

Anke Wiersma  
Crookston High School  
Crookston, MN  
Uganda, Irrigation

## **Improving Irrigation in Uganda**

Uganda has been experiencing incredible growth in the past few decades, but as of right now Uganda is and will be unable to provide for a growing population that is rife with poverty, especially in rural areas (NAPE, n.d., p. 2). In rural Uganda, farming is what the majority of the population relies upon for a living, but due to inept farming techniques and technology, it continues to fall short (The World Bank, 2018, p. 7). One method to alleviate this situation is by utilizing sustainable solar-powered irrigation, an efficient and economical technique to maximize crop yield. By carefully managing the amount of water dispensed to a crop, its yield can be largely increased while also minimizing water waste and the draining of soil nutrients.

Citizens in the majority of rural areas in Uganda have little to no access to commodities such as electricity, roads, schools, medical facilities, markets or sanitation facilities (Fan, Zhang, & Rao, 2004, p. 26). The government has focused on improving general infrastructure throughout the country, which has indeed lead to a decrease in poverty due to local communities now having access to larger and more diverse markets with more occupations and opportunities to make a profit (Fan et al., 2004, p. 27). Rural Uganda also has startlingly low access to electricity, 2.1% of all rural households are able to access and use electricity, (Fan et al., 2004, p. 26). Unless households are able to purchase and maintain an expensive private source of electricity, they are stuck relying on the fickle yet expensive national power grid or using more archaic means such as wood and coal burning as well as candles for light (NAPE, n.d., p. 2). This puts rural communities at an even larger disadvantage than the more urban communities.

However, in rural Uganda, agriculture remains the main source of income and livelihood for 72% of Uganda's population, the majority consisting of smallholder farms scattered throughout the rural areas (Wanyana et al., 2017, p. 1). Smallholder farms provide the majority of food resources in Uganda, however, due to a flawed market and inefficient farming, Uganda is unable to successfully provide for the growing population, (The World Bank, 2018, p. 1). Within these smallholder households, "one-quarter ... [are] living on less than US\$1.25 per day" (The World Bank, 2018, p. 7). Even with the current growth in Uganda's GDP by 6.4% since 1991, poverty and food insecurity remain wide-spread issues with Uganda (NAPE, n.d., p. 2). Rural Uganda holds 95% of the population who live in poverty in comparison to urban areas (Fan et al., 2004, p. 14). As the government was able to fund and implement policies to create and maintain better infrastructure for certain areas, especially in the more urban areas, poverty declined rapidly, but because of the isolated rural communities are still facing poverty in large numbers, increasing the gap between rural and urban communities (Fan et al., 2004, p. 14). Rural communities and by proxy smallholder farms are in need of access to government support as well as urban markets in order to make better progress in decreasing the percentage of those in poverty.

"On average, nearly half of all Ugandans consume fewer calories than they need every day. One in three schoolchildren has no food to eat during the school day" meaning that food insecurity is common amongst Ugandans (World Food Programme, n.d., p. 1). Food insecurity not only has immediate repercussions but has side effects much later in life, such as stunted brain development. With the population expected to continue to increase by 3.6% every year, pressure on the already strained natural resources and demands for better living conditions grows along with the growth of the population (NAPE,

n.d., p. 2). This is why it's so important for smallholder farms to produce crops in an efficient manner while being able to sell at both a profitable and affordable price.

To better grow crops while minimizing the overall loss in yield is to make use of an irrigation system. By providing crops with the necessary water, they are able to have a better yield. Irrigation can also expand the limits of what can be grown in Uganda. A farmer can create a wider variety of favorable conditions that suit a wider variety of crops, leading to Ugandans having access to a more diverse diet and a better supply of different nutrients. Yet most smallholder farms have little to no irrigation systems; instead, they rely on rain as the primary source of water (The World Bank, 2018, p. 15). Unfortunately, depending on rainfall has a major downside in that it is unpredictable. Uganda as a country has been deeply affected by climate change, having caused rainfall to be especially irregular, leading to both drought and flooding (The World Bank, 2018, p. 16). The government has spearheaded other initiatives to improve access to irrigation infrastructure with rural communities but very few have come to fruition and those who have been installed within communities in the past have suffered from the general lack of knowledge to operate the systems once put in place (Wanyana et al., 2017, p. 8). "It is common to find irrigation technologies and structures rendered redundant because of minor faults or lack of technical know-how on proper use and maintenance" (Wanyana et al., 2017, p. 8). Once a steady water source can be established and properly maintained, crops can reach their full potential, therefore, accessible and effective irrigation systems must be put into use (The World Bank, 2018, p. 13). In order for that to happen the issue remains, irrigation systems require both a water source, a power source, and the money and knowledge to install and maintain said system.

Contrary to popular belief, Uganda has a variety of water resources, as the country has numerous lakes, rivers, and basins that can all be utilized for irrigation. Around 11% of Uganda is covered in swampy wetlands and to an even further extent 98% lies within the Nile River Basin. On paper, Uganda is set up for success in terms of water supply, especially when compared to some of its neighboring countries (Wanyana et al., 2017, p. 3). Despite this, Uganda struggles to access these water sources in a sustainable and efficient manner. "Although Uganda's water resources are quite abundant, predictions show a physical and economic water scarcity by 2020 because of climate change and population growth ... because of increased demands of hydroelectric power production, agriculture production, domestic water supply[,] industry ... and poor land-use practices" (Wanyana et al., 2017, p. 3). In order to minimize the overall pressure exerted upon the natural water resources, it is important to use responsible irrigation practices in agriculture. When using a sustainable irrigation system, a farmer is able to minimize the amount of excess water usage as well as preventing runoff that can drain the already limited soil nutrients as well as have negative effects upon the land around the farm. Another way to minimize unnecessary water withdrawal from ground sources is to collect rainwater during the rainy season and this way in case of drought, communities have a back-up source of water.

Irrigation systems and technology require a power source, mainly in order to operate the water pump (Harishankar, Sathish Kumar, Sudharsan, Vignesh, & Viveknath, T., 2014, p. 342). Rural Uganda has little to no access to the national power grid, leaving it up to the individual households to install their own private source of energy which can be quite costly (NAPE, n.d., p. 2). Hydroelectricity is a popular renewable energy source but it does pose some problems because when mass-produced it often can have undesired effects on the local water ecosystem which is already put under a lot of stress (Wanyana et al., 2017, p. 3). With the growing need for access to electricity, fossil fuels fall short of the brief due to the high cost of these fossil fuels as well as having negative effects on the climate and environment, which is something that the Ugandan government wishes to avoid (NAPE, n.d., p. 3). There is another virtually untapped power source: solar power. "Uganda is endowed with sunshine that [is] well distributed and

throughout the year” (NAPE, n.d., p. 6). This opens up the possibility of having electricity that can be readily available throughout Uganda and that is able to produce a high amount of power, more than enough to power irrigation systems. Though solar power generally has a high initial cost, over the years of continuous use it will be able to pay itself off. By using a sustainable energy source, a smallholder farm is able to increase overall financial gain due to the lack of paying for the expensive national power grid or other sources, as solar power can be completely self-sufficient. By being self-sufficient, solar power eliminates the high cost of fuel or electricity, which saves the farmstead money over time. Currently, solar power is a largely untapped power source because of the general lack of knowledge and often the daunting price that accompanies the retail purchase, the installation of solar panels and associated technology (NAPE, n.d., p. 16). Both of these issues have easily attainable solutions that will be discussed later on.

The system, in essence, is fairly simple. The solar panels as an energy source convert energy from the sun and in turn stores it within a battery. When needed the energy is put through a converter and powers a water pump. It can either be done through a manual switch or an automatic process through a soil moisture sensor that can be adjusted for each specific crop. By having it dialed into specific soil and crop needs, unnecessary use of water can be eliminated while maintaining a successful crop. (Harishankar et al., 2014, p. 342). By introducing a more accurate way of irrigating crops, the environmental impact can be minimized, this can have a positive effect on the land as it reduces the risk of draining soil nutrients which is especially important, as Ugandan soil is not necessarily rich with soil nutrients (The World Bank, 2018, p. 7). This means that farmland is able to last much longer and still produce successful crops, especially when supplemented with fertilizer. This concept can be a viable solution for having more successful smallholder farms which will help alleviate poverty and food insecurity. Overall the costs of technology, not including installation, is an estimated US\$ 1,518. (Harishankar et al., 2014, p. 342). This is a feasible investment for many smallholder farmers through proper financing and government support. There is also the possibility of having a communal irrigation system, in which rural farming communities share a public irrigation system that is easily moved from crop to crop as well as being able to split costs between multiple farms (Wanyana, 2017, p.6).

Smallholder farmers are consistently in financial strain, so in order for the farmers to be able to afford such technology, the government needs to have a proactive approach (The World Bank, 2018, p. 26). There are already numerous policies in place to promote the use of renewable energy, however, the policies are often ineffective, (NAPE, n.d., p. 5). The government has put in tax waivers for the purchasing of renewable energy sources such as solar power, yet, all the associated costs remain uncovered still leaving options such as solar power quite expensive (NAPE, n.d., p. 16). There is a need for more supportive measures to be put in place to help alleviate the financial strain on the rural communities in order to have access to electricity. If the government were able to facilitate the purchase power technology and the accessories needed to be able to utilize the energy as well as other renewable sources by providing low-interest loans, interest-free loans, and/or subsidies (NAPE, n.d., p. 16). This will also help the government with its goal of increasing the use of renewable sources within Uganda (NAPE, n.d., p. 6). The government also has many policies in place to help support rural farmers as well as a moderate budget to help finance the improvement (The World Bank, 2018, p. 63). The execution of these policies is poor, often either not being put to actual use. If it is, it will fail later on due to the farmers in the rural communities not having the training to use and maintain the sources provided after the government withdraws (The World Bank, 2018, p. 63). This is largely due to miscommunication between the various organizations involved as well as the issue of being majorly understaffed. For example: “[Ministry of Agriculture, Animal Industry, and Fisheries] has a substantial discrepancy between allocated positions (411) and the actual staff (279)” (The World Bank, 2018, p. 63). By

improving these conditions that these organizations face, the government will be better able to handle executing the written policies and being able to maximize the budget without wasting it due to miscommunications between understaffed and stressed government organizations. They would then be able to actually help rural Uganda make the needed changes to their communities by boosting the use of irrigation technology and other ways that can help boost crop productivity and profits.

In rural communities, there is often a lack of knowledge of the installation and use of solar power and irrigation technology (Wanyana, et al., 2017, p.8). This can potentially lead to such technologies being rendered ineffective due to misuse and other minor technical issues that commonly occur (Wanyana et al., 2017, p. 8). A way for this problem to be reduced is for teaching courses or organizing demonstrations on how to operate, install and do maintenance on the systems that the government is helping to install throughout the rural regions of Uganda. The training would concern how to do maintenance as well as how to troubleshoot common problems that can occur with the use of irrigation and solar technology. Another way is to offer opportunities for people from these rural farming areas to be professionally trained and educated to be irrigation technicians or even further, irrigation engineers for little to no overall cost. If this were to be implemented, not only would there be an increase in the successful use of irrigation systems but it also opens up another field for employment and an increase in education, both of which can have beneficial impacts on the overall economy. By boosting the use and knowledge of the irrigation systems and promoting self-sufficiency within these smallholder farm communities, the crops produced will have larger yields, there will be room to diversify the crops produced as well. Rural Uganda will be able to continue to grow in a positive direction while decreasing poverty and food insecurity within its rapidly growing population.

There is another key factor that needs to be addressed in order for farmers to be able to maximize the profit from their crops, larger and cheaper market access (Wanyana et al., 2017, p. 9). Currently, the rural infrastructure is usually minimal, making any transport expensive, this restricts rural farmers' market access (Fan et al., 2004, p. 28). However, within the past couple of decades, the Ugandan government has been working hard to improve access to roads as well as improving the integrity of said infrastructure (Fan et al., 2004, p. 28). When farms are able to have access to a larger market and therefore a larger customer base, they are able to stabilize the prices of their products and furthermore simply being able to sell more of their products (Wanyana et al., 2017, p. 9). The customers will also now have access to a more diverse supply of food, helping them attain a nutrient-rich diet. As this continues to improve the need for sustainable irrigation practices increases. By using this technology, smallholder farms are able to increase the yield of their crops and are also able to decrease water waste, helping diminish the strain on the current water resources.

The ability to increase crop yield due to sustainable agriculture practices will boost the profits of smallholder farms which, in turn, will lead to financial stability and food security. Farms will begin to gain access to a more widespread market through the improvement of rural infrastructure that is not related to agriculture, such as, roads and telecommunications. It is important for them to be able to irrigate properly in order to improve crop yield. Utilizing solar power irrigation and integrating it within the daily lives of smallholder farm communities will create new opportunities for employment, specialized education and will improve the overall infrastructure of the rural regions, helping fight the high rates of poverty. When the national government is able to work efficiently in tandem with rural farming communities and smallholder farms on the improvement of agriculture infrastructures, such as sustainable irrigation systems, solar panels, and the need conversion equipment, improvement in poverty and food insecurity rates are sure to follow. The use of solar energy eliminates the routine and high costs of fuel and electricity, replacing it with an overall smaller initial investment, this will help the farms' ability to

have a larger profit margin. In addition, spreading the use of renewable energy sources throughout Uganda. When using a proper irrigation system the farmer is able to eliminate the risk of over or underwatering plants that will lead to crop damage and loss. It will also minimize the water waste and run-off, leaving a smaller agricultural carbon foot-print. The farmer can also grow more diverse crops, helping improve the diet of local people by introducing foods that are rich in nutrients that can currently not be grown. With solar power irrigation Uganda is able to continue growing into a successful and self-sufficient country.

## References

- NAPE (n.d.). A study and viability of solar power in Uganda, 1-36. Retrieved from <https://www.nape.or.ug/publications/energy/38-solar-enegey-viability/file>
- The World Bank (2018). Closing the potential-performance divide in Ugandan agriculture. Retrieved from <https://www.worldbank.org/en/country/uganda/publication/closing-the-potential-performance-divide-in-ugandan-agriculture-fact-sheet>
- Fan, S., Zhang, X., & Rao, N. (2004). Public expenditure, growth, and poverty reduction in rural Uganda. *International Food Policy Research Institute*, 1-71. Retrieved from <https://core.ac.uk/download/pdf/6388461.pdf>
- Harishankar, S., Sathish Kumar, R. Sudharsan, K.P., Vignesh, U., & Viveknath, T. (2014). Solar powered smart irrigation system. *Advance in Electronic and Electric Engineering*, 4(4), 341-346. Retrieved from [https://www.researchgate.net/publication/281685755\\_Solar\\_Powered\\_Smart\\_Irrigation\\_System](https://www.researchgate.net/publication/281685755_Solar_Powered_Smart_Irrigation_System)
- World Food Programme (n.d.) Uganda. Retrieved from <https://www1.wfp.org/countries/uganda>
- Wanyana et al., 2017, p., J., Ssegane, H., Kisekka, I., Komakech, A.J., Banadda, N., Zziwa, ...Kiyimba, F.L. (2017). Irrigation development in Uganda: Constraints, lessons learned, and future perspectives. *Journal of Irrigation and Drainage Engineering*, 145(5), 1-14. doi: 10.1061/(ASCE)IR.1943-4774.0001159