A treadle pump used for low-cost irrigation. (Charles-Lwanga Malingu)

Low-cost irrigation with a treadle pump (Uganda)

Money Maker

DESCRIPTION

Use of the manual Treadle pump is a relatively cheap and effective way to ensure adequate soil moisture to ensure crop production throughout the year.

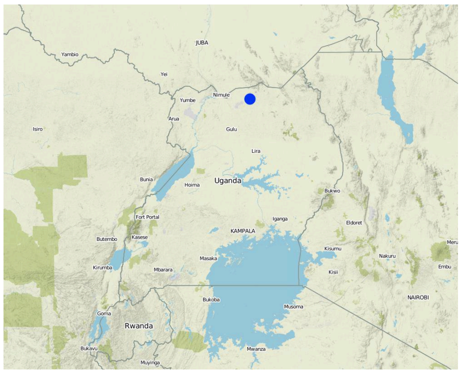
Northern Uganda receives low rainfall (600 – 1100 mm annually) and experiences longer dry spells (4 – 5 months) compared to other areas of the country. This makes the region vulnerable to drought, thereby increasing the risk of crop failure in most cases. Therefore, irrigation has the potential to improve land productivity. However, moving water from its source into cropland is labor-demanding for farmers, thereby making irrigation farming less profitable compared to rain-fed agriculture, even with the erratic nature of rainfall.

To engage in profitable irrigation farming, farmers have resorted to use simple contraptions such as the treadle pump. The treadle pump is used to move water from its source (which maybe a well, underground tank, valley dam or reserve tank) into the cropland with significantly lower labour requirements. This reduces the cost of irrigation and improves profitability. Treadle pumps are powered by human effort, with the legs and feet peddling up and down on treadles/ peddles that are connected to two small piston pumps. The pump is connected to a hosepipe, which dispenses the water, running from the water source into the cropland. This machine is gender-responsive because its energy requirements are very low and can thus be operated by any gender (men, women and teenagers).

Mechanically, a treadle pump is a suction pump that is placed on top of a well. It is designed to lift water from a depth of seven meters or less. It can lift five to seven cubic meters of water per hour (5-7 m3 hr-1) from wells and boreholes and can also be used to draw water from lakes and rivers. The pumping is activated by stepping up and down on a treadle/ peddles, which drive the pistons, creating cylinder suction that draws groundwater to the surface. The treadle pump can do most of the work done by a motorized pump, but costs considerably less. Its cost, including installation ranges between US$100 and 300. Since it is not motorized, it can also cost less (e.g. by 50%) to operate than a motorized pump. Many treadle pumps are manufactured locally, but they can be challenging to produce up to the right standards without highly skilled welders and production hardware. Use of manual rather than fossil fuel means that the technology is carbon neutral, another important climate smart dimension of the pump.

Despite its benefits, the adoption rate has been low due to the initial cost, which although is relatively lower compared to the motorized pumps, is still unaffordable by most smallholder farmers. To overcome this high cost, some farmers form groups, purchase one piece and share the cost among the group members. The second problem with this technology is the lack of nearby water sources, which may be a serious challenge or where the water table is very low and/or where porous soils do not allow significant harvestable water during rainy seasons. To ensure the technology is sustainable, farmers are building concrete tanks to harvest water from the roofs of their houses when it rains and use it for irrigation when the drought sets-in.

LOCATION



Location: Padibe s/county Lamwo District, Northern, Uganda

No. of Technology sites analysed: single site

Geo-reference of selected sites
- 32.754, 3.495

Spread of the Technology: evenly spread over an area (approx. < 0.1 km2 (10 ha))

In a permanently protected area?:

Date of implementation: 2012; less than 10 years ago (recently)

Type of introduction
- [ ] through land users' innovation
- [ ] as part of a traditional system (> 50 years)
- [ ] during experiments/ research
- [x] through projects/ external interventions

Structure of the treadle pump used for low-cost irrigation. (Otto Richard Kawawa)

CLASSIFICATION OF THE TECHNOLOGY

Main purpose

- [x] improve production
- [ ] reduce, prevent, restore land degradation
- [ ] conserve ecosystem
- [ ] protect a watershed/ downstream areas – in combination with other Technologies
- [ ] preserve/ improve biodiversity
- [x] reduce risk of disasters
- [x] adapt to climate change/ extremes and its impacts
- [ ] mitigate climate change and its impacts
- [x] create beneficial economic impact
- [ ] create beneficial social impact

Land use

Cropland

- Annual cropping: cereals - maize, legumes and pulses - beans, vegetables

Number of growing seasons per year: 3

Grazing land

Forest/ woodlands

Water supply

- [ ] rainfed
- [x] mixed rainfed-irrigated
- [ ] full irrigation

Purpose related to land degradation

- [ ] prevent land degradation
- [x] reduce land degradation
- [ ] restore/ rehabilitate severely degraded land
- [x] adapt to land degradation
- [ ] not applicable

Degradation addressed

biological degradation - Bl: loss of soil life

water degradation - Ha: aridification, Hs: change in quantity of surface water

SLM group

- irrigation management (incl. water supply, drainage)

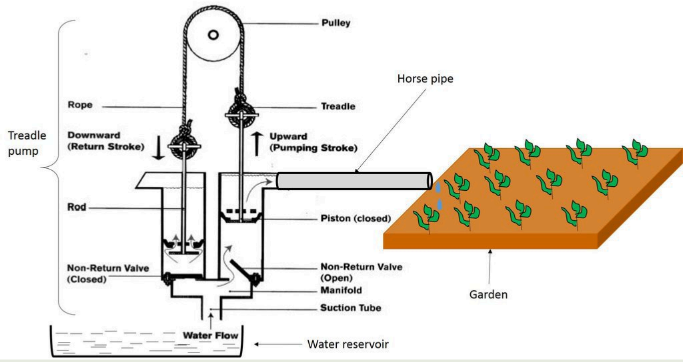
SLM measures

structural measures - S7: Water harvesting/ supply/ irrigation equipment

TECHNICAL DRAWING

Technical specifications

1. Water head should be within 7 meters from the ground.
2. The garden where watering will be done should be within 25 meters from the treadle pump if the area is flat.
3. The pump should fixed firmly in the ground to avoid falling while the peddling is going-on.



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ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs

- Costs are calculated: per Technology unit (unit: **Piece** volume, length: **One piece of treadle pump with its tubing to where the garden is**)
- Currency used for cost calculation: **Uganda Shilings**
- Exchange rate (to USD): 1 USD = 3500.0 Uganda Shilings
- Average wage cost of hired labour per day: 5000

Most important factors affecting the costs

Cost for acquiring the pump and the cost of labor for running the pump.

Establishment activities

1. Buying treadle pump (Timing/ frequency: Once)
2. Connection (Timing/ frequency: Once)
3. Pumping (Timing/ frequency: Once a day)

Establishment inputs and costs (per Piece)

Specify input	Unit	Quantity	Costs per Unit (Uganda Shilings)	Total costs per input (Uganda Shilings)	% of costs borne by land users
Labour					
Pumping	Man/days	30.0	5000.0	150000.0	100.0
Equipment					
Treadle Pump	Piece	1.0	1000000.0	1000000.0	100.0
Horse pipes	Meters	50.0	3000.0	150000.0	100.0
Total costs for establishment of the Technology				**1'300'000.0**	
Total costs for establishment of the Technology in USD				*371.43*	

Maintenance activities

1. pumping (Timing/ frequency: when needed)
2. Replacement of pipe (Timing/ frequency: When needed)

Maintenance inputs and costs (per Piece)

Specify input	Unit	Quantity	Costs per Unit (Uganda Shilings)	Total costs per input (Uganda Shilings)	% of costs borne by land users
Labour					
Labour for pumping water	Mandays	30.0	5000.0	150000.0	100.0
Equipment					
Treddle pump	Piece	1.0	1050000.0	1050000.0	
pipe	Meters	30.0	70000.0	2100000.0	
Total costs for maintenance of the Technology				**3'300'000.0**	
Total costs for maintenance of the Technology in USD				*942.86*	

NATURAL ENVIRONMENT

Average annual rainfall

- < 250 mm
- 251-500 mm
- 501-750 mm
- ✓ 751-1,000 mm
- 1,001-1,500 mm
- 1,501-2,000 mm
- 2,001-3,000 mm
- 3,001-4,000 mm
- > 4,000 mm

Agro-climatic zone

- humid
- ✓ sub-humid
- semi-arid
- arid

Specifications on climate

Name of the meteorological station: Gulu, Uganda

Slope
- [ ] flat (0-2%)
- [x] gentle (3-5%)
- [ ] moderate (6-10%)
- [ ] rolling (11-15%)
- [ ] hilly (16-30%)
- [ ] steep (31-60%)
- [ ] very steep (>60%)

Landforms
- [ ] plateau/plains
- [ ] ridges
- [ ] mountain slopes
- [ ] hill slopes
- [x] footslopes
- [ ] valley floors

Altitude
- [ ] 0-100 m a.s.l.
- [ ] 101-500 m a.s.l.
- [ ] 501-1,000 m a.s.l.
- [x] 1,001-1,500 m a.s.l.
- [ ] 1,501-2,000 m a.s.l.
- [ ] 2,001-2,500 m a.s.l.
- [ ] 2,501-3,000 m a.s.l.
- [ ] 3,001-4,000 m a.s.l.
- [ ] > 4,000 m a.s.l.

Technology is applied in
- [ ] convex situations
- [ ] concave situations
- [x] not relevant

Soil depth
- [ ] very shallow (0-20 cm)
- [ ] shallow (21-50 cm)
- [x] moderately deep (51-80 cm)
- [ ] deep (81-120 cm)
- [ ] very deep (> 120 cm)

Soil texture (topsoil)
- [ ] coarse/ light (sandy)
- [x] medium (loamy, silty)
- [ ] fine/ heavy (clay)

Soil texture (> 20 cm below surface)
- [ ] coarse/ light (sandy)
- [x] medium (loamy, silty)
- [ ] fine/ heavy (clay)

Topsoil organic matter content
- [ ] high (>3%)
- [x] medium (1-3%)
- [ ] low (<1%)

Groundwater table
- [ ] on surface
- [ ] < 5 m
- [ ] 5-50 m
- [x] > 50 m

Availability of surface water
- [ ] excess
- [ ] good
- [x] medium
- [ ] poor/ none

Water quality (untreated)
- [ ] good drinking water
- [ ] poor drinking water (treatment required)
- [x] for agricultural use only (irrigation)
- [ ] unusable

Water quality refers to:

Is salinity a problem?
- [ ] Ja
- [x] Nee

Occurrence of flooding
- [ ] Ja
- [x] Nee

Species diversity
- [ ] high
- [x] medium
- [ ] low

Habitat diversity
- [ ] high
- [x] medium
- [ ] low

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

Market orientation
- [ ] subsistence (self-supply)
- [x] mixed (subsistence/ commercial)
- [ ] commercial/ market

Off-farm income
- [ ] less than 10% of all income
- [x] 10-50% of all income
- [ ] > 50% of all income

Relative level of wealth
- [ ] very poor
- [ ] poor
- [x] average
- [ ] rich
- [ ] very rich

Level of mechanization
- [x] manual work
- [x] animal traction
- [ ] mechanized/ motorized

Sedentary or nomadic
- [x] Sedentary
- [ ] Semi-nomadic
- [ ] Nomadic

Individuals or groups
- [x] individual/ household
- [ ] groups/ community
- [ ] cooperative
- [ ] employee (company, government)

Gender
- [ ] women
- [x] men

Age
- [ ] children
- [ ] youth
- [x] middle-aged
- [ ] elderly

Area used per household
- [ ] < 0.5 ha
- [x] 0.5-1 ha
- [ ] 1-2 ha
- [ ] 2-5 ha
- [ ] 5-15 ha
- [ ] 15-50 ha
- [ ] 50-100 ha
- [ ] 100-500 ha
- [ ] 500-1,000 ha
- [ ] 1,000-10,000 ha
- [ ] > 10,000 ha

Scale
- [ ] small-scale
- [x] medium-scale
- [ ] large-scale

Land ownership
- [ ] state
- [ ] company
- [ ] communal/ village
- [ ] group
- [x] individual, not titled
- [ ] individual, titled

Land use rights
- [ ] open access (unorganized)
- [ ] communal (organized)
- [ ] leased
- [x] individual

Water use rights
- [ ] open access (unorganized)
- [ ] communal (organized)
- [ ] leased
- [x] individual

Access to services and infrastructure

health	poor		✓		good
education	poor		✓		good
technical assistance	poor		✓		good
employment (e.g. off-farm)	poor	✓			good
markets	poor			✓	good
energy	poor		✓		good
roads and transport	poor		✓		good
drinking water and sanitation	poor	✓			good
financial services	poor		✓		good

IMPACTS

Socio-economic impacts

Crop production	decreased						✓		increased
crop quality	decreased						✓		increased
risk of production failure	increased						✓		decreased

land management — hindered / simplified
irrigation water availability — decreased / increased

Increased construction of underground reservoirs and roof water harvesting have increased availability of water for irrigation.

Socio-cultural impacts

food security/ self-sufficiency — reduced / improved
SLM/ land degradation knowledge — reduced / improved

As the project was promoting the pump, sensitization about land degradation and options for improving management were also intruded to farmers, hence improving their knowledge on land degradation.

Ecological impacts

drought impacts — increased / decreased

Off-site impacts

groundwater/ river pollution — increased / reduced

COST-BENEFIT ANALYSIS

Benefits compared with establishment costs

Short-term returns — very negative / very positive
Long-term returns — very negative / very positive

Benefits compared with maintenance costs

Short-term returns — very negative / very positive
Long-term returns — very negative / very positive

CLIMATE CHANGE

Gradual climate change

annual temperature increase — not well at all / very well
seasonal temperature increase — not well at all / very well — Season: wet/ rainy season
annual rainfall decrease — not well at all / very well
seasonal rainfall decrease — not well at all / very well — Season: dry season

Climate-related extremes (disasters)

drought — not well at all / very well

ADOPTION AND ADAPTATION

Percentage of land users in the area who have adopted the Technology

- [ ] single cases/ experimental
- [x] 1-10%
- [ ] 11-50%
- [ ] > 50%

Of all those who have adopted the Technology, how many have done so without receiving material incentives?

- [x] 0-10%
- [ ] 11-50%
- [ ] 51-90%
- [ ] 91-100%

Has the Technology been modified recently to adapt to changing conditions?

- [ ] Ja
- [x] Nee

To which changing conditions?

- [ ] climatic change/ extremes
- [ ] changing markets
- [ ] labour availability (e.g. due to migration)

CONCLUSIONS AND LESSONS LEARNT

Strengths: land user's view

- Increase productivity.

Strengths: compiler’s or other key resource person’s view

- No risk of pump being stolen since it is portable, and can be shared by several farmers thus amenable to cost sharing.
- It can be used by many genders (Youth, male and female).

Weaknesses/ disadvantages/ risks: land user's viewhow to overcome

- Cost for acquiring. Farmers can share the cost of purchase and they utilize in tern.

Weaknesses/ disadvantages/ risks: compiler’s or other key resource person’s viewhow to overcome

- The low water table in the area makes it difficult to have sufficient water when it is needed. Construction of under ground tanks to harvest water during rainy seasons
- Only suitable for small gardens (one acre). Grow high value crops that take small spaces such as vegetable and fruits.

REFERENCES

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Resource persons
Charles Malingu - land user

Full description in the WOCAT database
https://qcat.wocat.net/af/wocat/technologies/view/technologies_2788/
Video: https://player.vimeo.com/video/254825002

Linked SLM data
n.a.

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Key references
- N/a:

Links to relevant information which is available online
- N/a: None