of strategies to meet this objective. He initially attempted to form a Community-Based Organization (CBO) and sought both local and external funds to dam the Kikumu River, creating a reservoir for irrigation; however, he was unable to mobilize sufficient support for this plan. He then attempted to secure funding for the CBO from the Ministry of Water and Irrigation to drill wells to supply water for both drinking and irrigation; again, without success.

Mr. Muthoka’s third effort was to use his own money to build a water distribution system and operate it as a private enterprise. That endeavor began selling water in December 2010 and has grown into a successful business, with Mr. Muthoka continuing to invest in expansion.

The primary objectives for the project’s initial operating phase were:

1. Build a sustainable business
2. Grow business to greater scale over a number of years by reinvesting cash flow and securing outside finance if possible
3. Ensure a reliable supply of safe, affordable water in the region, particularly in times of drought
4. Serve customers who have historically been underserved by existing water systems

**Project Region Characteristics**

The Onesmerc water system serves customers in the districts of Mbooni East, Mbooni West, and Machakos. The area is densely populated with farming communities: most residents are subsistence farmers; others include teachers, traders and government workers.

Government monitoring programs report that local spring water, when it is available, is of good quality. Seasonal rivers also exist, but the water is often dirty and can become contaminated with livestock waste. The area experiences some water-borne illnesses including schistosomiasis and typhoid. Groundwater is scarce, and where it exists it is salty and levels are dropping. People generally prefer spring water as it is softer than groundwater and is therefore better for washing.

A large NGO-funded, community-managed system was constructed in the 1980s covering the same region. As a result of poor management and lack of investment in the system, it is now essentially non-operational. Mr. Muthoka has discussed taking over management of the system, but has found that the issue is too politically charged and the communities are unrealistic regarding the value of the broken project. When the system provides water, it charges KES 3 at its kiosks. Otherwise, it is typical for people to travel up to 2 hours over hilly terrain to collect water, paying an average of KES 10 (US $0.11) per jerrycan, and up to KES 40 (US $0.44) in some locations.

**Project Implementation**

**Project Planning and Initial Construction**

Mr. Muthoka first hired a consultant to survey the water resources on his own land. Finding the existing groundwater insufficient, Mr. Muthoka located a tract of land in the hills about 8 km away that contained a natural spring and purchased it for KES 500,000 (US $5,000).

Initially 1-inch pipes were laid at a cost of KES 1.4 million (US $15,000), but these were found to be inadequate; much of the 8 km of pipeline had to be replaced with larger-diameter pipe for an additional KES 1 million (US $11,000), funded from early system revenues. A tanker truck was also purchased for an additional KES 1.6 million (US $17,000) to expand coverage to more distant towns, farms and schools.

A detailed breakdown of the capital expenses for the project is below. The major portion of expenses were related to the pipeline construction (including labor, engineering, and other costs). Apart from this initial construction, further capital costs have been kept relatively low due to the minimal need for purification and the use of simple kiosks, which can be added at a cost around US $800.
System Overview

Water from the spring is piped 8 km to Mr. Muthoka’s house, where it is stored in two 1,000L tanks. The tanker truck is filled at this location, after which the water is treated with two tsp of calcium hypochlorite per 10,000L in order to provide residual protection in the tank. Because it is already of high quality, the water does not need extensive treatment in order to ensure its suitability for drinking.

Once on the truck, the water is transported to kiosks where it is sold by the jerrycan. Some households and schools in the region have also arranged to have water delivered to them directly, with a higher price that reflects the additional transportation costs.

A simplified diagram of the system appears below.
**Current Operations**

Onesmerc currently operates 8 water kiosks with a staff of 14 employees, and provides treated, safe water at a price of KES 5 – KES 20 (US $0.05-0.22) per 20L jerry can, depending on the location. Water is cheapest at the main Kalawani market kiosk, which is connected by pipeline directly to the source, while prices at more distant kiosks are priced at KES 10 or KES 15 depending on distance and delivery cost. Likewise, sales to households and schools take into account the higher transportation costs to these locations. New home delivery business mainly comes in by referral; Onesmerc does not have an active selling program. School business is contracted via an open tender process.

The company began developing the spring source in early 2010, and began water sales in December 2010. The company’s office, located at the main kiosk in Kalawani Market, has been open since April 2011, and good financial records are available beginning at that time.

One challenge was developing and managing the distribution network and payment systems. Prepaid meters were rejected due to high up-front costs, and the project instead relies on a full-time office manager and part-time accountant to manage accounting and payment systems. Most customers pay cash, though Onesmerc now also accepts payment via M-Pesa, the Kenya-based mobile money transfer system.

Each of the 8 kiosks currently in operation is staffed with a sales agent with a salary of KES 4,000 (US $43) per month, and with accommodation and food provided in kind with a value of roughly another KES 4,000 per month. In addition to the KES 32,000 in salary for the sales agents, six admin employees are paid a total of KES 56,000 per month and one part-time employee earns KES 2,000 per month, for a total payroll cost of KES 90,000 (US $970) per month. Non-payroll expenses have ranged from KES 68,000 – KES 92,000 (US $730 - $US 1,000) per month.
Relations With Community and Government Groups

A Registered User Association (RUA) is given the responsibility of controlling water usage at the community level. However, this oversight does not extend to private entities, and therefore Onesmerc does not deal directly with the RUA.

The company has however been trying to comply with requirements of the Water Resource Management Authority (WRMA), which provides the company with its license for extraction. Onesmerc was required to provide WRMA with an area map, drawings, demand, last ownership, registered company certificate, and a fee of KES 15,000 ($US 160) to register, and must pay KES 7,000 ($US 75) per year on an ongoing basis to keep its license current. Although the company does not yet have its official extraction permit, WRMA representatives assured us that there was no issue and it would be given in time.

Mr. Muthoka approached the Ministry of Water and Irrigation (MWI) to request funding for his earlier plan for a community-based well-digging project, but did not receive their support, and he believes he is even less likely to secure any funding from MWI for a private business like Onesmerc. He is aware of plans to consolidate all government water projects in the area under a single publicly-operated water company; however, he believes it is in the best interests of his business and his community that Onesmerc remain an autonomous private entity.

Project Outcomes

Sales Volume

As discussed in the overview, though it is successful overall, the Onesmerc system suffers from heavy seasonality. During the dry period of July through September, the company has trouble keeping its kiosks stocked with water, particularly since it gives priority to higher priced sales to schools.

Following is an example of a daily sales chart for one of the kiosks, at the village of Iliani. Onesmerc was only able to make partial deliveries during the month of August, and the kiosk was without water on many days. When a delivery was made, water usually sold out the same day.
Meanwhile, in November, sales at this kiosk were only 876 L, with many days selling 10 L, 20 L or no water at all, making it difficult to justify the expense of maintaining a kiosk vendor.

Kiosks have represented the largest share of sales volume (44%), but on a revenue basis the three sales channels are roughly balanced. This is due to the higher pricing for household and school delivery. The school delivery business displays the greatest month-to-month fluctuation as it relies on a government tendering program that awards periodic high-volume deliveries rather than a steady stream of smaller-volume sales, and is dependent on the timing of disbursements under the program to support the drought-stricken region. Onesmerc uses rough standardized costs for fuel, depreciation, maintenance and other delivery expenses, ensuring that all delivery customers are profitable.
Financial Results

The Onesmerc project has a relatively short history, so any analysis at this stage must be considered preliminary; however, financial results are encouraging and indicate broad acceptance for Mr. Muthoka’s initiative. At current prices and volumes, the project makes a profit of roughly KES 6 (US $0.07) per 20L. As discussed in the overview, this profit would be sufficient to repay the investment on an interest free basis in approximately 7 years, and would make the system an interesting candidate for a Maji ni Maisha loan. We have modeled a slight reduction in average selling prices, which combines with cost inflation to generate lower profitability in future years. This should be considered a conservative base case; Mr. Muthoka’s plans are to continue to expand aggressively.

SAFE WATER NETWORK
CASE STUDY: ONESMERC (MBOONI AREA, MACHAKOS)
FINANCIAL PROJECTIONS

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Kiosk Revenue</td>
<td>1,030,434</td>
<td>140,625</td>
<td>1,171,059</td>
<td>1,170,559</td>
<td>1,229,087</td>
<td>1,290,543</td>
<td>1,355,069</td>
<td>1,422,822</td>
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<tr>
<td>School Revenue</td>
<td>1,091,300</td>
<td>247,500</td>
<td>1,338,800</td>
<td>1,453,472</td>
<td>1,526,145</td>
<td>1,602,453</td>
<td>1,682,575</td>
<td>1,766,704</td>
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<tr>
<td>Delivered Revenue</td>
<td>1,192,500</td>
<td>315,000</td>
<td>1,507,500</td>
<td>1,256,430</td>
<td>1,319,252</td>
<td>1,385,214</td>
<td>1,454,475</td>
<td>1,527,199</td>
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<tr>
<td>Total Revenue</td>
<td>3,314,235</td>
<td>703,125</td>
<td>4,017,360</td>
<td>3,880,461</td>
<td>4,074,484</td>
<td>4,278,208</td>
<td>4,492,119</td>
<td>4,716,725</td>
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<tr>
<td>Salary</td>
<td>501,348</td>
<td>165,000</td>
<td>666,348</td>
<td>1,083,600</td>
<td>1,137,780</td>
<td>1,305,801</td>
<td>1,371,091</td>
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<td>Vehicle/Delivery</td>
<td>631,640</td>
<td>135,750</td>
<td>767,390</td>
<td>724,056</td>
<td>798,272</td>
<td>880,095</td>
<td>970,304</td>
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<td>15,000</td>
<td>73,915</td>
<td>126,000</td>
<td>132,300</td>
<td>138,915</td>
<td>145,861</td>
<td>153,154</td>
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<td>Travel and Entertainment</td>
<td>58,915</td>
<td>15,000</td>
<td>73,915</td>
<td>75,600</td>
<td>79,380</td>
<td>83,349</td>
<td>87,516</td>
<td>91,892</td>
</tr>
<tr>
<td>Office Expense</td>
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<td>7,500</td>
<td>59,541</td>
<td>75,600</td>
<td>79,380</td>
<td>83,349</td>
<td>87,516</td>
<td>91,892</td>
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<tr>
<td>Rent</td>
<td>9,875</td>
<td>6,000</td>
<td>15,875</td>
<td>12,600</td>
<td>13,230</td>
<td>13,892</td>
<td>14,586</td>
<td>15,315</td>
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<tr>
<td>Licenses</td>
<td>15,000</td>
<td>15,000</td>
<td>18,900</td>
<td>19,845</td>
<td>20,837</td>
<td>21,879</td>
<td>22,973</td>
<td>24,048</td>
</tr>
<tr>
<td>Telephone and Utilities</td>
<td>5,033</td>
<td>8,013</td>
<td>12,600</td>
<td>13,230</td>
<td>13,892</td>
<td>14,586</td>
<td>15,315</td>
<td>16,152</td>
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<tr>
<td>Other</td>
<td>46,430</td>
<td>750</td>
<td>47,180</td>
<td>12,600</td>
<td>13,230</td>
<td>13,892</td>
<td>14,586</td>
<td>15,315</td>
</tr>
<tr>
<td>Total Expenses</td>
<td>1,455,918</td>
<td>348,000</td>
<td>1,803,918</td>
<td>2,141,556</td>
<td>2,286,647</td>
<td>2,554,020</td>
<td>2,727,926</td>
<td>2,915,264</td>
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<tr>
<td>Earnings before Interest and Taxes</td>
<td>1,858,317</td>
<td>355,125</td>
<td>2,213,442</td>
<td>1,738,905</td>
<td>1,787,837</td>
<td>1,724,188</td>
<td>1,764,192</td>
<td>1,801,461</td>
</tr>
</tbody>
</table>

It is important to note that sales and profits over this period are partly a reflection of the ongoing drought in the region. Some moderation of sales could be expected under more normal conditions. On the other hand, water demand in the dry season greatly exceeds the company’s ability to deliver, so unless there was a significant shift in traditional weather patterns, we expect that Onesmerc will be able to count on continued strong seasonal demand.

The Constituency Development Fund, the program that supports local-level development projects and funded the school purchases, will disappear as part of the new constitution. Onesmerc believes that a comparable program will continue under county government authority and that it remains the best-positioned provider of safe water to schools in the district.
Pricing

Prior to the implementation of the Onesmerc project, alternative sources of water in the area were priced at an average of KES 10 (US $0.11) per 20L, rising in some locations to KES 40 (US $0.44). Water from a donor-funded community system is priced at KES 3 (US $0.03) per 20L but is for all intents and purposes unavailable.

The chart below shows the prices from kiosks, household deliveries, and school deliveries for Onesmerc. Pricing at individual kiosks remained constant through the period, so monthly variations reflect relative changes in volumes between closer and more distant locations. Similarly, home delivery pricing reflects the cost of delivery points at various distances, except in December, when a customer with substantial seasonal storage took advantage of slack demand to negotiate a special price for off-season delivery; he will hold the water in storage until the dry season for livestock.

Ranging from KES 5 to KES 15 per 20L jerry can, kiosk pricing is considerably higher than the prices charged by other projects in Kenya, a function of the cost to deliver to distant kiosks by truck, and the need to recover the capital invested.

### Relative Pricing of Water Projects

<table>
<thead>
<tr>
<th>Source</th>
<th>Package Size (L)</th>
<th>Price (KES)</th>
<th>Per 20L (KES)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Onesmerc</td>
<td>20</td>
<td>5 - 15 (treated)</td>
<td>5 - 15 (treated)</td>
</tr>
<tr>
<td>WSUP Karagita</td>
<td>20</td>
<td>3 (treated)</td>
<td>2 (treated)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 (untreated)</td>
<td>1 (untreated)</td>
</tr>
<tr>
<td>LIFELINK (multiple)</td>
<td>20</td>
<td>2 - 3 (untreated)</td>
<td>2 - 3 (untreated)</td>
</tr>
<tr>
<td>Utility (national avg.)</td>
<td>1,000</td>
<td>43 (treated)</td>
<td>0.85 (treated)</td>
</tr>
</tbody>
</table>
Breakeven Analysis
At current volumes and prices, the project is on track to repay its capital investment. Our projections for future years assume modest price declines against underlying cost inflation, eroding profitability. If Onesmerc can maintain current prices while increasing volume 5% annually to offset the impact of cost inflation, EBITDA will be at the level needed to repay capital in 7 years, the threshold for which is marked in the charts below by the red line. The charts show the sensitivity to these projections; in 2011 average pricing was about KES 11 KES; for future years we are projecting KES 10.3. Monthly volume for 2012 is estimated at 630,000 L, a figure that should continue to expand modestly.

Health Outcomes
There has to date been no systematic health and hygiene education effort as part of the project, though Onesmerc has indicated that they are considering such a program for the future. The Machakos project was initiated primarily to address a problem of water scarcity rather than water quality, although the chlorine-treated spring water is likely safer than most available alternatives.

Conclusions, Future Plans, and Remaining Questions
Progress Against Original Objectives
Though Onesmerc continues to face challenges, the progress toward building a sustainable business is very encouraging, with anticipated operating profit ranging from KES 1.8 million to KES 2.2 million. Financing and cash flow remain a challenge given the need to continuously reinvest cash to grow the business, coupled with the difficulty navigating seasonal slowdowns.

While higher than most donor projects, pricing is lower than previously available alternatives, as evidenced by the sell-out demand levels in the dry season. Mr. Muthoka is hopeful that with investment in distribution pipelines, additional kiosk sales points will be able to sell at the same KES 5 per jerry can level that the main site currently does.
Challenges and Future Goals

Despite the strong results, there are a number of challenges to the project’s sustainability.

- **Seasonally Erratic Demand:** This makes sizing the system and generating a return on investment challenging and leads to seasonal financial losses. Onesmerc believes that an education program focused on the health benefits of safe water would reduce seasonality, but does not have the funds or experience to undertake such an effort.

- **Regulatory Compliance:** Like many small water projects, Onesmerc is not working under a valid license agreement (including an approved tariff regime). While local water officials we interviewed are supportive of the company’s efforts, and Mr. Muthoka is working to obtain the necessary licenses and permits, this lack of legal authorization represents an ongoing risk.

- **Availability of Outside Capital:** Given the short operating history and lack of regulatory compliance, combined with low comfort with the sector on the part of local banking institutions, it is doubtful that Onesmerc could secure commercial financing to support growth. Without outside capital, expansion will be slower and the system will continue to fall short of meeting peak demand.

- **Potential Competition from Not-for-Profits:** If the defunct community project were to obtain new funding for a re-start, it would likely sell water at lower prices, limiting demand for Onesmerc.

- **Government Funding:** One-third of sales are to schools that purchase using drought-relief funds from the central government’s Constituency Development Fund (CDF). Constitutional and administrative changes underway in Kenya mean that future funding will be disbursed by county governments according to their priorities. Although Mr. Muthoka believes that funding will still be made available to schools to purchase water, an interruption in the program would hurt sales.

Onesmerc plans to continue to expand the system to increase its reach to additional population centers and to expand to higher-value products. Primary initiatives being considered include:

- **Trench and lay pipelines to the remote sites.** Onesmerc estimates KES 1 million (US$ 11,000) is needed to reach the town of Tawa (Phase 1), and a further KES 1.5 million (US$16,000) to reach the town of Kithulumi (Phase 2). This will eliminate delivery cost to these sites, and allow the truck to serve additional locations.

- **Expand truck delivery to additional kiosks, as well as grow home delivery activity.**

- **Distribute water in smaller plastic bottles in shops for home use.** This project is very much at a preliminary stage, and it is estimated that the necessary mini-bottling system would cost at least KES 12 million (130,000 US $).

- **Develop partnerships with like-minded community members to act as shareholders in the company (likely to be necessary in order to pursue the bottling project).**

- **Develop health and hygiene education programs in order to increase public awareness of the importance of clean water sources.**

Another key initiative is to expand water availability, which would require investment in additional sources, or expanded storage. We analyzed several options for expansion with Mr. Muthoka, including seasonal storage, and found it difficult to justify the investment. We would point out that this type of investment is usually funded from the government rather than from user tariffs.
**Key Success Factors**

The Onesmerc case stands out as a particularly successful example of commercial safe water provision. Several factors can be identified that help to account for this success:

- Onesmerc is able to charge a premium price, and can also adjust that price for different market segments to reflect varying delivery costs. The prices charged by Onesmerc are higher than typical pricing under regulator-approved tariffs.
- Operating costs are kept low due to the low-cost, low-tech nature of the kiosks, and the gravity-fed system.
- Due to the high quality of the spring water source, there is little need for purification. The chlorine used is less expensive than forms of purification that are necessary in other cases.
- The project maintains a diversified revenue base, with kiosk, household, and school sales.

**Issues and Questions for Further Study**

Though the Machakos model is a commercial success, it enjoys a set of favorable circumstances that may limit its applicability elsewhere in the country.

In order to develop a clearer sense of the model’s scale potential, the following issues should be addressed:

- An assessment of comparable spring water sources including their availability within an overall watershed management program
- The extent to which education programs can increase off-season demand
- Possibility of government to make a longer term commitment to purchases (compared to the current, one-off tender process), which could serve as an underpinning for commercial finance
- Test similar systems in less drought-prone regions
- If seasonality cannot be improved, can seasonal storage be constructed at acceptable returns for the commercial investor?

Although most industry observers dismissed the Onesmerc model as a blueprint, Mr. Muthoka is convinced that there are multiple opportunities for similar systems, and could himself pursue them if he had adequate capital.
3. Grundfos LIFELINK

Summary

The Grundfos LIFELINK project is an innovative approach to decentralized water provision pioneered by water pump and equipment maker Grundfos. Initiated in 2009, there were approximately 30 sites in operation by the end of 2011, with up to 57 additional locations expected in Kenya for 2012. Initially Grundfos considered pursuing a capital recovery model, though it quickly became apparent that this would not be feasible. Of the sites currently in operation, the majority do not generate sufficient volumes to pay the monthly servicing fee, particularly during rainy months when sales drop significantly.

The borehole is driven by solar power and works with a pre-payment system based on M-PESA. Each end user receives an RFID smart key, which is used to access the water. The water key can be loaded with money from any M-PESA account in the country. Once the user is at the tapping station, they insert the chip, and water flows automatically until the chip is removed. The tapping station automatically deducts the amount of credits used and transfers the money in a closed payment system.

Objectives

LIFELINK was designed to address some of the challenges of providing a sustainable water solution to low income communities in rural and peri-urban areas in Kenya. These include the lack of power, problems with revenue collection or unaccounted-for water, and technical service and maintenance.

- **Standalone Off-Grid System** – With power supplied by the Grundfos Solar SqFlex pumping system, LIFELINK does not require a grid connection or generator.

- **Unmanned/Automated Payment System** – LIFELINK comes with an innovative, automated payment system, with users pre-paying via a mobile phone-based payment system that loads an RFID key fob. This eliminates collection issues and unaccounted-for water.

- **Servicing Network** – The LIFELINK system comes with a remote monitoring system and professional after sales service, in order to assure continued operation. The community enters a
service agreement with the Grundfos LIFELINK service team. Water revenue is transferred to a closed service account, with any excess amounts remitted to the community at the end of the year.

The main innovation is the development of the closed payment system based on mobile banking that allows the system to operate without an operator, and to avoid the problems associated with cash transactions and revenue collection. It uses the Safaricom M-PESA money transfer service, transferring the subscriber’s M-PESA balance to an RFID key card which can then be used to draw water, with the payment going directly to the closed service account. This in turn facilitates the collection of funds for service and maintenance, which is carried out through the service contract with the LiFELINK team.

Properly implemented, this system could solve one of the primary challenges incurred by other servicing networks that have been created to solve the issue of long-term maintenance. While such efforts have resulted in numerous trained technicians, these networks often fail for financial reasons, namely lack of payment from communities.

Project Region

The LIFELINK system has been installed throughout the country, with site selection based on finding communities with a water source whose safety is approved by local water authorities.

Half of the districts in Kenya have groundwater with fluoride concentrations higher than 1.5 parts per million. Because it can only be used for groundwater that requires no treatment, the solution is only appropriate for the areas without fluoride in the groundwater. Grundfos is currently developing various new systems for treatment of the water source, either groundwater or surface water. These solutions will build on the concept of solar energy and low maintenance, and will be introduced in Kenya and other countries. Any additional treatment will necessarily increase the capital cost versus a system with no treatment, as well as add to the operating complexity. While working to develop these additional options, Grundfos is working to reduce the capital cost of the basic system, so that it remains competitive with other options in the market.

Project Implementation

Grundfos LIFELINK employs a full service team able to evaluate new sites, engage with communities, manage the projects to completion and provide post-implementation support. As a private company, Grundfos does not disclose the cost of this project development activity, or whether the system cost of approximately $45,000 includes recovery of the upfront development and implementation costs.

Once a system is operational, the water committee or water service provider is responsible for the daily operation and management, and Grundfos LIFELINK manages the service and maintenance on the community’s behalf, for an annual fee of about KES 215,000, or about KES 18,000 ($200) per month.

System Overview

The Grundfos LIFELINK concept is based on the Grundfos SQFlex submersible pump system, powered by solar panels. Water is stored in a water tank placed on a foundation or steel tower, and is dispensed via an automatic RFID computer-controlled system. Grundfos seeks to use only safe underground drinking sources, as the current model of the system does not include any treatment.

The system is currently sold on a lump-sum, turnkey basis, and no breakdown of the cost of various components has been supplied. At a cost of $45,000 per installation, which provides access to
communities of between 1,000 and 3,500 people, capex ranges from $14 to $45 per capita. This is a relatively high upfront figure compared to comparable mechanized borewell systems, though Grundfos LIFELINK points out that a fairer comparison will only be possible over a longer period, taking into account an expected far lower failure rate resulting from the incremental investment of the payment and service model. Moreover, the volumes actually dispensed per capita are well below minimum consumption rates, meaning that the systems are likely serving only a fraction of the water needs for each community. Adjusting for this, the true per capita cost would be higher.

Part of the economic model is for the higher cost of the solar-powered system and the automated payment approach to be compensated by lower operating costs. Indeed, the two largest expense categories in a decentralized kiosk system are typically personnel and electricity. The conversion of these expenses into a fixed monthly charge means that there is strong operating leverage; if a system successfully provided 7.5L per capita to a population of 2,000, the cost would be less than KES 1 per jerry can. To date, however, volumes have not reached this level, which diminishes the benefit of the fixed cost approach.

The solar approach packaged with the original LIFELINK solution is a polycrystalline panel marketed by Grundfos. Lower-cost alternatives exist in the market, and with PV panel prices having fallen by more than half since Grundfos began to implement the systems, there could be an opportunity to reduce the cost of the solution while still taking advantage of the payment system.

Results and Project Outcomes

Financial Results

Based on our analysis, the majority of sites do not appear to be generating sufficient volume to cover the monthly servicing fee. The culprit is low per capita consumption.

<table>
<thead>
<tr>
<th>Borehole</th>
<th>Date</th>
<th>Village</th>
<th>Population</th>
<th>Average Vol. m³/month</th>
<th>Cum Cash Flow</th>
<th>Vol. Incr. for B/E</th>
<th>Daily Cons/Per Capita (L)</th>
<th>Volatility/Seasonality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baranyanga</td>
<td>18/01/2011</td>
<td>Ukwala Siaya</td>
<td>2000</td>
<td>169</td>
<td>303,383</td>
<td>NM</td>
<td>2.82</td>
<td>2.3 x 0.2 x</td>
</tr>
<tr>
<td>Eendei</td>
<td>21/06/2011</td>
<td>Kithyoko</td>
<td>2500</td>
<td>29</td>
<td>(190,233)</td>
<td>316%</td>
<td>0.38</td>
<td>2.5 x 0.1 x</td>
</tr>
<tr>
<td>Gakili</td>
<td>9/11/2011</td>
<td>Isiolo</td>
<td>2000</td>
<td>33</td>
<td>(131,550)</td>
<td>264%</td>
<td>0.55</td>
<td>3.4 x 0.1 x</td>
</tr>
<tr>
<td>Ivovoani</td>
<td>12/6/2010</td>
<td>Athi River</td>
<td>2000</td>
<td>51</td>
<td>(122,350)</td>
<td>134%</td>
<td>0.86</td>
<td>12.2 x 0.0 x</td>
</tr>
<tr>
<td>Kalukuni</td>
<td>2/10/2009</td>
<td>Yatta</td>
<td>2000</td>
<td>118</td>
<td>(3,517)</td>
<td>2%</td>
<td>1.97</td>
<td>1.7 x 0.3 x</td>
</tr>
<tr>
<td>Kambi Juu</td>
<td>20/09/2010</td>
<td>Yatta</td>
<td>3500</td>
<td>47</td>
<td>(295,517)</td>
<td>154%</td>
<td>0.45</td>
<td>2.0 x 0.5 x</td>
</tr>
<tr>
<td>Kathangathini</td>
<td>23/05/2010</td>
<td>Yatta</td>
<td>2500</td>
<td>101</td>
<td>(42,550)</td>
<td>19%</td>
<td>1.34</td>
<td>2.5 x 0.1 x</td>
</tr>
<tr>
<td>Kattika</td>
<td>23/06/2009</td>
<td>Kitui central</td>
<td>1800</td>
<td>110</td>
<td>(26,017)</td>
<td>9%</td>
<td>2.04</td>
<td>1.5 x 0.5 x</td>
</tr>
<tr>
<td>Kishamba</td>
<td>30/12/2010</td>
<td>Voi</td>
<td>2000</td>
<td>113</td>
<td>194,583</td>
<td>NM</td>
<td>1.88</td>
<td>1.8 x 0.3 x</td>
</tr>
<tr>
<td>Kiwanja</td>
<td>30/10/2011</td>
<td>Isiolo</td>
<td>2000</td>
<td>7</td>
<td>(137,933)</td>
<td>1678%</td>
<td>0.11</td>
<td>3.6 x 0.1 x</td>
</tr>
<tr>
<td>KMC</td>
<td>12/8/2010</td>
<td>Athi River</td>
<td>3500</td>
<td>170</td>
<td>142,883</td>
<td>NM</td>
<td>1.62</td>
<td>1.4 x 0.6 x</td>
</tr>
<tr>
<td>Kola</td>
<td>12/1/2010</td>
<td>Machakos</td>
<td>3000</td>
<td>149</td>
<td>173,517</td>
<td>NM</td>
<td>1.65</td>
<td>11.8 x 0.0 x</td>
</tr>
<tr>
<td>Kyenge</td>
<td>10/10/2011</td>
<td>Katutu</td>
<td>2500</td>
<td>41</td>
<td>(105,450)</td>
<td>190%</td>
<td>0.55</td>
<td>3.5 x 0.1 x</td>
</tr>
<tr>
<td>Marere</td>
<td>14/11/2011</td>
<td>Imenti</td>
<td>2500</td>
<td>48</td>
<td>(78,683)</td>
<td>151%</td>
<td>0.64</td>
<td>3.9 x 0.0 x</td>
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<tr>
<td>Matabithi</td>
<td>03/11/2011</td>
<td>Tigania East</td>
<td>2500</td>
<td>181</td>
<td>(600)</td>
<td>-34%</td>
<td>2.41</td>
<td>1.6 x 0.1 x</td>
</tr>
<tr>
<td>Munyeki</td>
<td>23/08/2010</td>
<td>Nyandarua</td>
<td>2000</td>
<td>7</td>
<td>(232,083)</td>
<td>1724%</td>
<td>0.11</td>
<td>8.3 x 0.0 x</td>
</tr>
<tr>
<td>Murera</td>
<td>20/03/2010</td>
<td>Igembe North</td>
<td>1000</td>
<td>71</td>
<td>(4,417)</td>
<td>70%</td>
<td>2.36</td>
<td>1.8 x 0.5 x</td>
</tr>
<tr>
<td>Musinga</td>
<td>10/03/2009</td>
<td>Musinga</td>
<td>1800</td>
<td>98</td>
<td>(62,317)</td>
<td>23%</td>
<td>1.81</td>
<td>2.5 x 0.2 x</td>
</tr>
<tr>
<td>Muthembwa</td>
<td>07/06/2010</td>
<td>Kithyoko</td>
<td>2000</td>
<td>71</td>
<td>(181,833)</td>
<td>70%</td>
<td>1.18</td>
<td>1.8 x 0.5 x</td>
</tr>
<tr>
<td>Mwambathaa</td>
<td>13/10/2011</td>
<td>Yatta</td>
<td>2500</td>
<td>33</td>
<td>(62,317)</td>
<td>267%</td>
<td>0.44</td>
<td>4.3 x 0.0 x</td>
</tr>
<tr>
<td>Rurii</td>
<td>19/06/2009</td>
<td>Rurii</td>
<td>2000</td>
<td>200</td>
<td>229,133</td>
<td>NM</td>
<td>3.33</td>
<td>6.2 x 0.0 x</td>
</tr>
<tr>
<td>Samburu</td>
<td>01/11/2010</td>
<td>Kitimany</td>
<td>2000</td>
<td>1,077</td>
<td>2,854,750</td>
<td>NM</td>
<td>17.95</td>
<td>8.3 x 0.0 x</td>
</tr>
<tr>
<td>Wendano</td>
<td>24/01/2010</td>
<td>Yatta</td>
<td>1800</td>
<td>(111,535)</td>
<td>(318,143,650)</td>
<td>-100%</td>
<td>(2,065.46)</td>
<td>-0.1 x 19.2 x</td>
</tr>
</tbody>
</table>
According to LIFELINK, water pricing at most projects is either KES 2 or KES 3 per jerry can, though there are a few as low as KES 1 as well as some that are KES 4 or 5. The servicing fee is KES 215,000 annually. Thus, a village paying KES 2 would need monthly volume of about 180,000 L (9,000 jerry cans @ 2KES = 18,000 KES), while a community paying 3 KES would need 120,000 L to generate sufficient water sales to pay the monthly servicing contract.

As the next chart shows, based on volumes from inception through February 2012, only KMC was generating sufficient volume to service the fee at a price of 2 KES, while six communities were generating sufficient volume to manage the fee at a 3 KES price, with five additional communities being very close to achieving this result. The remaining communities were quite distant from operating sustainably, needing volume increases of at least 100%.

Grundfos LIFELINK has evaluated the factors behind low water consumption in the communities, and its conclusions echo the economic and social hurdles identified in this report. In response, Grundfos LIFELINK has had to move beyond the technically-focused support structure envisioned in the original business model to initiate a program of community monitoring and support designed to increase consumption. This reflects the company’s commitment to success for its projects, though the necessity of such initiatives represents an additional cost and a barrier to commercial provision. For decentralized water initiatives to succeed at scale, this burden should be shifted to institutions with the appropriate mission and long-term funding, a critical component to creating the “Enabling Environment” discussed in Section 8.

In summary, at current volumes, the following chart shows the percentage of sites that could generate sufficient cash to pay the monthly service charge at different price points.
Considering the population of each community, it seems evident that in most cases the LIFELINK system is not the main water source for local consumers.

As shown in the charts below, the seasonal variation of consumption is a major contributing factor to the lack of volume. The Kishamba site provides a fairly typical seasonal picture. Serving a population of 2,000, the site generates per capita consumption of about 3 L during peak seasonal periods, but only 0.5 L per capita in the rainy season. This represents the difference between being able to service the maintenance contract at the original pricing or not. In response, Grundfos LIFELINK has worked with the community to agree to a higher price of KES 5 that can cover the contract in all but three months of the
In other communities, Grundfos LIFELINK are working to generate higher usage and volume, where price increases may be more difficult. Furthermore, the company has stated that it will not abandon a community even in cases where the service contract is not fully covered.

Under the current model, and in the locations where the system has been installed, capital recovery is not feasible. If a population of 2,000 used 7.5L per capita per day, a price of KES 3 could recover capital in 7 years, with KES 0.5 paying the service fee and KES 2.5 dedicated to capital repayment. But as mentioned earlier, this consumption level is two times higher than the most successful site, and an order of magnitude higher than the weaker locations. The near term plans are therefore to continue to install the systems with donor funds, while developing a long-term program for demand generation within each community.

**Health Outcomes**

The LIFELINK systems are designed to provide sustainable supply of safe water from boreholes. According to Grundfos LIFELINK, in approximately 60% of cases the LIFELINK system has been installed on a capped, non-functioning borehole, meaning that residents were likely relying on contaminated surface water. Of the remaining sites, nearly all replaced a hand pump system, while just two replaced a diesel generator. Where the LIFELINK system replaces a hand pump, the quality of the water is expected to be the same, but convenience is higher and waiting time lower, which should translate to increased consumption and a positive health impact.

Although there have been no detailed third-party health impact assessments published, according to internal LIFELINK evaluations communities report a significant decrease in water borne diseases, as well as a time saving relating to fetching water. An additional benefit may come from the use of water for kitchen gardens and livestock, which would increase general nutrition levels.

The systems do not incorporate any residual chlorine protection, or an area to clean containers prior to filling. Considering numerous studies as well as the observed condition of containers in rural Kenya, the potential for re-contamination is high, even where the water is safe at the selling point. Grundfos LIFELINK is focused on developing alternative chlorine dispensing systems that can provide accurate and safe chlorine dosing, without losing the economic benefit of the unmanned kiosk model.

**Future Plans**

In the coming years, Grundfos is planning a significant expansion of LIFELINK in Kenya, and also expanding operations to several countries in Africa and Asia. Based on initial learning, the company is
now developing the third generation of the LIFELINK dispenser with applications for both rural and urban settings, with an aim to bring down the cost considerably. Grundfos LIFELINK is also developing a water treatment solution for surface water, to be introduced to markets in Africa and Asia during 2013.

Perhaps more exciting for the sector, Grundfos LIFELINK will be providing the different components of the system on a disaggregated basis, which will allow the water dispensing and payment systems to be used in existing water schemes. If volumes and economics can be improved, the framework of a payment system that can fund not only current operations but also generate reserves for maintenance, and keep these funds safe from interference, corruption and mismanagement, could solve a critical hurdle that has plagued rural water systems.

**Conclusions, Issues and Questions**

LIFELINK combines a number of key elements which could at some point form a viable solution for decentralized systems. Though not at present commercially viable in most of the locations where it has been installed, it has served a pioneering function and is showing a path for future innovation.

Assuming Grundfos is not seeking to subsidize the continued system operating deficits indefinitely, volumes will need to increase. Currently, most projects appear to be generating very low per capita consumption rates, if the population figures cited by Grundfos for each location represent the actual target user base. The main focus should be to understand whether the issue is user penetration (i.e. is each system actually reaching the expected number of users, or are they opting for more convenient sources), or whether it is an issue of broad use but low per capita consumption. A single point system such as Grundfos LIFELINK will always face a challenge in rural communities where population density is low and populations are scattered. In response, Grundfos LIFELINK is working with the communities to develop broader distribution methods.

Another option would be to try to decrease the service cost, which could perhaps be accomplished by focusing on clusters of communities to bring down the cost to serve each one. But a monthly charge of $200 is already quite low, if it must pay not only routine maintenance but also unexpected breakdowns.

Although in the first years of operations in Kenya, Grundfos offered LIFELINK as a turnkey concept, the company is now offering the payment and dispensing system separately to customers and project sponsors. This should serve to increase the applicability of the technologies in urban and peri-urban areas, where the dispensers can be connected as automatic water kiosks in existing water schemes. It is possible that the payment system could have wide applicability. In rural areas, projects to mechanize
existing borewells, or to add kiosks to existing systems, could perhaps be accomplished more efficiently by using the M-PESA system. Urban “Water ATMs” using the system could eventually flourish, including under entrepreneur or franchise models.

**Issues and Questions for Further Study**

- **Reducing the Capital Cost** – the cost of approximately $45,000 for the unit, exclusive of borehole cost, is viewed as quite high particularly considering that there is no treatment, and is a barrier to commercial feasibility. Detailed comparisons on a like for like basis with similar systems used in India and elsewhere could identify opportunities to reduce the expense. To address this barrier, Grundfos LIFELINK is developing a new version of the dispenser with lower cost.

- **Target Population Demographics** – Though the system has generally been thought of as appropriate for rural populations without grid power, the high cost and single dispensing point may be more appropriate for higher-income, more densely populated areas, if the model is to prove full commercial viability. By offering the water dispenser and payment system on a component basis for urban water schemes, it will be possible to determine if a fully commercial model is possible. As Grundfos builds up an inventory of locations, the information captured via RFID should enable analysis to determine necessary characteristics for success.

- **Health Outcomes** – A detailed health assessment would be very useful to assess the magnitude of reduction in water-borne diseases, particularly in cases where an existing, functioning handpump system is being used as the source. Considering that the source water is not changing, health improvements in such cases would come from the convenience drawing people from other unsafe surface water sources.

- **Groundwater Quality Issues** – as groundwater quality tends to deteriorate over time, what procedures can ensure that LIFELINK continues to supply only safe water? If a water source were to no longer be safe, would the community accept the higher price required to add treatment?

- **Treatment options** – In its current form, the system is only appropriate for the areas of Kenya where the groundwater is safe for human consumption. What are the capital, operating cost and servicing implications of including water treatment in order to expand coverage to all of Kenya? At a minimum, are there options for reliable low-cost chlorine dosing while maintaining the unmanned model?

- **Increasing consumption of safe water** – The experience of Grundfos LIFELINK reflects the general issues raised earlier in the report. Consumers are willing to pay for water to a certain extent, but a range of factors will cause a large group of consumers to opt for water sources that are freely or more cheaply available, despite the water sources being unsafe. Further study into the social, cultural, and practical barriers and enablers for making people choose to pay for safe water is needed.
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