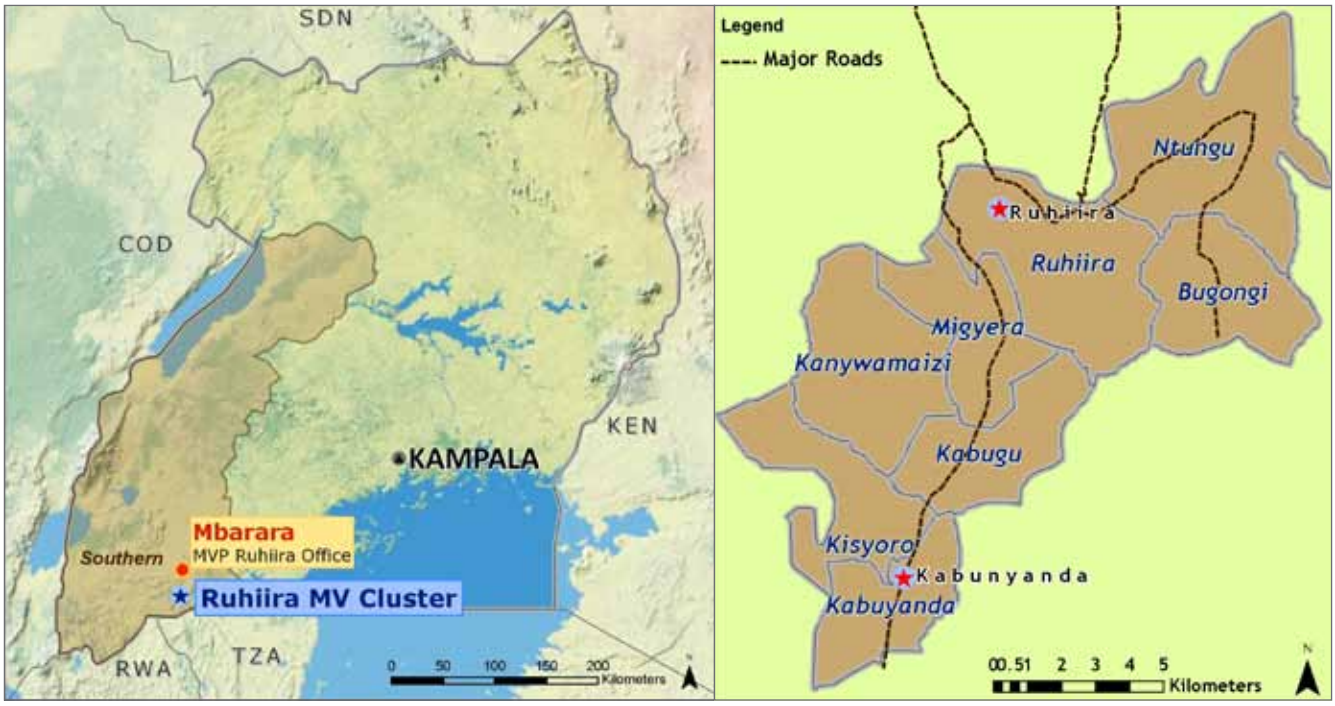
CHAPTER 9

Site Profile: Ruhiira, Uganda



Ruhiira is a cluster villages located in the Isingiro District of southwestern Uganda, near the town and commercial center of Mbarara. The cluster has a total population of about 50,000 people, 95 percent of whom practice agriculture as their primary occupation, with plantains as the primary staple food and cash crop. The area covers about 140 square kilometers, with elevations ranging between 1,350 and 1,850 meters, and rainfall between 900 to 1200 millimeters annually. The undulating hills are characterized by steep slopes, which drain into the valley bottoms, creating a stream system that finally drains into the Kagera River, which flows into Lake Victoria.

Ruhiira is a relatively recent settlement that was created after sub-tropical forest was cleared in the early 1950s. Clearing indigenous forest for farming is estimated to have left only about five percent of the land under tree cover. There are serious signs of deforestation, environmental degradation and a shortage of available wood (for firewood, construction, etc.). High population density, continued growth rates and commercial over-cropping have contributed to land shortages and degradation. Ruhiira is among the poorest of areas of southwestern Uganda, with close to half the people (40-50 percent) earning less than one dollar a day.

Summary of Infrastructure Outcomes and Lessons Learned

- MVP increased the proportion of residents using improved drinking water from seven percent at baseline to 56 percent by year five with a combination of piped water and improved springs. Topography was decisive for piped water schemes, leading to a factor of three to four times difference in costs for serving villagers in upland areas (served by pumps) versus lowlands (served by gravity-flow systems).

- Plans for comprehensive grid electrification with the cost sharing between the government and MVP experienced multi-year delays. SharedSolar micro-grids were undertaken to fill the resulting gap in household electricity access.

- Improved institutional cookstoves in schools can dramatically decrease the fuel consumption of school meals programs. Households have shown a willingness to pay (~$10) for improved, manufactured household stoves that are sold with ~50 percent subsidy.

- MVP road works consisted of substantial widening and grading (>50 kilometers), new road construction (40 kilometers), and installation of drains and culverts (~30 kilometers).

Energy in the Ruhiira Cluster

MVP Target: 50% Grid Electrification	Community-level electricity service to 50% of cluster population
Status at Project Launch: 0%	No grid connection in Ruhiira
Outcome at 5th Year: k13% Grid Electrification + SharedSolar for off-grid	13% of the population lives within 2km of the grid
MVP expenditures: $150,000 (estimate)	$45,678 for grid-related costs. Estimated $100,000 spent so far on SharedSolar
Partner / Government contribution: N/A	Costs for grid extension to Kabuyanda are not available.

Before the MVP, the nearest electricity gridline was 15 to 20 kilometers outside the Ruhiira cluster. Most clinics had inadequate power or none at all, and households relied on kerosene, candles or dry cell batteries for lighting and other non-cooking energy tasks. Several households and some market centers had diesel generators for lighting, cell phone charging and small appliances. MVP Ruhiira aimed to halve the number of institutions and households lacking access to modern energy. Plans were developed to extend the electricity grid via collaborations with the local energy utility and national Rural Electrification Agency. However, government cost-sharing contributions were delayed, and MVP undertook SharedSolar (standalone mini-grid systems serving 10 to 20 households) where grid extension activities were not feasible.

After an early MVP appeal, the Rural Electrification Agency (REA) offered over $1 million in cost sharing (>50 percent of total project costs) for comprehensive grid extension throughout the Ruhiira cluster, serving social infrastructure and water points. While the government did support MV grid extension to one important location—Kabuyanda, which has a population of greater than 5,500, a major market, a hospital and two schools—full cost-sharing support from REA was not forthcoming for the rest of the electrification plan within the project's timeframe. In response, the MVP initiated installations of SharedSolar, a standalone micro-grid solar system (see Chapter 5), as an alternative strategy to meet project electrification targets. In the Ruhiira cluster, eight SharedSolar systems were planned across three to four communities. One system installed in Ruhiira is now serving 20 customers (mostly households), with others planned for Nyankitunda and other locations not yet identified.

SharedSolar sites were selected based on a combination of technical and social criteria: no electric grid now or planned in the near future, a high density of potential customers (10-20 within a 100 meter radius) with willingness and ability to pay, strong and consistent mobile phone network coverage and year-round vehicle accessibility. Community sensitization in-

volves three steps: i) community meetings to describe SharedSolar, noting how it differs from both grid electricity and solar home systems and identify possible sites for the central generation equipment; ii) targeted small group conversations to plan the pathways of wires to homes, with a goal of reducing total line length and helping move targeted consumers to the next step; iii) registration, which details initial and recurring costs (i.e. scratch cards) plus a survey of household characteristics, energy use and related expenditures. Registration concludes with customers paying connection fees.

The first SharedSolar system carried a capital and installation cost of about $27,000: $5,000 for the meter, $10,000 for the PV system and about $12,000 for the civil and electrical works, including a shed, trenches, labor, wire etc. Each household contributed ~$55 as a connection fee for the first system installation in Ruhiira (estimated at $70 for future customers). At $25,000, the cost is nearly $18/Wp installed, and the cost per household connection is $1,250. The cost of future installations is expected to fall—by 20 percent in the short term and 60 percent in the long term (i.e. down to $500 per connection)—as experience is gained in civil and electrical works, management and economies of scale.

HOUSEHOLD COOKSTOVES

Fuelwood scarcity, due primarily to cleared forests for farming, caused many cluster villagers to rely on farm waste (maize stokes and banana rhizomes) as their major energy source for cooking, and some reported limiting the number of meals cooked per day due to lack of fuel. The MVP improved cookstove program was introduced to ameliorate these problems by introducing improved, fuel saving stoves. The Project conducted Controlled Cooking Tests (see Chapter 4) to compare fuel use of the locally-produced Ugastove, the imported StoveTec and the three-stone fire combined with a survey to evaluate which stove users preferred. Results indicated statistically significant fuel savings for both the StoveTec and the Ugastove (around 35-40 percent for each), but cooks showed a greater preference for the StoveTec.

Based on these results, the MVP introduced StoveTec stoves through a program in which stoves were sold via an energy cooperative and village vendors at a subsidy of ~50 percent: 20,000 USh each ($9) purchased individually, or 100,000 USh ($45) for six stoves ($7.5 each) purchased in bulk. The majority of customers opted to buy as a group, through one of 14 village vendors, who received a 500 USh commission (~$0.50) per stove. Over 1,000 stoves were sold, indicating villagers' willingness and ability to pay. Delays

Figure 9.1, SharedSolar, (left to right): a shed housing the batteries and electronics; solar panel installation; home with electric lights powered by SharedSolar next to a home using kerosene lighting

Figure 9.2: Three-stone fire (left); household Rocket-style cookstove (right)

in the arrival of the second order of cookstoves complicated marketing and program operations and caused some vendors to lose motivation. In response, raising vendors' per-stove commissions from 500 USh to 1,500 USh incentivized them to stock stoves and to provide better post-sales service.

Energy and Infrastructure for Health

MVP Target:	Electrify health facilities as required by MVP health sector
Status at Project Launch: 33% of health centers electrified	6 clinics existed in cluster, 2 electrified with solar at baseline
Outcome at 5th Year: 100% of health centers electrified	One facility (Kabuyanda) has grid power and solar All others have solar power
MVP expenditures: US$11,568	Includes small solar systems, diesel generators
Government contribution: N/A	Costs for electricity grid extension to Kabuyanda are not known

At baseline, the Ruhiira cluster had six health facilities, only two of which had consistent power (solar systems), and one used a generator intermittently. Due to the inadequacy of local facilities and services, the Ruhiira population often traveled 58 kilometers to the regional referral hospital in Mbarara for major medical services such as surgeries. By year five, one of the health facilities had been connected to the grid, which the Ugandan government extended to Kabuyanda, and the remaining four had standalone solar systems.

The introduction of the Ruhiira water scheme also provided the Ruhiira health center with access to clean tap water with three fully installed rainwater harvesting tanks, plumbing, a pump and an elevated water tank (500 liters). The other five clinics all had one to two new rainwater harvesting tanks installed. The project assisted in the construction of gender-separate, brick VIP latrines in order to improve the sanitary conditions at the health facility.

Figure 9.3: Health Facility Electrification in the Ruhiira cluster

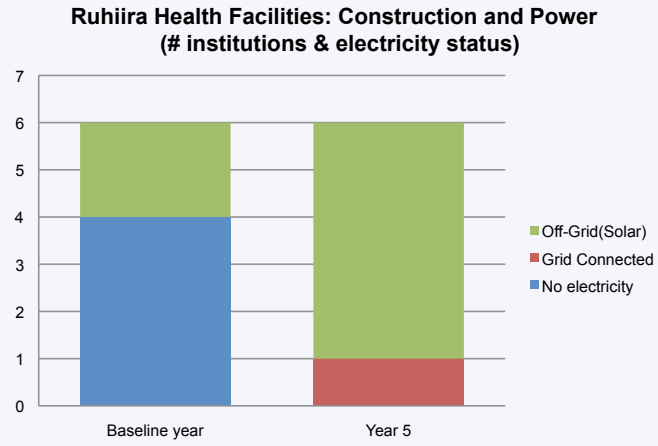


Figure 9.4: Rainwater harvesting with PVC tanks (left); VIP at Ruhiira District health center (right)

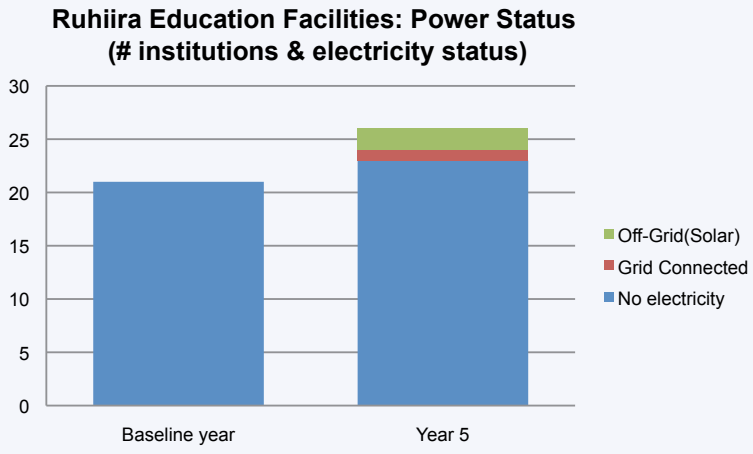
Energy and Infrastructure for Education

MVP Target:	Electricity service to education facilities as required by education sector
Status at Project Launch: 21 schools, 0% electrified	None of the cluster's 21 schools had electricity
Outcome at 5th Year: 26 schools, 12% electrified	5 new schools were built. 3 schools have electricity (12%): 2 have solar power, 1 is connected to the grid.
MVP expenditures: $3,000	Two solar systems at $1,500 each.
Government contribution: $0	$0

At the start of the MVP, there were 21 schools in the cluster, 18 primary schools and three secondary schools, and none of them had access to grid electricity. At year five, the project had constructed an additional five schools, bringing the total number of schools to 26 (19 primary schools, four secondary schools and three nursery schools). The project also electrified two schools using solar systems and connected one school to the grid near the Kabuyanda extension.

In school kitchens, MVP installed more than 40 Rocket cookstoves in more than 20 schools. These improved stoves reduced the burden of fuel collection as well as fuel costs of the meal programs. Each of the institutional stoves cost roughly $1,800, which was covered by MVP.

Figure 9.5: Construction and electrification of educational facilities in the Ruhiira cluster



The Project also upgraded rainwater harvesting activities by introducing PVC and ferro cement rainwater tanks in schools to reduce contamination. This provided students with washing stations for use after leaving the latrines, improving sanitary conditions. Between baseline and year five, the project installed an additional 34 rainwater harvesting tanks in cluster schools. Also, in accordance with Ministry of Education guidelines, 324 VIP latrines were constructed (25 to 30 students per stall), in order to improve the attendance of girls who might avoid school if required to share latrines with boys. The five stance VIP latrine blocks were constructed by MVP at a cost of $3,896 each, including a small community contribution to the project.

Standalone solar systems were installed in two schools for lighting and powering donated computers. Each system cost approximately $1,500 and was funded through the project's education budget in conjunction with the ICT program to bring connectivity to schools (see ITC section below).

Transportation

The Ruhiira cluster is located in a hilly setting with heavy rainfall and steep elevation changes causing rainwater to rapidly damage road surfaces. At baseline, there were only two all-weather roads: one connecting Ruhiira to Kabuyanda, and another connecting Ruhiira and Nyakitunda. The MVP's roads and transportation strategy focused on improving roads and providing access to timely, motorized ambulance service for medical emergencies.

MVP Target:	Fifty percent coverage of population within 2km of an all-weather road
Status at Project Launch: 20% of the population	20% of the Population within 2km of an all-weather road (Roughly 20km of existing road)
Outcome at 5th Year: 75% of population	75% of population within 2km of an all-weather road (Representing 70km of opened, graded and maintained.)
MVP expenditures: $176,370	Including assessments, road related salaries and road work
Government Contribution: $19,330	Including assessments, road related salaries and road work

At baseline, MVP assessed all roads within the cluster and created a plan for road improvement in the cluster. This meant working with local authorities to compile a list of roads with lengths, locations and current status; community meetings to prioritize road construction and rehabilitation; consultations with district engineers to avoid overlap with government roads works; and creation of a final list of priority

Figure 9.6: Rehabilitation of the Kaaro-Karungi-Kisyoro road, before (left) and after (right).

roads for MVP rehabilitation and construction.

At year five, over 50 kilometers of community roads have been widened and graded, and 40 kilometers have been newly constructed. Around 30 kilometers of local roads were outfitted with side drains and line culverts to reduce water damage during the rainy season. The Project maintained all-weather specifications for all newly-constructed, graded, and spot-graveled roads to ensure they would be passable during heavy rains. These roads have improved access to the nearby Kabuyanda market and have increased the community's access to cluster markets in general, health facilities, schools, water sources and other institutions.

For future maintenance, the project organized beneficiaries into road committees and trained them in simple road maintenance tasks such as culvert cleaning, weed removal, spot-graveling, etc. Also, each year, the district classifies and takes over the roads that have been constructed or rehabilitated by MVP, making them eligible for annual road maintenance programs supported by district funding.

Water and Sanitation

MVP Target:	100% Coverage: Proportion of population using an improved drinking water source, year-round during wet and dry seasons
Status at Project Launch: 7%	Most underground water sources contaminated by salts; protected springs were far from homes
Outcome at 5th Year: 57%	Combination of piped water and protected springs
MVP expenditure: $157,148	Including borehole rehabilitation, shallow wells, springs protection and piped water design, planning and construction
Government contribution: $82,645	Including piped water design, planning and construction

The provision of cleaner drinking water was perhaps the primary challenge for the Ruhiira MVP. Despite an estimated annual rainfall of between 900 to 1,200 millimeters and two rainy seasons annually, only seven percent of the cluster's population had reliable access to clean water at the Project's start. Most underground water sources contained concentrations of iron and salts at levels that made them unsuitable for human consumption. A limited number of protected springs were available; however, a 400-500 meter elevation differential between hilltops where most villagers live, and valley bottoms where springs are located, made access a daily challenge. Villagers typically lined up at springs as early as 5 a.m. to access clean water, and these long morning queues contributed to school absenteeism and tardiness.

These difficulties led residents to obtain water for drinking and cooking elsewhere. Some collected pooled rainwater from road drainage ditches, ponds or puddles. Others employed informal rainwater harvesting (RWH) methods, gathering rain from rooftops, using simple gutters made from strips of corrugated metal or split plastic pipes to guide water into bucket containers or tarpaulin-lined underground tanks. Both methods risked contamination. Most institutions in the cluster, particularly health and educational facilities, did not have access to clean water. In schools, the majority of the buildings used less than 50 percent of their major roofs for rainwater harvesting.

The site's primary water and sanitation sector goals are: i) to halve the proportion of people without access to safe drinking water within 1 kilometer from the household; ii) to provide basic sanitation services. Toward these ends, MVP performed an extensive assessment of Ruhiira's water and sanitation resources and needs: the demands of households and institutions; the quality of water sources and the specifications of the local water authority. This included information gained through local government agencies, community members and other development partners. Feasibility studies were performed to determine the technical, social, cultural, institutional, financial, and environmental viabilities of the intervention. Existing water sources and communities were identified and viable interventions are prioritized for improvement.

The result was work-plan for constructing four piped-

Figure 9.7: Collecting water from a ditch (left); rainwater harvesting from roof to underground tank (right)

water schemes (in Ruhiira, Kyeyare, Kyenyanga and Kabuyanda) using a total of 11 water springs at an estimated cost of $1.75 million. Due to limited funds, two water schemes were prioritized through a collaborative effort between MVP, the local water authority and villagers: 1) a pumped water system in Ruhiira costing $480,000 and serving an estimated 5,073 villagers ($24 per capita); and 2) a gravity-fed water system for Kabuyanda, costing $180,000 and serving 7,637 villagers ($95 per capita).

The reason for the difference in construction costs was topography: The source for the Kabuyanda system was 150 meters away and allowed for gravity distribution. However, the source for the Ruhiira scheme was almost 300 meters below the village and required the addition of four pumps (two duty and two standby), two diesel generators to operate the pumps, over 1,400 meters of ductile iron transmission pipe to withstand the pressure of the pumped water and two 150 cubic meter water storage tanks (one made of reinforced concrete to capture the water from the springs before it is pumped into an elevated pressed steel reservoir at the highest point).

Supplementary interventions were required to provide remaining villagers with access to safer water. These interventions included i) upgrading rainwater harvesting activities through the use of PVC tanks at schools and health centers to reduce contamination in 52 facilities, ii) expanding the number of water points from 86 to 163 and iii) increasing the number of protected water sources from three to 16.

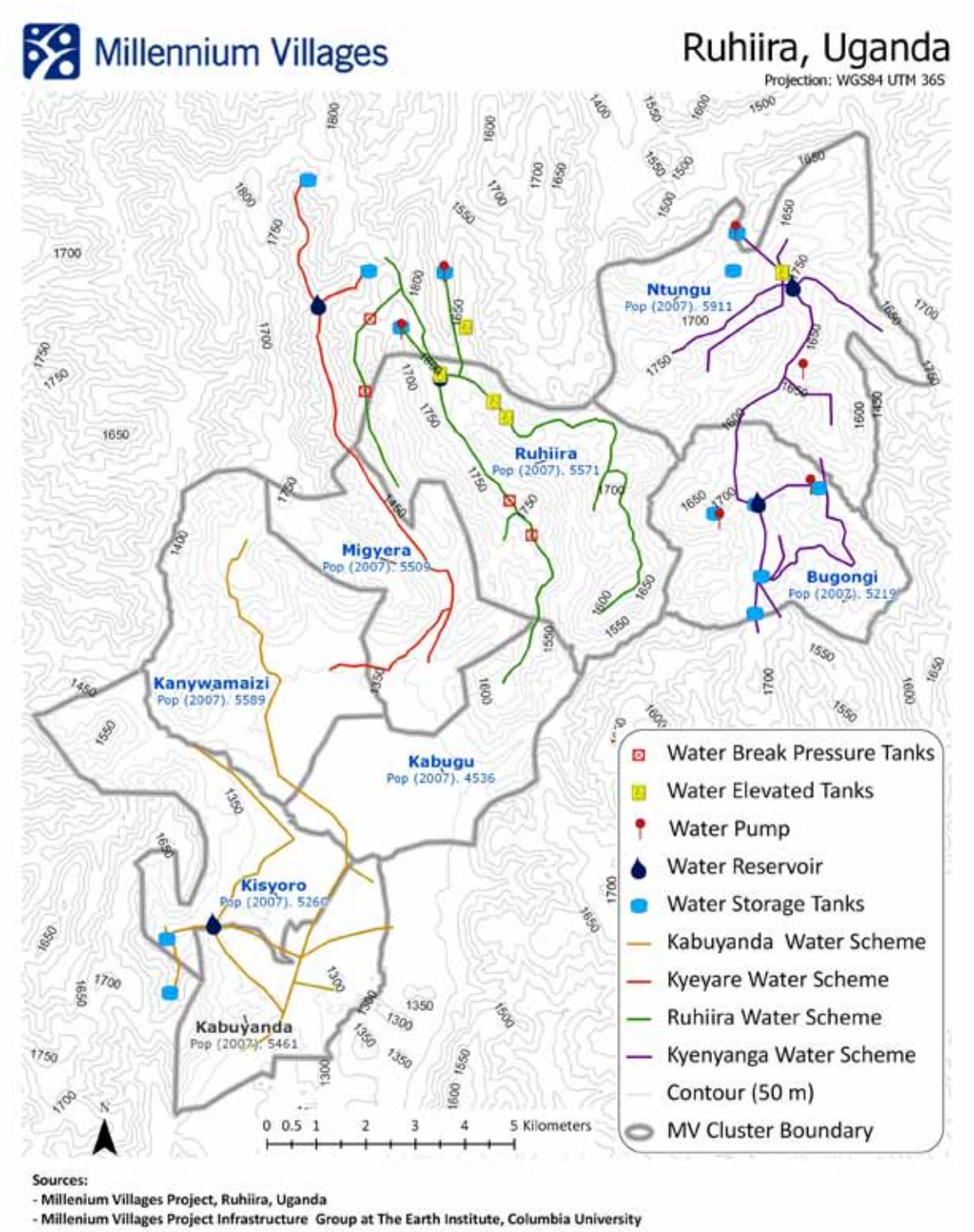
MVP Target:	Reduce by half the percentage of population without access to basic sanitation
Status at Project Launch: N/A	Baseline information not available.
Outcome at 5th Year: 100% institutions	MVP programs to construct VIP latrines resulted in 500 latrines in households, 84 in institutions.
MVP expenditure: $60,000	MVP contributed around $90 for each household latrine ($44,973 total); estimate of $15,000 for 84 institutional latrines.
Community contribution: $45,800	Each household contributed ~$91 (materials and labor).

As assessment of primary school latrines revealed that none achieved the minimum standard for providing access (no more than 40 students per stance), and many latrines were made of earthen materials with doors of woven dried banana leaves and contained no hand washing stations. In response, MVP constructed institutional and household latrines. MVP supported the construction of Ventilated Improved Pit

Table 9.1: Breakdown of the two constructed water schemes

Water Scheme	Population Served (2010)	Cost		Pipes		Transmission		Distribution & Connection
		Construction (total)	per captia	Total (m)	Ave cost per km	Ductile iron (m)	HDPE (m)	PVC (m)
Kabuyanda	7,637	$180 K	$23.50	35,890	$5,000	—	11,500	24,390
Ruhiira	5,073	$480 K	$94.70	44,255	11,000	1,430	3,337	39,488

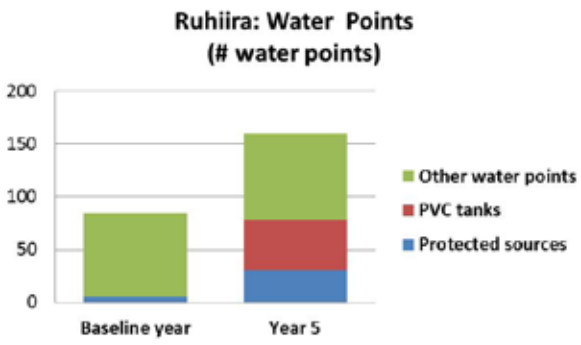
Figure 9.8: Piped water projects in the Ruhiira cluster



Sources:
- Millenium Villages Project, Ruhiira, Uganda
- Millenium Villages Project Infrastructure Group at The Earth Institute, Columbia University

Figure 9.9: Protection of Ruhiira's water source

Figure 9.10: summary of cluster water point interventions



(VIP) latrines (50 stances) in schools, six at health facilities (26 stances), and three at other institutions (12 stances). At the household level, a total of 500 homes have benefitted from latrines and the project aims to construct an additional 1,500 household latrines in the coming years. The project costs are divided between MVP, which contributed approximately $90.40 for each latrine (iron sheets, PVC pipe, treated poles, concrete, and skilled labor, transport, and oversight), and households, which provided in-kind contributions of approximately $91.40 (pit evacuation, poles, water, mud and labor). Beneficiary households are selected by Community Health Workers and are given sensitization trainings on latrine use and handwashing at village-level meetings.

Information and Communication Technologies (ICT)

MVP Target:	Achieve mobile phone network access within 2 km of 80% of all households
Status at Project Launch: N/A	Very limited basic telecommunication
Outcome at 5th Year: 80% of households	Over 80% of HH are within access to mobile phone networks
MVP expenditure: $80,000 (estimate)	Approximately $50,000 for computer installations; around $30,000 on towers, and $20,000 for community radio.
Government contribution: N/A	N/A

At baseline, only Kabuyanda, with less than 20 percent of the population, had mobile phone reception. There was no wireless data service in the area, and health facilities and schools had no computers. The MVP's primary strategies were to increase cell phone coverage, install computers in clinics and schools and establish a community ICT Center in Ruhiira as well as a community radio station to facilitate low cost communication throughout the community.

MVP constructed and furnished a community ICT Center that was equipped with a computer laboratory providing Internet access and word processing. To enable Internet connectivity and basic VOIP (voice over Internet) services, the MVP installed a 65 kilometer WiFi network connecting the ICT Center in Ruhiira with the MVP office in Mbarara, as well as six clinics, four primary schools, two community learning centers, a community radio station, two community ICT kiosks and two MVP field offices. Each of the community ICT kiosks was set up to improve Internet and connectivity access to people throughout the cluster. The communities ran them as businesses and are responsible for maintenance and any expansion. MVP also supported the purchase of 28 computers in total: two computers in four clinics, allowing OpenMRS and ChildCount; and four computers each in five schools, which allowed students and teachers of Nyakamuri Primary School to access the Internet and discuss world matters with students from other parts of the world via the School to School program. E-learning programs have been launched at Omwichwamba Primary School and Kabuyanda Central School.

Later, Ericsson, working with local mobile phone network operators, added cell phone towers that provided cell phone coverage for 70 percent of the area and population. These networks were upgraded with data service (EDGE/3G), which is available in most areas that have cell phone coverage.

To establish the community radio station, MVP supported the procurement of a transmitter/mast, a frequency license, acoustic preparations for a radio room and the training of two operators. The station, the Millennium Voice at 102.2 FM, is a tool for villagers to learn about such things as price and market information on local commodities, agricultural best practices (e.g., seed selection, watering, fertilizing, etc.) and local news bulletins (weather conditions, emergencies, etc.). ■