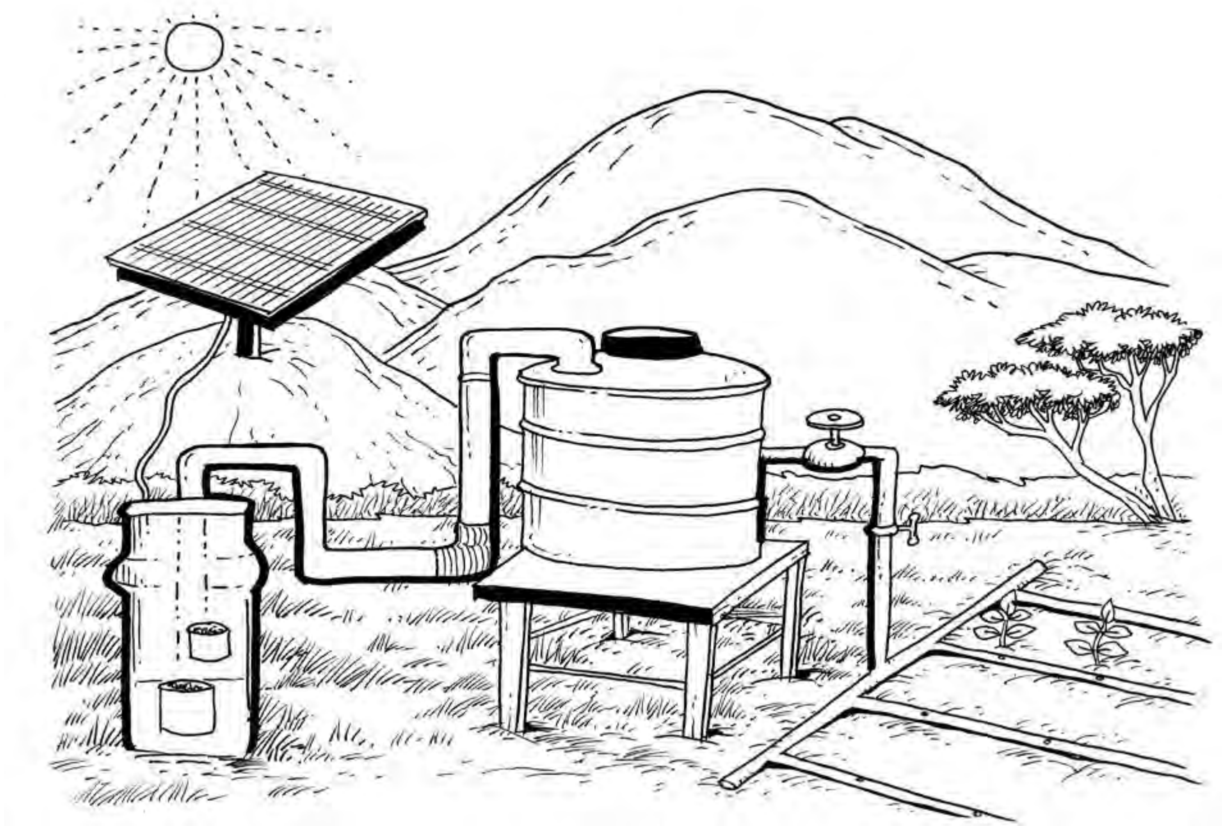
Exploring Groundwater Sources for Sustainable Smallholder Agricultural Production in Northern Uganda:

The Case of Agago District



When the Lord's Resistance Army insurgency in northern Uganda ended, relative peace returned and the internally displaced persons' (IDPs) and the camps for internally displaced persons (IDPs) had to be closed down. The people resisted returning to their homes because they were destitute. They had no means of livelihood after two decades in the camps. Forty percent of IDPs living in the Kalongo camp were extremely vulnerable, with no means of livelihood and mostly depending on direct aid (GOAL, 2009). Food production in the district was very low with only 28% of the population in Agago accessing food from their own produce, 63% from the market, and 9% from other sources (Kalebbo and C, 2010). After closing, the Kalongo IDP camps, the majority of returnees settled in Pakol parish in Parabongo sub-county, and started growing millet, potato, beans, and simsim for consumption. They also produced cotton and vegetables such as cabbage, onions, and tomatoes for sale. The community already had experience in vegetable production, mainly growing cabbage and tomatoes in the swarms during the dry seasons. Agricultural work was primarily done by women and children, who sold their produce in the Kalongo market (GOAL, 2009). The returnees had no other sources of income and depended entirely on the sale of their produce, but their production was characteristically low because of the erratic rainfall distribution and severe drought periods. Pakol parish is in the northern agroecological zone with a less pronounced bimodal rainfall pattern. The rainfall is often erratic with occasional dry spells; it cannot guarantee a satisfactory crop under rainfed agriculture.

Goal International, a nongovernment organization, initiated an irrigation project to help smallholder farmers during dry spells and long droughts. The project objective was to enhance the returnees' livelihoods and strengthen the community's capacity through provision of supplemental water for increased agricultural production. It targeted 100 households by piloting vegetable production under irrigation on 14 acres of land.

Implementation

To meet project objectives, the need to increase water availability and maximize water use to produce more with less water were the key elements considered at the design and implementation levels. The following tasks were accomplished.

- **Community mobilization and problem identification**
  The intended beneficiaries were mobilized in a brainstorming session so as to identify problems and propose interventions. The community proposed the provision of irrigation water to overcome water stress on crops that result from dry spells and unreliable rainfall.
- **Assessment of crop water requirement** The calculation of net irrigation water requirement was based on 80% dependable rainfall to cover periods of long droughts. The crop water requirement for cabbage and tomatoes, as analyzed using the Aqua Crop tool (FAO, 2012) was 5 mm per day. Considering drip irrigation for the project (because of its highly efficient of water application), it was estimated that only 20% of the area would be irrigated. Therefore, the net crop water requirement would be 1 mm per day, translated into 56 m^3 of water per day for the 14 acres of land under the project.
- **Assessment of water sources**
  The project analyzed the feasibility of rainwater harvesting, river damming, and groundwater abstraction, but the surface water option was immediately ruled out because there were only seasonal streams that also dry up during dry seasons. Roof-top catchment of rainwater was not feasible because most of the houses in the project neighborhood were grass-thatched. While the runoff catchment was feasible and had the potential to yield more water, the topography of the project area limited its successful exploration. Fortunately, an assessment of groundwater revealed a huge potential and was, therefore, adopted for the project. Empirical assessments of groundwater parameters found aquifer potential and yield adequate for the project. The drilled well had a sustainable yield of 7.5 m^3/day.
- **Power sources to operate groundwater pumps**
  The project area had no supply of electricity from the national grid and the option of diesel engine to run the pumps was not appropriate because its running costs would overburden the already poverty-stricken returnees. In the light of sustainability, a solar-powered pump was installed but because its performance is tied to sunshine, it would only be effective for at most 10 h daily. The capacity of the available solar-powered pump from the local market was limiting too. So, two pumps with a capacity of 2.4 m^3/h each against a head of 65 m were installed at depths of 40 m and 45 m below the ground level.
- **Storage reservoirs**
  The total capacity of the reservoir tanks was chosen to match the capacity of the installed pumps. It was estimated that the solar-powered pumps would effectively work for a maximum of 10 h on a good sunny day, thus delivering a total of 4.8 m^3/h. To achieve an adequate head (water pressure) to distribute water to the drippers, the 14 acres of land were divided into five subplots of equal size and each had a 10,000-liter capacity reservoir tank installed near it. The reservoirs were all raised 2 m above the ground so as to provide the necessary water head to run the drip irrigation system.
- **Water application methods**
  Considering the cost involved in water abstraction and water as a limiting factor in production, it is prudent to use methods that are efficient in application. The farmers, however, were trained on all irrigation methods, including furrow irrigation, drip irrigation, and sprinkler irrigation methods and how to reduce water loss during application. However, drip irrigation was recommended for use because of its high water

application efficiency. Five sets of drippers were installed but farmers were also provided with garden hoses to complement the drippers or in cases that they fail. The garden-hose method of water application is a cheaper alternative to drippers, but extreme caution is required when irrigating young and delicate crops. On-farm methods of water management such as mulching were encouraged to reduce evaporative water loss.

Results

The irrigation project gave returnees hope and a new beginning. It encouraged all the IDPs to return home and the Kalongo camps have since been closed.

The beneficiaries of the Pakol irrigation project are no longer depending on direct aid. They are able to buy seeds in the subsequent seasons and have now diversified their production, growing maize and beans on a larger scale. The farmers have also upgraded their group to establish a village savings scheme where they pool proceeds from their production and loan it to members with interests. This has played a vital role in financing small-scale farmers who have no collateral to access loans from financial institutions.

The technology of supplemental irrigation is now spreading with some households excavating small ponds near swamps to collect water for use during dry spells. From the ponds, they use treadle pumps to draw water and apply on their crops, owing to the training and experience gained from the demonstration plots.

Challenges

The communities were IDP returnees expecting handouts in the form of money, farm inputs, and in kind (food), which were beyond project deliverables.

The adoption of the technology is slower than anticipated. Many households are still depending on the demonstration field for production. The initial cost of the system is prohibitively high for returnees who have just started rebuilding their lives.

Lessons learned

Managing community expectations is very important to ensure delivery of project goals. This can best be achieved through effective engagement of communities, which allows meaningful participation. Communities should be involved right from problem identification, proposal generation and implementation, up until monitoring and evaluation. More importantly, during implementation, the community must be made aware about contributing some resources to enhance a sense of ownership to sustain the project.

Conclusion and recommendations

With all the benefits of restoring livelihoods of a destitute community (as was in Pakol) and the potential of doubling proceeds of smallholder farmers, irrigated agriculture is one of the most important tools for fighting food insecurity. In all instances, the yield and returns from irrigated agriculture are higher than those from rainfed agriculture. In Ethiopia, Fitsum *et al.* (2009) have shown that returns on irrigated agriculture by a smallholder farmer can be up to 200% higher than the returns from rainfed agriculture. With good agronomic practices, such as soil and water conservation, the economic returns of irrigated farming can transform farmers from being peasants to commercial producers within a short time.

Harnessing groundwater for supplemental irrigation takes away the fear of drought due to erratic rainfall. Many times, people have considered groundwater as a pure source of water that must be reserved for domestic purposes only, but it is high time we overcome the hurdle and explore all sources of water, including groundwater to improve agricultural production. For sustainable and successful harnessing of groundwater for irrigation for a community of smallholder farmers, the following are recommended:

- Formation of water users (beneficiaries) into groups with a management team: The management team would liaise with government agencies and development partners with a bid to mobilizing resources and technical support. This approach has successfully been applied in managing the rural community water supply and sanitation systems in Uganda.
- The management team would not only be in charge of operation but will also work out an agreeable formula for charging farmers for services rendered. A formula for charging can be based on the volume of water applied, the area irrigated, or a fraction of the final produce. This, however, has to be agreeable to all.
- The beneficiary community needs to be adequately sensitized on project benefits. The beneficiaries need to be made aware of their responsibilities and contributions to the project.

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References

FAO (Food and Agriculture Organization). 2012. Aqua Crop V40. AquaCrop User Manual. FAO, Rome, Italy.

Fitsum, H., Godwill, M., Regassa, E. N., Seleshi, B.A. 2009. Importance of irrigated agriculture to the Ethiopian economy: capturing the direct benefits of irrigation. Internation Water Management Institute, Colombo, Sri Lanka.

GOAL. 2009. TOR for the assessment, design and installation of irrigation system in Parabongo subcounty. Goal International Kampala, Uganda.

Kalebbo, B., & C, K. (2010). Strengthening an M&E system for GOAL's livelihood and Food Security Programs, Pader and Abim Districts. Marerere University, Kampala, Uganda.

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