

# Remote Monitoring of Privately-Managed Rural Water Supply Systems Using Grundfos LIFELINK

Andrew M. Armstrong

Water Missions International, 1150 Kinzer St. Building 1605, North Charleston, SC 29405-2043, USA

## Abstract

As alternative service delivery models that share the management burden traditionally placed on local water committees among public and private stakeholders begin to be explored, technologies that allow water system performance to be tracked remotely are becoming increasingly relevant. Water Missions International is utilizing one such technology to monitor rural water supply systems implemented under its "TradeWater" private service delivery model. The LIFELINK unit developed by Grundfos is a water distribution point that is integrated with a secure payment facility and real-time GSM monitoring capabilities. Users are able to pay for water by inserting a "water key" that is loaded with credit into the unit. A collection fee is deducted from the key as water is withdrawn. The funds transferred and volumes distributed during each transaction are recorded in an online database that can be viewed in real time. The LIFELINK unit encourages accountability and transparency while allowing an extensive amount of water use data to be collected and used to develop water businesses.

A summary of LIFELINK operational data for the first three months of a TradeWater operation in Kikondo, Uganda is presented here. During the observed time period 150 water keys were sold and 145 were actively used in the community of 380 homes, representing a penetration rate of 38.2%. On average, each water key was used to draw 66.6 L from the LIFELINK unit over 2 tapping sessions every day. GPS labeling of residences associated with water keys allowed a negative correlation between distance traveled to collect water and average volume of water collected each day to be observed. The amount of water purchased by each key represented a household consumption expenditure of 2.9% assuming average household monthly income in the Eastern Region reported by the Uganda Bureau of Statistics. On average, a total of \$5.07 USD worth of credit was sold each day. The remote monitoring system described here has enabled the progress towards performance goals of rural water supply systems to be gauged in an unprecedented manner. If scaled, the technology could revolutionize the way stakeholders monitor and evaluate such systems.

## Background

The Rural Water Supply Network identifies the assumption that "communities are always capable of managing facilities on their own" as one of the major myths plaguing the rural water supply sector today. In truth, the typical water committee that is responsible for a community-managed water supply system is faced with a multitude of technical and financial challenges that are often insurmountable even with adequate post-construction support. As alternative service delivery models that share the management burden traditionally placed on local water committees among public and private stakeholders begin to be explored, technologies that allow water system performance to be tracked remotely are becoming increasingly relevant.

Water Missions International, a nonprofit Christian engineering ministry providing sustainable safe water solutions to people in developing countries and disasters, is utilizing one such technology to monitor rural water supply systems implemented under its "TradeWater" private service delivery model. The LIFELINK unit developed by Grundfos is a water distribution point that is integrated with a secure payment facility and real-time GSM monitoring capabilities. The system encourages accountability and transparency while allowing an extensive amount of water use data to be collected and used to develop water businesses.



Users collect water from LIFELINK units installed at Water Missions International TradeWater projects in Uganda (left) and Malawi (right).

## Background (continued)

The LIFELINK unit allows users to pay for water by inserting a "water key" that is loaded with credit into the unit. A collection fee is deducted from the key as water is withdrawn. The funds transferred and volumes distributed during each transaction are recorded in an online database that can be viewed in real time.



Various water-related services are offered at Water Missions Uganda's TradeWater Business Center in Kikondo (left); users purchase and collect water from a LIFELINK unit at the Kikondo business center (right).

In communities where the TradeWater program is implemented, Water Missions International constructs and maintains responsibility for all operational and administrative aspects of the water supply system. Trustworthy members of the community (called "Water Agents") are employed to operate the water system under a sustainable, nonprofit business model. The TradeWater approach allows Water Missions International to operate as a low-cost water service provider in settings where community-based management is unfeasible but where a sustainable water-related business can be established. The first TradeWater pilot project opened for business in Kikondo, Uganda in February of 2012.



Site map of the water treatment and supply system in Kikondo, Uganda. The distribution kiosk and TradeWater business center is located in the center of the village.

A summary of LIFELINK monitoring data and analysis for the first three months of TradeWater operations in Kikondo is presented here.

## Results

During the observed time period 150 water keys were sold and 145 were actively used in the community of 380 homes, representing a penetration rate of 38.2%. On average, each water key was used to draw 66.6 L from the LIFELINK unit over 2 tapping sessions every day. Assuming an average household size of 5.6 (2010 Eastern Region census data from the Uganda Bureau of Statistics), the average daily per capita consumption in Kikondo during the observed time period was 11.9 L. Household surveys indicated that this volume of water was being used for drinking and cooking and that lake water was being used for other domestic purposes including laundry, bathing, and dishwashing.

Daily trends in total volume of water distributed from the LIFELINK unit, total number of tapping sessions, and number of users over the observed time period is displayed in Figure 1.

## Results

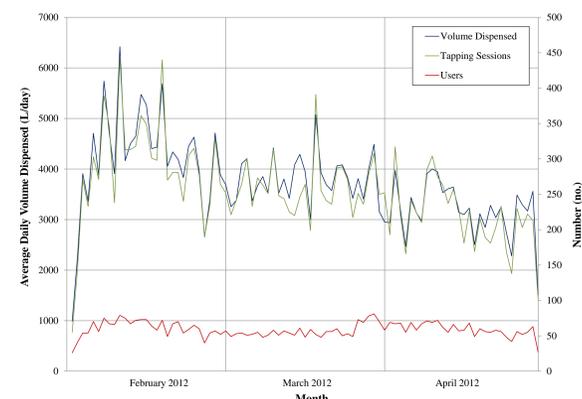


Figure 1: Trends in Daily Distribution, Tapping Sessions and Users

GPS labeling of residences associated with water keys allowed a negative correlation between distance traveled to collect water and average volume of water collected each day over the three-month observation period to be observed. This relationship is illustrated in Figure 2.

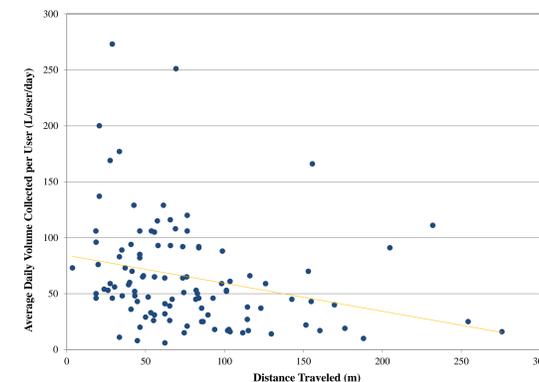


Figure 2: Daily Volume Collected per User versus Distance Traveled

Further analysis showed a decrease in number of users, in addition to average daily volume collected, as distance from residence to the TradeWater Business Center increased.

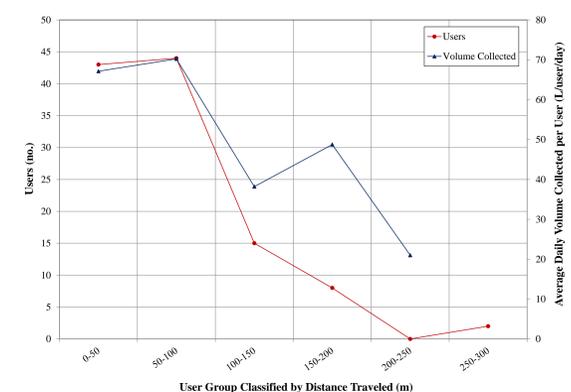


Figure 3: Effect of Distance on Number of Users and Volume Collected

Although the entire village of Kikondo is less than 0.5 km in diameter, it appears that distance of residence from the TradeWater Business Center plays a role in water use decisions. While this finding is certainly not groundbreaking, it suggests water sales could be increased if accessibility was improved through construction of additional distribution points.

## Results (continued)

The amount of water purchased by each key represented a household consumption expenditure of 2.9% assuming average household monthly income in the Eastern Region reported by the Uganda Bureau of Statistics. On average, a total of \$5.07 USD worth of credit was sold each day. Monthly water sales declined slightly over the observed time period, and the program continued to operate under a slight deficit even with the addition of revenue from phone charging and bathing shelter sales.

Table 1: Revenue Summary

	Water Sales [USD/month]	Other Sales* [USD/month]	Total Sales [USD/month]
February	\$125.70	\$22.25	\$147.95
March	\$117.66	\$46.33	\$163.99
April	\$94.84	\$43.60	\$138.44
Average	\$112.73	\$37.39	\$150.13

Table 2: Expense Summary

	Operating Expenses** [USD/month]	Est. Maintenance Expenses*** [USD/month]	Total Expenses [USD/month]
February	\$123.63	\$50.00	\$173.63
March	\$115.97	\$50.00	\$165.96
April	\$106.98	\$50.00	\$156.97
Average	\$115.52	\$50.00	\$165.52

\*Includes phone charging and bathing shelter sales.

\*\*Includes local agent commissions and salaries, chemical costs, cash transport expenses, water unit internet, and banking fees.

\*\*\*Includes maintenance and repair estimates for all equipment and water unit. Does not include depreciation costs which were estimated to be \$327 USD/month.

## Discussion

Ongoing critical analysis of household penetration and consumption is essential for adequate financial management of water supply systems. Data made available through the LIFELINK distribution unit has greatly simplified the tracking of these variables in Water Missions International's TradeWater programs and has enabled the analysis of additional indicators of sustainability.

When systems are found to be operating under a financial deficit, as in Kikondo, steps must be taken to increase revenue. This can be accomplished by increasing penetration, consumption, or water price, or by generating revenue from alternative sources. Each of these avenues come with unique challenges. Traditional marketing and promotion techniques can be employed to increase the number of water users in a particular community. In addition, when accessibility is found to hinder potential users from collecting water from the system as appears to be the case in Kikondo, additional water points can be added to reduce the amount of travel and time required to collect water and increase number of users. However, this can become costly when LIFELINK units are used as the distribution points because the current design would require installation of multiple units in a community. Grundfos is working to reduce the price of the LIFELINK unit in order to make this option more feasible. When attempting to increase consumption or considering an increase in water price, care must also be taken to ensure that consumption expenditure remains as low as possible. The consumption expenditure during the observed time period in Kikondo (2.9%) is just under the 3% value that the UNDP has suggested as an indicator of economic hardship (Human Development Report 2006). This implies that there is not much room to increase consumption or water price in the project without limiting financial accessibility.

The remote monitoring system described here has enabled the progress towards performance goals of rural water supply systems to be gauged in an unprecedented manner. If scaled, the technology could revolutionize the way stakeholders monitor and evaluate such systems.