Completion of a Model, Low Cost, Novel PV Powered Water Delivery Project in Rural Ethiopia

Samuel Lakeou, PhD (1, 2)
Mengesha Mamo, PhD (3), Gudeta Gelalcha BSc (4)
(1) Department of Electrical and Computer Engineering
University of the District of Columbia, Washington, DC, USA
(2) Director, Center of Excellence for Renewable Energy
University of the District of Columbia, Washington, DC, USA
(3) Associate Professor, Department of Electrical and Computer Engineering, Institute of Technology, Addis Ababa University, Addis Ababa, Ethiopia
(4) Executive Director, Hope2020, Addis Ababa, Ethiopia

The paper highlights the final stages showing the completion of a renewable energy project consisting of solar powered water delivery system in Komboltcha, rural Ethiopia. The potable water delivery system which serves up to 33,000 inhabitants of the rural community was started in 2009 and has now been inaugurated after the completion of its second phase. The project benefited from the cooperation between the University of the District of Columbia, the Faculty of Technology of Addis Ababa University and a local nongovernmental organization, Hope2020, which together signed a memorandum of understanding for the implementation of the project. The project includes a low cost, novel approach to water delivery to the local community, including a double reservoir system at different elevations. The initial work was presented at a previous EUPVSEC conference. The current paper summarizes the final stages of the project as well as lessons learned during its implementation.

Keywords: Stand-alone PV Systems

1 INTRODUCTION

In 2009, the University of the District of Columbia (UDC), the Addis Ababa University (AAU), and the NGO, Hope2020 had signed a memorandum of understanding (MOU) which defines their individual contributions for the realization of a water development project near the city of Kombolcha, in the West Showa zone of the State of Oromia, the largest state of the Federal Democratic Republic of Ethiopia (FDRE). Since then, major achievements have been recorded in the implementation of the project [1]. During the first phase of the project a pole mounted 900W PV system was installed pumping spring water with a submersible pump. A 10,000L water reservoir and a water distribution point were constructed. However, due to the mounting need of the local population in potable water, the addition of a much larger reservoir was considered. After securing additional funds from various donors, the addition of a much larger reservoir was then implemented with great success. In fact, instead of adding a second reservoir to the one built in the first phase, a new project including two reservoirs placed at two altitudes was undertaken from scratch. The new project provides a much higher altitude level for the second reservoir and would therefore provide more gravity for serving more distribution points.

2 MAIN FEATURES OF THE PROJECT

The double level water delivery system comprises two pole mounted solar panels as described in Fig. 1.

The first reservoir is filled with water pumped with a submersible pump from the spring water chamber. After the water surface in the first reservoir reaches a certain height in the reservoir, a second submersible pump placed in the first reservoir is activated and lifts the water up to the second reservoir placed at a higher altitude. The two pumps work in tandem and a judicious monitoring of the water level is recommended. The pump in the first reservoir will automatically shut off if the water level is below a predetermined threshold.

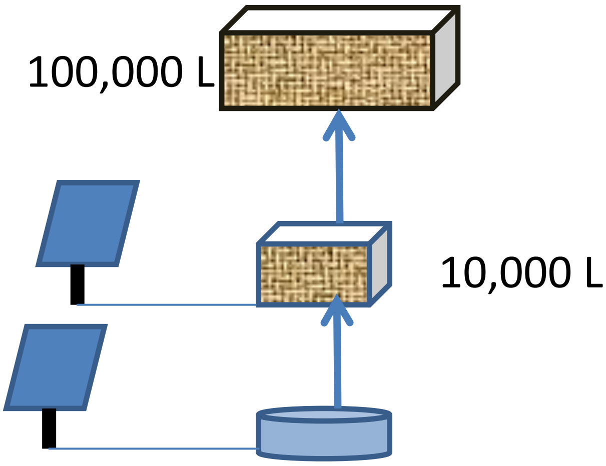

Figure 1: Double level water delivery

The main advantages of this system include the following:

- High gravity level is achieved at the second reservoir level allowing for a larger number of water distribution points located at longer distances from the reservoir; and
- The need for a powerful AC operated pump for pulling the water from the spring level to the second reservoir is eliminated, thus cutting down on inverter and battery cost.

3 HIGHLIGHTS OF THE PROJECT

The project was completed at the Shukute site in the western Shewa region, near the town of Jeldu, in Oromia.

Spring: Sombo/Faro
Location: N09^{0} 21.817' E-038^{0}02.077'
Elevation: 2608 m a.s.l
Yield/Discharge: 2.3l/s
Beneficiary: 7,800 villagers

The water chamber at the spring level is shown in Fig. 2.

Figure 2: Water chamber at the spring level

Figure 3: PV system at the spring level

Figure 5: PV system at the level of the first reservoir

Figure 6: First reservoir at the lower altitude

Figure 7: Reservoir at the second reservoir.

Figure 8: Exposed PVC pipe

4 LESSONS LEARNED AND FUTURE PROSPECT

The project was inaugurated in June 2012 and has been functioning ever since with great acclaim from all sectors of the local, national and international communities.

A few points of interest need to be pointed out:

- The length of the pipe from the spring to the first and the second levels may lead to some pipe damage due to traditional plowing with oxen. As shown in Fig. 8, pipe exposure may result in major water leak;

- The metal structure holding the PV modules on the pole may need some reinforcing for withstanding heavy wind. A redesign is in order; and

- The location of the reservoir is better served if it is within a villager's private compound. Better security and maintenance will be provided by the villager in exchange for access to free potable and irrigation water at the reservoir level. The villagers "hosting" the first reservoir (see Fig. 9) were most jubilant with such a deal.

It is planned to further improve the system with appropriate modifications. The success of the project has stimulated a high level of interest among donor organizations supporting water development projects in the country and particularly in Oromia. In one instance, one donor organization has approved the installation of solar powered water delivery systems for more than one hundred planned projects thus abandoning the projected use of fuel powered generators.

Figure 9: Villager private compound "hosting" the reservoir and the PV system

5. References

[1] *Low Cost, Novel PV Powered Water Delivery Project in Rural Ethiopia*, S. Lakeou et al, EUPVSEC25