Water and Irrigation Relief

Universidad de Alcalá

IRRIGATION PROJECT FOR SMALLHOLDER FARMERS IN UGANDA

Ignacio Rodriguez Piñeiro

ignatiusrod@gmail.com

+256 753647305

And Ben Barnes

Irrigation Project in Eastern and Northern Uganda

Introduction

Uganda is one of the counties most affected by global climate change and its geographic position in the far north of sub-Saharan Africa makes it especially vulnerable.

The availability of water is by far the most limiting factor for agricultural production in Uganda, as most farmers are reliant on rainfed agriculture. The availability of water for crops and livestock, especially in Uganda's Eastern and North regions, is already being affected by changes in weather patterns. These periods of extreme weather variability are expected to continue in the coming years with severe consequences for rural livelihoods.

Uganda's emerging economy is largely dependent on their agricultural sector, with over 85% of its estimated population of 42 Million living in the rural areas dominated by subsistence farming. This means that most of the country's GDP and food security is in the hands of family run smallholdings.

With this in mind, it seems that the modernisation of agriculture is a critical path for empowering the poor and vulnerable members of society. Providing smallholder farmers with better extension services, quality inputs, and credit will elevate poverty by providing farmers with sustainable livelihoods.

Current farming communities

The Eastern and Northern regions of Uganda are home to approximately 18 million people. These largely rural regions are heavily reliant on subsistence agriculture, mostly comprising of small parcels of privately-owned land of one acre or less. Farmers mostly choose to grow low value crops such as maize, beans and cassava. These crops are often grown to provide families with both food and income. Sadly, they often fail to deliver both, due to poor yields and low market value. As a result, there is not enough food to feed the family or enough income to pay for schooling and healthcare when needed.

Farmers in Eastern and North Uganda are in real need of affordable irrigation system to help them cope with the changing climate that has led to many bad harvests in recent years. The United Nations Framework Convention on Climate Change defines climate change as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods".

For many years, farmers have been able to follow a relatively consistent weather pattern, which helped them decide when to complete their seasonal farming activities. However, recent changes to local climatic conditions now mean they often cannot rely on past weather patterns for their agricultural calendar, making it hard to consistently produce the qualities of food needed for their families.

Hydrological conditions

The majority of Uganda sits within the drainage basin of the River Nile. Lake Victoria is the source of the White Nile, which runs north through Uganda to Lake Kyoga in the Central region and then into Lake Albert in the west, before heading north to the border with South Sudan.

Uganda is endowed with abundant water resources. Indeed, the total renewable groundwater is 39,000 Million cubic meters/year but only 259 million cubic meters/year are currently being withdrawn for agricultural irrigation purposes (Figure 1).

In many areas at Eastern and Northern Uganda the water table is between 1 and 20 meters below the surface, this huge aquifer of water is so close to the farmers, but they simply don't have the technology to efficiently access it.

Renewable water resources

Renewable freshwater resources:			
Precipitation (long-term average)	-	1 180	mm/yr
	-	285 000	million m^3/yr
Internal renewable water resources (Long-term average)	-	39 000	million m^3/yr
Total renewable water resources	-	60 100	million m^3/yr
Dependency ratio	-	35	%
Total renewable water resources per inhabitant	2013	1 599	m^3/yr
Total dam capacity	2013	80 082	million m^3

Water use

Water withdrawal:			
Total water withdrawal	2008	637	million m^3/yr
- Agriculture (Irrigation + Livestock + Aquaculture)	2008	259	million m^3/yr
- Municipalities	2008	328	million m^3/yr
- Industry	2008	50	million m^3/yr
• Per inhabitant	2008	20.3	m^3/yr
Surface water and groundwater withdrawal (primary and secondary)	2008	637	million m^3/yr
• As % of total actual renewable water resources	2008	1	%
Non-conventional sources of water:			
Produced municipal wastewater	2012	7	million m^3/yr
Treated municipal wastewater		-	million m^3/yr
Direct use of treated municipal wastewater		-	million m^3/yr
Direct use of agricultural drainage water		-	million m^3/yr
Desalinated water produced		-	million m^3/yr

Figure 1: FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO)

Irrigation technology

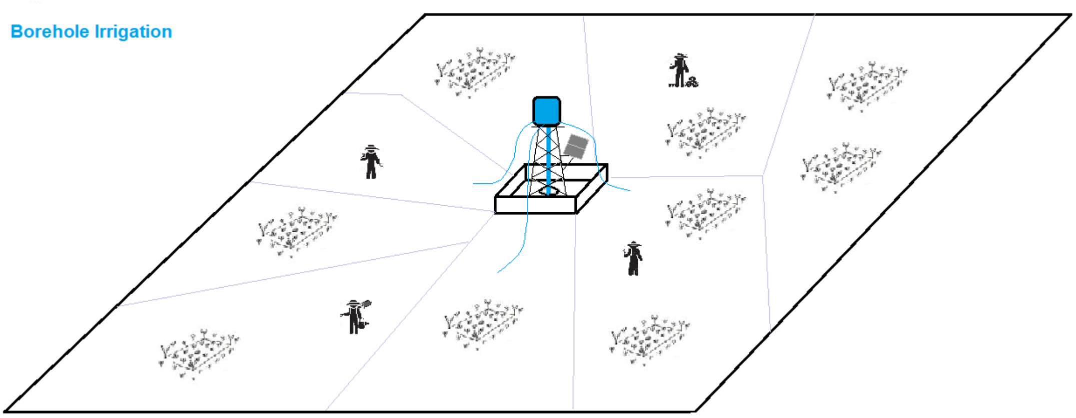
The project aims to promote a simple and cost-effective system that combines modern solar pumping technology with user-friendly gravity irrigation. This is ideal for smallholder farmers as it has low running costs and is simple to operate and repair.

The project will start by drilling a new borehole and installing a highly efficient DC Solar water pump which fills a water tank 6 meters above the ground. A single long flexible pipe will come out of the tank and be used irrigate the farmers plots. This means the farmers don't have to turn the solar pump on and off as it will automatically refill the tank during daylight hours. They simply open the tap at the end of the long pipe and irrigate their crops.

To safeguard the project, the area where the tank and borehole are, must be protected by a fence, with only the project beneficiaries having access to this area.

In order to optimise the cost effectiveness of the system, each borehole will fill a 5 cubic meter water tank, which will irrigate 8 acres of land.

1 acre is the average size of a smallholding in the area, so 8 farmers could share one irrigation system. This would mean scheduling the irrigation, so that the single irrigation pipe is shared fairly between the families. In practice 2 farmers would be able to irrigate each day, with all 8 acres being irrigated once in a 4 day rotation.



Technical specifications

1. Average static pumping head height: 16 m (52 feet) = 10 meters to surface plus 6 meters to the water tank inlet

2. Daily flow needed: 4 cubic meters required per acre per day, as 2 acres are irrigated per day, 8 cubic meters will be needed daily

3. Irrigating flow at maximus distance (150 meters from the water tank):

- Pipe size 32 mm
- Total head 6 meters
- Flow speed: 0.6 meters/second
- Irrigating flow estimated: 0.5 liters/second
- Head loss: 2.5 meters
- Time spent to irrigate one acre: 2 hours

4. Solar pumping system:

- Lorentz PS100HR7 pump with a 120-Watt Solar panel, can pump 0.9 cubic meters per hour

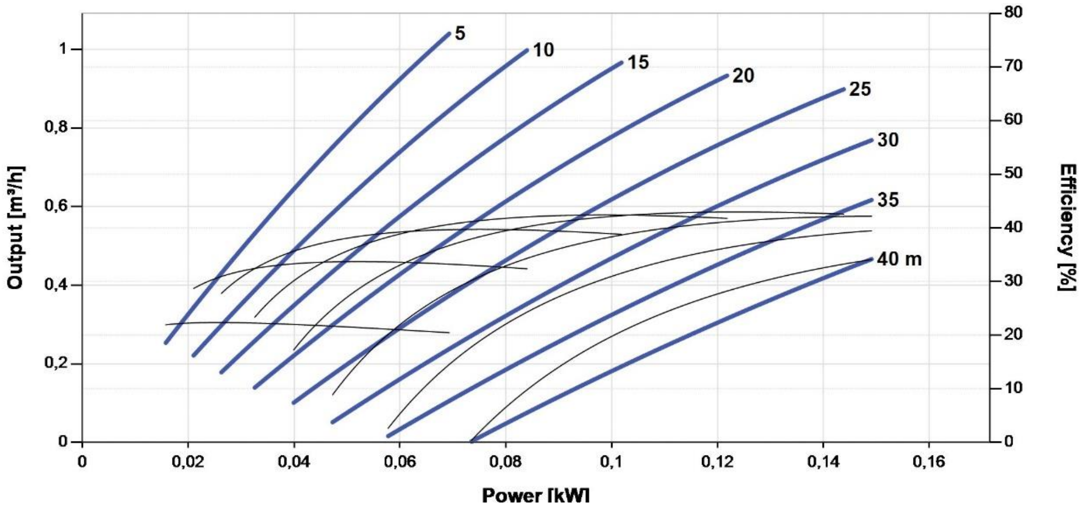


Figure 2: Lorentz compass 2019

Figure 3: Solar Irradiation at Soroti Town, Eastern Uganda (1° North; 33° East)

Social considerations

The majority of farmers already know how important irrigation is to farming, as they utilise natural wetlands to grow rice. One of the major issues is that farmers have become used to NGO's starting projects without the correct buy in from the community. This has created many "'white elephants'" that often result in broken boreholes being abandoned and water tanks or water harvesting systems breaking and never being repaired. Farmers are sometimes waiting for another NGO to come along and repair the equipment, as they have not been empowered with a sense of project ownership as well as the technical and financial expertise to repair it themselves.

The most critical component of the project is to empower the local community, so they have a real sense of ownership over the irrigation system. To achieve this goal farmers must contribute to the initial cost of setting up the system. The level of contribution will depend on a farmer's acreage. Once the project is up and running the farmers must repay a percentage of the remaining cost of the irrigation system. The farmers must also make monthly contributions to a community reserve fund that will be used to maintain and repair the system when needed.

The idea is that they must feel like they are purchasing this technology to improve their yields and ensure year-round production, rather than seeing themselves as lucky beneficiaries of an international pilot project.

The long-term aim of the project is to be fully sustainable by providing this irrigation system to the farmers under a low interest long-term financing plan. Once the first community of farmers has utilised the system to increase their household food and income security, it is hoped that the project can be replicated with other communities within the Eastern and Northern regions of Uganda.

Project finances

The total estimated cost of the project is 45 Million Ugandan Shilling (M. Ugx):

Item	Cost (M. Ugx)
Bore hole + 110mm PVC well with casing + 6m well screen with packed pea gravel	20
6-meter high welded tower (including masonry work to fix)	7
5 cubic meters polymer water tank	2
Solar pumping system	12
Consumables + other expenses	4

Cost benefit analysis

Currently most farmers plant twice a year, during the two rainy seasons. If they had access to irrigation technology, they could grow three or more crops per year. The simplest way to understand the financial benefit of this irrigation system is estimate the value of growing a third crop during the dry season.

Tomato's:

- Prices: 2,500 Ugx per kilo (rainy season), 3,500 Ugx per kilo (dry season)

- Total yield per acre: 1 kilo per plant X 4,000 plants per acre
  = 4,000 kg per acre

- Gross profit: 4,000 kg per acre X 3,500 Ugx per kilo
  = 14 M. Ugx per acre

- Net profit: 14 M. Ugx per acre (sales) - 5 M. Ugx per acre (costs)
  = 9M. Ugx per acre

In total each acre under irrigation can provide a family with around 9 M. Ugx additional income, meaning a total of 72 M. Ugx will be generated for all the families involved in the project per year.

Onions:

- Prices: 3,500 Ugx per kilo (rainy season), 5,000 Ugx per kilo (dry season)

- Estimated harvest: 3,000 Kg per acre (with irrigation)

- Gross profit: 3,000 kg per acre X 5,000 Ugx per kilo
  = 15 M. Ugx per acre

- Net profit: 15 M. Ugx per acre (sales) - 4 M. Ugx per acre (costs)
  = 11 M. Ugx per acre

In total each acre under irrigation can provide a family with around 11 M. Ugx additional income, meaning a total of 88 M. Ugx will be generated for all the families involved in the project per year.

This simple cost benefit analysis suggests that the yearly profit is considerably higher than the total cost of installing the irrigation system.

Conclusions

- The combination of modern solar pumping technology with the simple gravity fed irrigation systems makes this project particularly suitable to the local climate and the smallholder farmers in these regions.
- The cost benefit analysis shows that local farmers should already be taking the initiative to organise themselves into groups to ultilise this cost-effective technology. Sadly, due to there being a lack of knowledge, and access to equipment and finances they are not able to do so.
- Uganda now has many developing cooperative societies which should be encouraged to take up this technology, so that the benefits of cooperation can be seen within local communities.
- Hopefully, this will act as a catalyst encouraging farmers to also work cooperatively to purchase inputs, market their produce and add value.